The Interaction of Fiscal and Monetary Policies in Egypt and their Response to External Shocks

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تفاعل السياستين المالية والنقدية في مصر واستجابتهما للصدمات الخارجية

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Abstract:

The purpose of this paper is to empirically investigate the interaction between monetary and fiscal policies and their macroeconomic relative effects on real GDP growth and prices in Egypt. The paper focuses on how fiscal and monetary variables respond to external shocks. We employ Auto-Regressive Distributive Lag Bounds Model (ARDL Bounds test) for cointegration, the Error Correction Model (ECM) in the ARDL Framework and the Set Theory for the time from 1975 to 2022 to study the interaction and the extent of coordination among fiscal policy, monetary policy and economic activity based on annual data. The paper uses the conventional transmission channels of both the fiscal policy and the monetary policy (money supply, government revenue and expenditure, interest rate and exchange rate) that are assumed to function for Egypt.

Keywords:

Monetary and Fiscal policies interaction, external shocks, economic growth, ARDL, VAR

JEL Classifications : E51, E52, E58, E62

الملخص:

الغرض من هذه الورقة هو التحقيق التجريبي في التفاعل بين السياسات النقدية والمالية وتأثيراتها النسبية على الاقتصاد الكلي على نمو الناتج المحلي الإجمالي الحقيقي والأسعار في مصر. وتركز الورقة على كيفية استجابة المتغيرات المالية والنقدية للصدمات الخارجية. نحن نستخدم نموذج حدود تأخر التوزيع التراجعي التلقائي (اختبار حدود ARDL) للتكامل المشترك ، ونموذج تصحيح الخطأ (ECM) في إطار ARDL ونظرية المجموعات للوقت من ١٩٧٥ إلى ٢٠٢٢ لدراسة التفاعل ومدى التنسيق بين السياسة المالية والسياسة النقدية والنشاط الاقتصادي بناء على البيانات السنوية. تستخدم الورقة قنوات الانتقال التقليدية لكل من السياسة المالية والسياسة النقدية (عرض النقود والإيرادات والنفقات الحكومية وسعر الفائدة وسعر الصرف) التي يفترض أنها تعمل لصالح مصر.

الكلمات المفتاحية:

تفاعل السياسات النقدية والمالية، الصدمات الخارجية، النمو الاقتصادي، VAR ،ARDL

تصنيفات JEL: E51 ، E52 ، E58 ، E62

I. Introduction

Since the beginning of the 1980s, the discussion regarding the roles of central banks and governments, as well as the relationship between monetary and fiscal authorities, started to gain more relevance. Although central banks focus on inflation, whereas governments are concerned with cyclical conditions and the level of government indebtedness, the control of both variables depends on policy coordination, whereby monetary and fiscal policies depend on each other However, this coordination does not always lead to the most desirable results, which are consequently dependent on the role assumed by each authority. Sargent and Wallace (1981) argued that both authorities could be relevant in a "dominant" way. When monetary policy dominates fiscal policy, it is the monetary authority that permanently controls inflation, as it is free to set the base level for money. However, if fiscal policy dominates monetary policy, then the latter authority loses some of its influence in controlling inflation phenomenon. Aiyagari and Gertler (1985) introduced the distinction between Ricardian and non-Ricardian regimes, which characterizes the behavior of a government.

The Egyptian Economy has gone through different changes and face external shocks: external debt crisis (1985-1990), Economic Reform (1991-2007[1]), the post global financial crisis (2008-2010), the post revolution (2012-2014), Economic Reform (2016-2019), The Covid-19 pandemic(2019-2022), and the Russian-Ukrainian War(2022-present.

Monetary policy and fiscal policy have witnessed major reforms. The era of inflation targeting—i.e. maintaining inflation within a band—has perhaps begun in Egypt more recently. Country experiences show that inflation targeting is a best-practice strategy for monetary policy. While the monetary policy appears more responsive to inflationary pressures recently in Egypt, it is noted that there is no core inflation measure and the Central Bank of Egypt takes targeting decisions based on the inflation rate released by the CAPMAS consumer price index off-the-shelf.

[1] The comprehensive economic reform and structural adjustment program of the Egyptian Government for the years 1991–1992 to 1992–1993 included several economically supportive elements and actions. To lessen the adverse effects of economic reforms on the poor during the transitional phase of the reforms and to facilitate the reintegration of migrant Egyptian workers, these included reforms covering macroeconomic, public enterprise, domestic price liberalization, foreign trade liberalization, private sector reforms, and the establishment of the Social Fund for Development.

In Law No. 88 for the year 2003, the goal of price stability was initially specified as one of the Central Bank's primary objectives. It was most recently reemphasized in Law No. 194 for the year 2020. As a result, this obligation has been incorporated into monetary policy. The Central Bank of Egypt expressly stated its aim to "put in place a formal inflation targeting framework to anchor monetary policy once the fundamental requirements are realized" in a monetary policy statement published in June 2005.

The MPC decided to strengthen clarity regarding the planned disinflation path in its regular remarks as well as in the quarterly series of the monetary policy report established in March 2017 to further anchor inflation expectations. This decision was made in May 2017. The high annual headline inflation rate will be maintained for a while to accommodate the first-round effects of supply shocks before it is aimed to fall to 13% (+_3 percentage points) by Q4 2018 and to single digits thereafter. The MPC considers this target path to be suitable for reducing unwelcome macroeconomic volatility. According to Egypt's economic history, achieving low and steady inflation over the medium term increases real incomes and retains competitiveness gains made.

The Central Bank of Egypt's inflation target was reduced from 13 percent (three percentage points) on average during Q4 2018 to 9 percent (three percentage points) on average during Q4 2020 in December 2018 due to the aforementioned factors and to promote macroeconomic stability. Temporary departures from previously announced target rates may be caused by exogenous variables that are outside the purview of monetary policy.

After December 2020 the next inflation target for the Central Bank of Egypt has been reduced from 9 percent (three percentage points) on average during Q4 2020 to 7 percent (around two percentage points) on average during Q4 2022 as the bank continues to ensure macroeconomic stability. Utilizing monetary policy tools, one may control demand-side pressures, the ripple effects of supply shocks, and anchor inflation expectations. There may be brief variations from previously stated target rates due to exogenous events outside the purview of monetary policy.

Dec. 20, 2022, The MPC believes that recent developments in real economic activity relative to potential capacity, higher broad-based inflation outturns, and higher broad money growth are evidence that demand side pressures have risen. The MPC has set its forthcoming inflation targets at 7 percent (plus or minus 2 percentage points) on average by Q4 2024 and 5 percent (plus or minus 2 percentage points) by Q4 2026, in line with the CBE's commitment to achieving price stability over the medium term.

From 1991 to 2013, there were significant changes to fiscal policy. The government implemented more efficient policies because of the Economic Reform and Structural Adjustment Program's implementation in 1991. Real GDP growth quickly picked up, rising from low stagnation rates in 1991/92 to above 4 percent in 1995/96, while the inflation rate sharply decreased. The ratio of external debt to GDP and, to a lesser extent, the debt service ratio was dramatically reduced because of fiscal restructuring and debt relief from the Paris Club.

To promote economic growth and broaden the tax base, the government adopted a new tax law in 2005–2006 that features uniform personal income tax rates, corporation moderate tax rates, and tariff levels.

Reforming fiscal policy has been extremely difficult ever since the events of January 25, 2011. Adopting an expansionary strategy was necessary to boost economic growth, create new jobs, and provide incentives for the private sector while the budget deficit grew in response to social demands. The same deficit expansion also indicated the necessity for tighter fiscal policies at the same time. The difficulty of solving the problem resulted in the government's inability to get an IMF loan and repeated cabinet changes.

Egypt's fiscal policy has several distinguishing features, including a relatively high debt-to-output ratio, low tax buoyancy and yields on the revenue side, and rising wages and untargeted subsidies on the expenditure side (Alba, Al-Shawarby, and Iqbal 2004). The levels of debt-to-GDP ratios have been seriously impacted by the ongoing structural budget imbalance (Youssef 2007). On the revenue side, structural issues that are linked to a heavy reliance on indirect taxation, substantial tax backlogs, a tax code that is biased against wage-paid workers, and an ineffective tax administration system continue (Atlam et al. 2012).

To achieve fiscal solvency, this article examines the linkages between monetary and fiscal policy for Egypt from 1975 to 2022. The Egyptian economy, which is marked by persistent government deficits, seems to be an interesting case study to examine how budget deficits were financed, allowing us to identify the dominant policy regime throughout the analysis period, i.e., "monetary dominant" (MD) regime or "fiscal dominant" (FD) regime.

The study is organized as follows: after the introduction, section two reviews the theoretical literature on how fiscal and monetary policy interact, and section three discusses the empirical literature. Sections four and five focus on the methodology used and the empirical results .The last section provides some conclusions.

II. Theoretical Literature Review

Decisions about monetary policy have long been thought to be the only things affecting inflation. Following Friedman (1970), new-Keynesian theories assert that "inflation is always and everywhere a monetary phenomenon" and that the price level is established as the unique value that strikes a balance between the supply and demand of money. To counteract low inflation episodes, expansionary monetary policy is used, whereas high inflation episodes are combated by contractionary monetary policy. However, conventional monetary policy seems to be less successful now that interest rates have been held at the zero lower bound throughout the recent financial crisis. This situation has led to fresh research into alternative theories of price determination, such as the Fiscal Theory of the Price Level (hereafter: FTPL).

Even if monetarist premises are true, according to Sargant and Wallace (1981), Friedman's list[2] of things that monetary policy cannot manage must be widened to include inflation. An economy that conforms to monetarist assumptions has a monetary base that is tightly correlated with its price level and one in which monetary policy can increase surplus. They put two assumptions:

1. The public's desire for interest-bearing bonds places two restrictions on the government. A. It limits the quantity of bonds that can be issued by the government in relation to the size of the economy. B. It has an impact on the rate at which the government must borrow money.

2. There are two polar coordinating methods. A. The fiscal budget is bound by the amount of monetary policy, if monetary policy dominates fiscal policy.

According to the fiscal theory of the price level (FTPL), monetary policy only has a minimally significant role in determining the price level, which is solely governed by government debt and fiscal policy. The monetarist theory, which contends that the major determinant of price level and inflation is the money supply, conflicts with this idea. Furthermore, a lot of academics have claimed that the FTPL's reliance on the fiscal rules is incorrect. They examine the

[2] Milton Friedman In his presidential address to the American Economic Association (AEA), (1968) warned not to expect too much from monetary policy. Friedman argued that monetary policy could not permanently influence the levels of real output, unemployment, or real rates of return on securities.

points of contention and draw attention to ideas on which some agreement has been reached.

Leeper (1991) used a stochastic maximizing model examine the interconnections between monetary and fiscal policy. Depending on how responsively a policy is to shocks in the level of public debt, it is either "active" or "passive." Plans for funding deficits and, thus, the existence and distinctiveness of equilibria depend on two aspects of policy. The model is used to (i) describe the equilibria implied by different financing schemes, (ii) construct policies where fiscal conduct dictates how monetary shocks affect prices, and (iii) reinterpret Friedman's 1948 policy framework. In the study, the finding that prices are unpredictable when the nominal interest rate is pinned is reconsidered.

Sims (1994) introduced a representative-agent model with money holdings motivated by transactions costs, a fiscal authority that taxes and issues debt, no production, and a convenient functional form for agents' utility is presented. The model can be solved analytically and illustrates the dependence of price determination on fiscal policy, the possibility of indeterminacy, even stochastic explosion, of the price level in the face of a monetary policy that holds *M* fixed, and the possibility of a unique, stable price level in the face of a monetary policy that simply pegs the nominal interest rate at an arbitrary level.
In a rational expectation, market-clearing equilibrium model with a costless-produced fiat money that is useful in transactions, the following things are true under broad assumptions.
- A monetary policy that fixes the money stock may (depending on the transactions technology) be consistent with indeterminacy of the price level—indeed with stochastically fluctuating, explosive inflation.
- A monetary policy that fixes the nominal interest rate, even if it holds the interest rate constant regardless of the observed rate of inflation or money growth rate, may deliver a uniquely determined price level.
- The existence and uniqueness of the equilibrium price level cannot be determined from knowledge of monetary policy alone; fiscal policy plays an equally important role. Special case models with interest-bearing debt and no money are possible, just as are special cases with money and no interest-bearing debt. In each the price level may be uniquely determined.
Determinacy of the price level under any policy depends on the public's beliefs about what the policy authority would do under conditions that are never observed in equilibrium.

These points are not new. Eric Leeper [1991] has made most of them within a single coherent model. Woodford [1993], in a representative agent cash-in-advance model, has displayed the possibility of indeterminacy with a fixed quantity of money and the possibility of uniqueness with an interest-rate pegging policy. Aiyagari and Gertler [1985] use an overlapping generations model to make many of the points made in this paper, without discussing the possibility of stochastic sunspot equilibria. Sargent and Wallace [1981] and Obstfeld [1983] have also discussed related issues.

According to Farmer and Zabczyk (2019), the Fiscal Theory of the Price Level (FTPL) is the idea that, in some common theoretical models, fiscal policy occasionally determines the price level as opposed to monetary policy. In the models where this claim has been proven, it is assumed that a representative agent with limitless life makes all decisions. They offer an alternative model with sixty-two generations of humans in it that is perhaps more realistic. They adjust our model to a U.S. income profile, and we demonstrate that the FTPL fails. Even when both monetary and fiscal policies are in effect, their model predicts an undetermined price level and real interest rate. However, their findings contradict conventional wisdom regarding what makes a good mix.

The distinction between Ricardian and non-Ricardian regimes, which describes how a government behaves, was first presented by Aiyagari and Gertler in 1985. In a non-Ricardian system, the government sets the primary budget balances at its discretion, and prices are endogenously determined by budgetary limitations. As a result, the fiscal authority does not promise to finance the debt entirely through further taxes, which results in monetary financing. The government must attain a specific amount of primary budget surplus to ensure that the budget constraint is consistent with the repayment of the original stock of debt and to ensure fiscal solvency in a Ricardian system, where the monetary authority decides the money stock and price level.

According to Leeper (1991), fiscal policy can either be "active" or "passive" depending on how it responds to a shock to the level of public debt. A passive authority's decision rule, on the other hand, is dependent on the current level of government debt after it has been constrained by the actions of the active authority and by private optimization. An active authority avoids the state of government debt and independently establishes a decision rule that depends

on past, present, and future variables. Taylor (1993) expanded on the estimation of the policy reaction function by initially suggesting the Taylor rule, a monetary policy guideline that was used to reduce inflation in the United States in the early 1990s and to enable central banks to successfully stabilize inflation and output gap.

The Taylor 2001 rule is a typical reaction function. It details the nominal interest rate that the government's central bank sets in response to three factors: the inflation rate, the long-term real interest rate that is assumed, the inflation rate's departure from the target level, and the log of the ratio of real GDP (production) to potential output.

In a "Ricardian regime," government balances (i.e., government revenues minus expenditures) are established in such a way that the government budget constraint always applies for every price level, claims Woodford (1995). In this instance, monetary policy determines the price level in the manner that conventional monetarist theories suggest. In contrast, government balances can be determined arbitrarily under a "non-Ricardian regime," and the price level can change to ensure government solvency. In this instance, the unique value that compares the real value of the government debt to the anticipated present value of future government balances is used to calculate the equilibrium price level.

When the fiscal authority makes wise decisions and the debt does not prohibit the implementation of monetary policy from achieving the inflation target, Woodford (1995) characterized fiscal policy as Ricardian (Monetary Dominance). On the other hand, a non-Ricardian regime exists when the monetary authority must generate inflationary "surprise" to deflate the nominal value of the public debt due to the threat of fiscal insolvency (Fiscal Dominance). Since government bonds do not represent net wealth in the Ricardian model, this terminology is extremely clear. For instance, a tax decrease financed by bonds shouldn't have an impact on the price level under MD, but it might under FD.

Additionally, Woodford (2003) demonstrates that if taxation is locally Ricardian or fiscal policy is responsive to debt, equilibrium is only determinable when the monetary policy response to inflation is greater than unity. If local fiscal policy is non-Ricardian, monetary policy will have to deviate from the Taylor Principle and temper its response to inflation to stop

the skyrocketing level of public debt. As a result, excessive borrowing calls for monetary accommodation.

The FTPL asserts that evidence for a non-Ricardian regime indicates that national budgetary policies are what determine national pricing levels. In these situations, monetary policy has little impact on how prices are set.

When monetary policymakers are constrained by the zero lower bound, as they have been since the Global Financial Crisis, fiscal policy must play an even more significant role in accomplishing the price stability aim. For instance, according to Sims (2016), if the FTPL is true, fiscal authorities must use their interest savings (caused by the low interest rate) for fiscal expansions for expansionary monetary policy to be effective during times of low inflation or deflation. Sims (2016) further asserts that, in accordance with Barro (1979)'s Ricardian equivalence theorem, consumers must be aware that the primary government deficits coming from such a fiscal expansion will be paid for by future inflation rather than future taxes or spending reductions.

The monetary policy reaction function measures the value of a monetary policy tool that a central bank selects—or is advised to select—in response to some economic indicator.

Since either the price level (in the original FTPL) or the level of real economic activity (in the Keynesian version of the FTPL developed by Sims) will change to make the real contractual value of the outstanding stock of nominal public debt equal, it is claimed by Buiter (2017) that arbitrary (non-Ricardian) policies governing public spending, taxes, interest rates, and monetary issuance will satisfy the intertemporal budget constraint of the State in equilibrium.

This means systems that are overdetermined or inconsistent unless (a) the price level is adjustable, (b) the interest rate is the tool for monetary policy, and (c) there is a stock of nominal government bonds that is not zero. As a result, a sticky price level suggests over determinacy or another inconsistency, and the rule of the nominal money stock implies over determinacy. When all three requirements are met, undesirable anomalies take place, including the possibility of negative price levels, the FTPL's ability to value money when it doesn't exist, its logic's applicability to the intertemporal budget constraint of a single household, and its absence when the bond pricing equation is correctly specified.

The FTPL has nothing to do with fiscal policy that is either active or passive, or with monetary dominance. According to the FTPL, there is never an issue with government debt because it is always taken care of by the level of prices or genuine economic activity rather than by unexpected inflation or financial repression. Fiscal authorities may take action, with potentially dire results.

Seigniorage has a sound fiscal theory behind it. The creation of fiscal space and assurance that a combined monetary-fiscal stimulus always increases nominal aggregate demand are achieved through the central bank's issuance of return-dominated and/or irredeemable money.

III. Empirical Literature Review

The dynamic relationship between Algeria's monetary and fiscal policy from 1963 to 2017 is examined by Chibi et al. (2019). First, they put forth a reaction function between monetary and fiscal policies and used a vector autoregression (VAR) model to analyze the fiscal policies of Algeria. The findings show that Algeria's budgetary strategy is not Ricardian (a negative correlation between fiscal balances and government liability). These findings support the fiscal theory of price level determination, which holds that price movements are influenced by fiscal policies and that the price level must adjust to maintain balance in private sector wealth and governmental solvency.

In the second exercise, they use the ARDL model to try to estimate the policy reaction function for the Algerian government's fiscal balance equation and the Central Bank of Algeria's interest rates equation. According to the reaction function between the monetary and fiscal authorities, throughout this time, fiscal policy is more responsive than monetary policy.

Additionally, they measure how far both policies stray from their original goals (i.e., active, or passive policies). The findings reveal that monetary policy has smaller variations than fiscal policy (fiscal policy is more dominant for the case of Algeria). Additionally, they examine how monetary and fiscal policies interact by using a State-space model with Markov switching to calculate the relationship's time-varying parameters. The evidence suggests that Algeria's monetary and fiscal policies have acted in opposition to one another during most of the sample period.

These findings point to a game in which the fiscal authority initiates play (or is active) and the monetary authority adopts a passive role in setting debt levels for the prices set by the fiscal policy. This benefits financial hegemony.

Afonso et al. (2019) investigate the nature of monetary and fiscal policies of each respective authorities and evaluate how economic and institutional events influence each authority's reaction functions using a panel data set of the 28 EU countries from 1970 to 2015. Our findings demonstrate that governments raise their primary balances when faced with increases in government debt, and that inflation has a major impact on monetary policy during the whole time under investigation and controlling for institutional variables. We also discover a substitution relationship between the two strategies, in which the central bank takes on a more active role, particularly in situations with higher debt levels. In addition, the adoption of a single currency by 19 of the 28 EU nations had a structural effect on the response and the interaction between the two policies.

Using annual time series data from 1970 to 2013, Asamoah and Adu (2016) conduct an empirical examination of the factors influencing the bank lending rate in Ghana. They discovered evidence of a long-run equilibrium relationship between the variables that influence the average loan rate commercial banks charge and the rate itself. Long-term nominal exchange rates and the monetary policy rate of the Bank of Ghana have a positive impact on bank lending rates in Ghana; however, the fiscal deficit, real GDP, and inflation have a negative impact. Additionally, they show that both the monetary policy rate and the bank lending rate have favorable short- and long-term relationships with exchange rates. Their findings specifically suggest that the exchange rate and monetary policy rate of the Bank of Ghana both exhibit substantial contemporaneous influence on the average bank lending rate in Ghana.

Shahid et al. (2016) investigates fiscal and monetary policy interaction in Pakistan using dynamic stochastic general equilibrium model. They find that fiscal and monetary policy interacts with each other and with other macroeconomic variables. Inflation responds to fiscal policy shocks in the form of government spending, revenue and borrowing shocks. Monetary authority’s decisions are also affecting fiscal policy variables. It is also evident that fiscal discipline is critical for the effective formulation and execution of monetary policy.

Shahid et al. (2016) use a dynamic stochastic general equilibrium model to study the interplay between Pakistan's monetary and fiscal policies. They discover interactions between monetary and fiscal policy as well as with other macroeconomic factors. Government spending, revenue, and borrowing shocks are examples of how inflation reacts to fiscal policy shocks. Fiscal

policy variables are also impacted by monetary authority choices. It is also clear that sound monetary policy must be developed and implemented with great care.

Indonesia's monetary and fiscal policies' dynamic interaction throughout the years 1999 to 2010 is examined by Kuncoro and Sebayang (2013). They first suggest the reaction function between the monetary and fiscal policies. They then point out interest rate and primary balance surplus as the fundamental factors influencing both interaction decisions. The findings of the quarterly data estimation demonstrate that, in the short term, monetary policy responds to fiscal policy as anticipated, allowing governments to operate a primary surplus. In the long run, this step makes achieving budgetary sustainability simpler.

Contrarily, fiscal policy only slightly responds to monetary policy (interest rate), making it more challenging to achieve fiscal sustainability given governments' opposing reactions to shocks in the level of public debt. The interaction matrix also shows that Indonesia has a stronger monetary policy than other countries. In these conditions, an active fiscal policy should be implemented to achieve long-term economic growth sustainability.

Chuku (2010) examines the relationships between monetary and fiscal policy in Nigeria from 1970 to 2008 using quarterly data. A vector autoregression (VAR) model is used by the author to analyze the budgetary policies of Nigeria. Evidence of Nigeria's non-Ricardian fiscal policy can be found in the generalized impulse response graphs created from the VAR estimation. The research also examines the interconnections between monetary and fiscal policy by using a State-space model with Markov switching to calculate the relationship's time-varying parameters. The evidence shows that over most of the sample period, Nigeria's monetary and fiscal policies interacted in an antagonistic way (1980-1994). A consistent pattern of interaction between the two policy factors is not apparent at other times, but between 1998 and 2008.

Lawrence Adu Asamoah & George Adu (2016) use cointegration and error correction methods d to analyze the factors influencing interest rates in Ghana. In particular, the study is one of the few to look at structural, macroeconomic, and monetary aspects together when looking at bank lending interest rates in emerging nations. Their results of the research show that monetary disturbances and macroeconomic instability provide a general framework for explaining the evolution of average loan rates charged by commercial banks in Ghana. The findings support the impact of Ghana's real GDP, inflation, nominal exchange rate, monetary policy rate, and fiscal

deficit on changes in lending interest rates. They also find that , the nominal exchange rate and monetary policy rate have the largest concurrent effects on the lending interest rate.

The dynamic relationship between Indonesia's monetary and fiscal policy from 1999 to 2010 is examined by Kuncoro and Sebayange (2013). They define interest rate and primary balance as standing for, respectively, monetary and fiscal policies. They view the domestic interest rate to US interest rate ratio, inflation rate, output gap, changes in money supply, rate of domestic currency depreciation, price of oil, primary balance to GDP ratio, debt to GDP ratio, and a dummy for inflation targeting as the main factors of monetary policy. The primary balance to GDP ratio, the inflation rate, the output gap, the changes in the real money supply, the rate at which the domestic currency depreciates in relation to the US dollar, the domestic interest rate to US interest rate ratio, and other factors are all used to explain how fiscal policy reacts to these events.

Fialho and Portugal (2005) want to verify the predominance of a monetary or fiscal dominance regime in Brazil in the post-Real period. The analysis is based on a model proposed by Canzoneri, Cumby and Diba (2000). This model proposes that there is a relationship between the public debt/GDP and primary surplus/GDP series by using the vector autoregression (VAR) framework and analyzing the impulse response functions. Another aim is the extension of the article written by Muscatelli et al. (2002) about the interactions between monetary and fiscal policies using the Markov-switching vector autoregressive model (MS-VAR) introduced by Krolzig (1997), since the relationship between these policies may not be constant over time. In conclusion, the macroeconomic coordination between monetary and fiscal policies in Brazil was virtually a substitute policy throughout the study period, with a predominantly monetary regime, in opposition to the non-Ricardian policies of the Fiscal Theory of The Price Level.

In their 2005 study, Fialho and Portugal seek to confirm the predominance of a fiscal or monetary dominance system in Brazil throughout the post-Real era. The study is based on a model that Canzoneri, Cumby, and Diba proposed (2000). This model uses the vector autoregression (VAR) framework and impulse response function analysis to suggest a link between the public debt/GDP and primary surplus/GDP series. Since the relationship between these policies may not be constant over time, a second goal is to expand on the study done by Muscatelli et al. (2002) about the interactions between monetary and fiscal policies using the Markov-switching vector

autoregressive model (MS-VAR) introduced by Krolzig (1997). As a result, in contrast to the non-Ricardian policies of the Fiscal Theory of The Price Level, the macroeconomic coordination between monetary and fiscal policies in Brazil was essentially a substitution policy throughout the research period, with a primarily monetary regime.

Muscatelli et al. (2004) use the generalized method of moments (GMM) to estimate a New Keynesian model in a system of multiple equations. They make it possible for fiscal policy to have two instruments—taxation and expenditure—and they inspire interactions between the two by both the cyclical structure of each policy and the movement of the production shocks. They discover that the Taylor principle is satisfied by monetary policy attenuation, which responds in a stabilizing way. They draw the conclusion that the interaction is shock dependent. While inflation shocks replace fiscal and monetary policy production, inflation shocks function as a supplement to it.

Overall, they discover that the type of shocks to the economy do have a significant impact on the systematic reactions of fiscal and monetary policy tools to one another. Our historical simulations show that since the 1990s, the two policy instruments have moved together in a more complementary way, contrary to the New-Keynesian structure of the model, which suggests a degree of substitutability between the two policy instruments in response to unexpected shocks in the policy rules. This is mostly a result of the fundamental structural and policy shocks being different in the 1990s than they were in the 1980s. Demand shocks have increased in prevalence, and the variance of violations from policy guidelines has decreased.

To determine if the insertion of endogenous fiscal policy rules significantly alters the best monetary policy rule, they then perform some normative analysis using our estimated models. To do this, we contrast our estimated monetary policy rule with those that can be obtained from an optimum control experiment. It's interesting to note that when monetary policymakers are optimizing their decisions, countercyclical fiscal policy might reduce welfare.

To understand the pricing level, some investigations have been done. The bivariate vector autoregressive system was employed by Canzoneri, Cumby, and Diba in (2000) to examine if a Ricardian regime existed in the US from 1951 to 1995. These authors define a fiscal dominance (FD) regime as one in which primary surpluses are decided independently of the level of debt such that money supply and price level satisfy the government's fiscal responsibilities. The money stock and price level, however, may be set by money supply and demand in a monetary domination (MD) regime if primary

surpluses react to the level of debt in a way that ensures the government's fiscal solvency.

To assess the degree of coordination between monetary and fiscal policies in Nigeria from 1981 to 2015, Oboh (2017) employs the Set Theoretic Approach (STA). Our key conclusions point to a typically weak level of policy coordination—roughly 17%. When the results were further broken down, it became clear that the era of poor growth and high inflation coincided with the highest degree of coordination, which was 36.4 percent. However, there was little indication of coordination when the GDP and inflation were rising rapidly. These results highlight the clear requirement for fiscal and monetary authorities to improve policy coordination in the direction of increased macroeconomic stability.

Obeng and Saky (2017) looked at the macroeconomic factors that affected interest rate spreads in Ghana from 1980 to 2013. The estimation was performed using the autoregressive distributed lag bounds test to cointegration. Exchange rate volatility, lending interest rate volatility, public sector borrowing from commercial banks (crowding-out effect), deposit interest rate volatility, economic growth, fiscal deficit, inflation, monetary policy rate, and a gauge of institutional quality were macroeconomic variables taken into consideration. Evidence of a cointegrating relationship between these variables is revealed by the cointegration test. According to long-term projections, Ghana's interest rate spreads will increase because of inflation, the fiscal deficit, the crowding-out effect, exchange rate volatility, deposit interest rate volatility, economic growth, money growth, and monetary policy rate. Only the long-term coefficient of exchange rate volatility, the budget deficit, and public sector borrowing from commercial banks are taken into consideration.

IV. Methodology

1. The unit Root test

We use both the Augmented Dickey Fuller Test : the null hypothesis is that the series has a unit root and the Phillip -Perron unit root test in which the null hypothesis is that the series has a unit root .[3]

[3] The Phillip-Perron test has an advantage that it specifies the lag on its own. Besides, the Phillip-Perron test tends to work better in cases where the unit root is close to one. So it is always good to complement the Augmented Dickey Fuller test with the Phillips-Perron test.

2. Bivariate Vector Autoregressive Model of the two variables of the fiscal policy, the Debt, and the fiscal balance to determine whether the fiscal policy is a Ricardian fiscal policy or a non-Ricardian fiscal policy.

$$FB_t = \alpha_1 + \alpha_{11} FB_{t-1} + \alpha_{12} Debt_{t-1} + u_t \quad (1)$$

$$Debt_t = \alpha_2 + \alpha_{21} FB_{t-1} + \alpha_{22} Debt_{t-1} + V_t \quad (2)$$

Under the assumption that the variables $FB_t \; and \; Debt_t$ are stationary and $u_t \; and \; v_t$ are white noise disturbances which are called innovations or shock terms.

If the variables $FB_t \; and \; Debt_t$ are non-stationary, we estimate the Bivariate Vector Autoregressive Model in the first difference of the two variables.

$$\Delta FB_t = \alpha_1 + \alpha_{11} \Delta FB_{t-1} + \alpha_{12} \Delta Debt_{t-1} + u_t \quad (3)$$

$$\Delta Debt_t = \alpha_2 + \alpha_{21} \Delta FB_{t-1} + \alpha_{22} \Delta Debt_{t-1} + V_t \quad (4)$$

3. Bounds Autoregressive Distributed Lag Model ARDL

ARDL is an OLS model consisting of lags of both the dependent variable and the independent variables.

ARDL (p, q) is a model consisting of p lags for the dependent variable Y and q lags of the independent variable X

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_\rho Y_{t-\rho} + \delta_1 X_t + \delta_2 X_{t-1} + \cdots + \delta_q X_{t-q} + \varepsilon_t \quad (5)$$

In Compact form: ARDL (ρ, q):

$$Y_t = \beta_0 + \sum_{i=1}^{\rho} \beta_i Y_{t-i} + \sum_{i=0}^{q} \delta_i X_{t-i} + \varepsilon_t \quad (6)$$

The ARDL model is “autoregressive” because Y is explained, in part, by lagged values of itself.

ARDL model is also “Distributed “lag because Y is further explained by lagged values X.

Current values of X may be included in the model.

The ARDL Bounds Test Equation:

To test for the existence of cointegration we use the ARDL Bounds Test

$$\Delta Y_t = \beta_0 + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \cdots + \beta_\rho \Delta Y_{t-\rho} + \delta_1 \Delta X_t + \delta_2 \Delta X_{t-1} + \cdots + \delta_q \Delta X_{t-q} + \varphi_1 Y_{t-1} + \sum_{i=1}^{n} X_{i,t-1} + \varepsilon_t \quad (7)$$

4. The Error Correction Model in the ARDL Bounds Test Framework:

Given that the cointegration exists the question is what is the speed of adjustments to long run equilibrium after a deviation has occurred in the short-run ?

$$\Delta Y_t = \beta_0 + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \cdots + \beta_\rho \Delta Y_{t-\rho} + \delta_1 \Delta X_t + \delta_2 \Delta X_{t-1} + \cdots + \delta_q \Delta X_{t-q} + \varphi\, ECT_{t-1} + \varepsilon_t \quad (8)$$

The coefficient of the error correction term φ is the speed of adjustment to long run equilibrium. To ensure the convergence toward long run equilibrium $-1 < \varphi < 0$ and significant and if it is significant, it also means the explanatory variables Granger causes the dependent variable in the long run.

The monetary policy reaction function:

$$Interest = \alpha_0 + \alpha_1 outputgap + \alpha_2 INF + \alpha_3 RealEXrateVol + \alpha_4 Oilrent + \alpha_5 MGR + \alpha_6 TotalDebt + \alpha_7 OverallFB + \varepsilon \quad (9)$$

The fiscal policy reaction function

$$TotalDebt = \beta_0 + \beta_1 outputgap + \beta_2 INF + \beta_3 RealEXrateVol + \beta_4 Oilrent + \beta_5 MGR + \beta_6 Interest + \beta_7 OverallFB + \varepsilon \quad (10)$$

5. The Set Theory to Measure the Extent of Coordination between the Fiscal policy and the Monetary policy:

Macroeconomic Performance Matrix (1)

		Inflation	
		Positive	Negative
Growth	Positive	PP	PN
	Negative	NP	NN

The economic performance is reflected in growth and inflation. Therefore, we concentrate on inflation and growth shocks for which a policy response is required. Four different combinations of shocks to growth and inflation are provided by the matrix in box 1, where P and N stand for positive and negative shocks, respectively. As a result, PP stands for positive shocks to both growth and inflation, PN for a positive growth shock and a negative inflation shock,

and so on. Given these shocks, the policy response matrix suggests a possible coordinating behavior (Matrix 2).

Policy Response Matrix (2)

		Monetary Policy	
		contraction	expansionary
Fiscal Policy	contraction	CC	CE
	expansionary	EC	EE

If there is a positive shock to both growth and inflation, then fiscal policy should at the very least refrain from being expansionary and monetary policy should also be contractionary to control inflation. If there is policy coordination, one should be aware of this policy combination, which we refer to as CC.

On the other hand, in the event of coordination, both monetary and fiscal policies should adopt an expansionary attitude if both growth and inflation are negatively affected by shocks. In the Matrix 2, this policy combination is designated as EE.

Real GDP growth deviations from the sample mean are used to calculate the shock to growth, while the difference between actual inflation and Egypt's inflation threshold is used to calculate the shock to inflation.

Changes in the high-power money, M-2, and the overall budget deficit, both expressed as a percentage of GDP, are used to define changes in the monetary policy and fiscal policy attitude.

An expansionary monetary policy and a favorable fiscal policy, respectively, are represented by positive changes in the money supply and overall budget deficit, whereas contractionary policies are represented by negative changes in these two variables.

A list of the years in which a specific combination of economic shocks and policy stance were observed is contained in each cell of the macroeconomic performance matrix and policy reaction matrix.

The extent of coordination (μ) is then defined as the following:

$$\mu = \delta / N$$

$$\delta = n\,(PP \cap CC) + n\,(PN \cap CE) + n\,(NP \cap EC) + n\,(NN \cap EE)$$

N is the total number of years in the study.

There would be perfect coordination if the four quadrants of macroeconomic environment matrix and policy response matrix are congruent (or equivalently μ =1) and no coordination if $\mu = 0$.

It should be noted that this definition of the extent of coordination does not necessarily require the existence of a formal coordination between the central Bank of Egypt and the Egyptian Ministry of Finance.

V. Data definition and Sources

Variable		Definition
INT	Interest ratio	The Egyptian Lending inters rate% to the US lending interest rate% ratio. The lending rate is the bank rate that usually meets the short- and medium-term financing needs of the private sector. This rate is normally differentiated according to creditworthiness of borrowers and objectives of financing. The terms and conditions The Lending Interest rates are obtained from World Bank: World Development Indicator.
GAP	Output Gap The output gap is an economic measure of the difference between an economy's actual and prospective production. Potential output is the greatest quantity of products and services an economy can produce at maximum efficiency or full capacity.	Is measured by Hodrick Prescott HP filter which is commonly used to smooth macroeconomic variables. HP decomposes a time series Y_t into a trend τ_t and a cyclical component C_t. $$Y_t = \tau_t + C_t$$ The trend may not be stationary (containing stochastic or deterministic trend) . however, the cyclical component C_t is stationary. The cyclical component is calculated as the difference between the actual series and the trend . $$C_t = Y_t - \tau_t$$ $$min\left[\sum_{t=1}^{T}\left(Y_t - \tau_t)^2 + \lambda\sum_{t=1}^{T}\{(\tau_t - \tau_{t-1})\}^2\right]\right.$$ The filter computes the trend (τ_t) of (Y_t) by minimizing the variance of (Y_t) around the trend (τ_t)

	The output gap is utilized by monetary planners while arriving at their policy decisions.	The first term is the sum of the squared differences between actual output and the trend –(distance of trend from data) The second term is the squares of the trend component second differences (smoothness of the trend) (λ) is the smoothing parameter and can only take positive values. The larger (λ) $the\ smaller\ the\ volatility\ of\ the\ trend.$ Since the filter assumes a linear growth of the time series log is applied on real gross domestic product before we apply the filter. Real GDP at Egyptian currency obtained from World Bank data base
Growth	GDP growth (annual %)	Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2015 prices, expressed in U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.
INF	Inflation Rate	Inflation rate = consumer prices (annual %) Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used. IFS
REX	Real Exchange rate and Real Exchange Rate Volatility	Real exchange rate is measured as $e^* = Nominal\ Exchange\ rate * \left(\frac{USCPI}{RGCPI}\right)$ Nominal Exchange rate= Official exchange rate (LCU per US$, period average) Real exchange rate volatility is measured by GARCH (1,1)

OIL	Oil Price and Oil Rent	Oil rents (% of GDP) Oil rents are the difference between the value of crude oil production at regional prices and total costs of production.
M	Money Supply Annual Growth	Broad money growth (annual %) Broad money (IFS line 35L..ZK) is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper.
MGDP	Broad money (% of GDP)	Broad money (IFS line 35L..ZK) is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper.
DEBT	Total Debt =Domestic Government Dent+ External Government Debt	Total Debt=Domestic debt as a percentage to GDP+ External debt as a percentage to GDP External debt stocks, public and publicly guaranteed (PPG) (DOD, current US$) Public and publicly guaranteed debt comprises long-term external obligations of public debtors, including the national government, Public Corporations, State Owned Enterprises, Development Banks and Other External Debt is converted to Egyptian pounds. External debt stock current US$*official Exchange Rate Domestic debt is obtained from IFS and CBE External debt stock is obtained from the World Bank: World Development Indicators.
FB	Overall Budget Deficit	Is Budget deficit/Surplus as percentage of GDP% Is obtained from IFS, CBE, Ministry of Finance

VI. Empirical Results

The data period is from 1975 to 2022. All the data sets are provided by International Financial Statistic (IMF), Word Bank Development Indicators, Central Bank of Egypt, and Ministry of Finance. Before undertaking the VAR estimation, we test for stationarity of the variables, using the Augmented Dickey-Fuller (ADF) unit root test. The results indicate that some variables are stationary at their first differences and some variables see Table 1). And table (2). Hence, we use the first differences of the fiscal balance and government fiscal balance series in the VAR estimation. With one lag of the variables (see Table 3), the results obtained from the estimation are thus:

Table (1) Augmented Dickey Fuller Unit Root Test

Levels			First Difference		
Variables	**Constant**	**Constant& trend**	**Constant**	**Constant & trend**	**Degree of integration**
Overall_FBl	**-1.232952 0.6525**	**0.004312 0.9952**	**-4.224152 0.0017**	**-4.330899 0.0065**	**I(1)**
Interest	**-1.577595 0.4856**	**-4.573002 0.0034[4]**	**-5.913729 0.0000**	**-5.850350 0.0001**	**I(1)**
Total debt	**-1.481484 0.5340**	**-2.882393 0.1775**	**-6.451747 0.0000**	**-6.414241 0.0000**	**I(1)**
Output gap	**-4.811945 0.0003**	**-4.751556 0.0021**	**-**	**-**	**I(0)**
MGR	**-3.188884 0.0269**	**-3.550992 0.0454**	**-**	**-**	**I(0)**
INF	**-3.411756 0.0155**	**-3.249504 0.0908[5]**	**-9.759121 0.0000**	**-9.692067 0.0000**	**I(1)**
oil rent	**-1.664465 0.4424**	**-3.263161 0.0851**	**-5.943993 0.0000**	**-5.916882 0.0001**	**I(1)**
Realexchratevol	**-4.103374 0.0023**	**-4.110280 0.0116**	**-**	**-**	**I(0)**

Test statistics and probability

The Augmented Dickey Fuller results show that over_FB, Interest, Total_Debt, Inflation and oil rent are stationary at first difference and are I(1). Output gap, broad money supply annual growth and real exchange rate volatility.

[4] Stationary level with intercept and trend

[5] At 10 percent level

Table (2) PP Unit Root Test Results

Levels			First Difference		
Variables	Constant	Constant& trend	Constant	Constant & trend	Degree of integration
Overallfb	-1.273804 0.6341	0.036628 0.9956	-4.258238 0.0015	-4.324078 0.0067	I(1)
Interst	-1.549789 0.4999	-2.388725 0.3804	-5.450642 0.0000	-5.528235 0.0002	I(1)
TotalDebt	-1.622083 0.4634	-2.915180 0.1674	-6.451747 0.0000	-6.414241 0.0000	I(1)
outputgap	-3.922837 0.0039	-3.904176 0.0197	-	-	I(0)
MGR	-3.129872 0.0311	-3.590753 0.0415	-	-	I(0)
INF	-3.349766 0.0182	-3.562575 0.0445	-	-	I(0)
oilrent	-1.664465 0.4424	-3.346184 0.0714	-6.028224 0.0000	-5.952143 0.0001	I(1)
realexchratevol	-4.062679 0.0026	-3.977667 0.0163	-	-	I(0)

Test Statistics and Probability

Overall Fiscal balance, Interest, Total Debt, and oil rent are stationary at the first difference. Output Gap, Money Supply annual growth rate, Inflation and real exchange rate volatility are stationary at level,

2. Results of the Bivariate VAR Model:

As a result, we investigate the relationship between the fiscal balance and government obligations. The debt of the Central Government serves as a proxy for government obligations, while the fiscal balance represents the overall surplus or deficit of the government's financial resources (The use of the overall budget balance is consistent with previous studies of budget deficit sustainability). We divide the two variables by nominal GDP to scale them.

Table 3

Vector Autoregression Estimates
Sample (adjusted): 1977 2021
Included observations: 45 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	D(OVERALLFB)	D(DEBT)
D(OVERALLFB(-1))	-0.083537	-0.002044
	(0.15248)	(0.00809)
	[-0.54787]	[-0.25264]
D(DEBT(-1))	2.807593	0.121226
	(2.88695)	(0.15318)
	[0.97251]	[0.79138]
C	-0.164021	-0.000478
	(0.24002)	(0.01274)
	[-0.68337]	[-0.03752]
R-squared	0.027952	0.015842
Adj. R-squared	-0.018336	-0.031022
Sum sq. resids	107.7420	0.303338
S.E. equation	1.601651	0.084984
F-statistic	0.603879	0.338047
Log likelihood	-83.49647	48.63806
Akaike AIC	3.844288	-2.028358
Schwarz SC	3.964732	-1.907914
Mean dependent	-0.150972	-0.000166
S.D. dependent	1.587166	0.083696
Determinant resid covariance (dof adj.)		0.018522
Determinant resid covariance		0.016135
Log likelihood		-34.85180
Akaike information criterion		1.815635
Schwarz criterion		2.056524

Where FB are over all fiscal balance and total debt as percentage to current GDP, and the values in parenthesis are the t-values. The results from the VAR estimation show the positive and insignificant relationship between. overall fiscal balance and total debt in the first equation.

Table (4) VAR Lag Order Selection Criteria

Endogenous variables: OVERALLFB TOTALDEBT						
Exogenous variables: C						
Sample: 1975 2022						
Included observations: 43						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-301.1803039353476	NA	4562.710	14.10141	14.18333	14.13162
1	-232.924404049972	126.9877*	229.8583*	11.11276*	11.35851*	11.20339*
2	-232.0988431107938	1.459131	266.8724	11.26041	11.66999	11.41145
3	-228.6901432647547	5.707590	275.3395	11.28791	11.86133	11.49937
4	-226.7977646564895	2.992599	305.7432	11.38594	12.12319	11.65782
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Table 5 VAR Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Sample: 1975 2022

Included observations: 46

Lags	LM-Stat	Prob
1	0.9964625110756028	0.9103319132257734

Probs from chi-square with 4 df.

Since the probability 0.9 is greater than 5 percent the null hypothesis of no serial correlation cannot be rejected.

Table (6) VAR Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Sample: 1975 2022
Included observations: 46

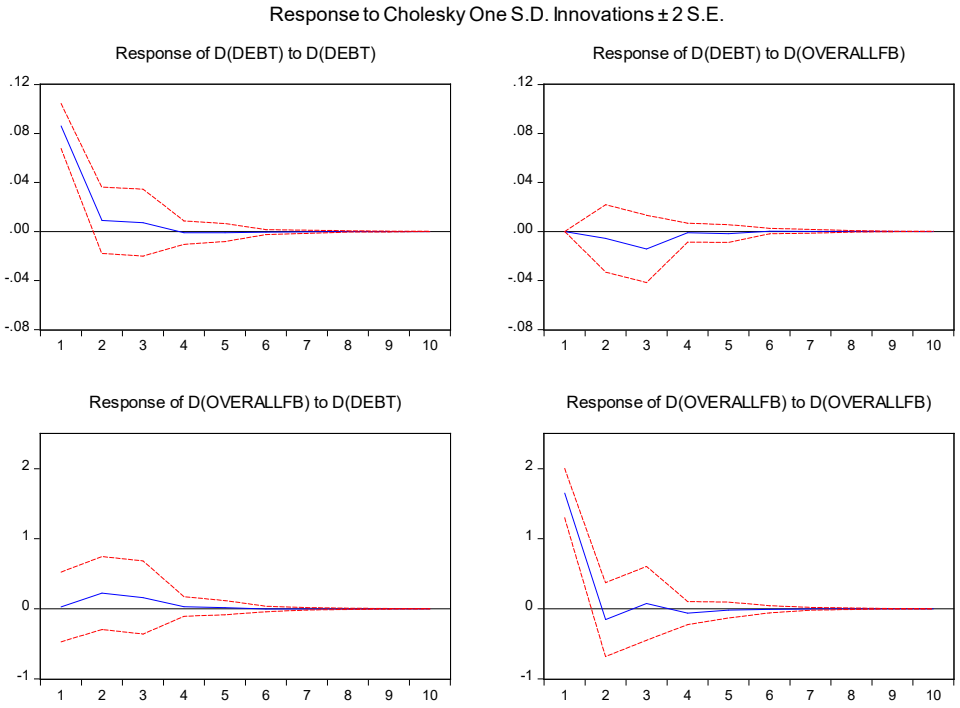
Component	Skewness	Chi-sq	df	Prob.
1	-3.367783246167513	86.95505728094385	1	0
2	2.094730206073777	33.64052554449046	1	6.629700566307405e-09
Joint		120.5955828254343	2	0

Component	Kurtosis	Chi-sq	df	Prob.
1	17.86308347209907	423.4132297389538	1	0
2	7.803058765029701	44.21629920896322	1	2.940225840575295e-11
Joint		467.629528947917	2	0

Component	Jarque-Bera	df	Prob.
1	510.3682870198976	2	0
2	77.85682475345368	2	0
Joint	588.2251117733513	4	0

The probability is less than 6 percent level of significance, therefore, null hypothesis of residuals are multivariate normal cannot be rejected.

Figure 1



The impulse response graphs indicate that one-standard deviation innovation in Total debt does not causes a positive response in overall fiscal balance, and similarly, one S.D innovation in in overall fiscal balance also does not induce positive response . This suggests that net borrowing does not decrease when the fiscal balance decreases This observed relationship does not suggest the existence of Ricardian fiscal regime in Egypt.

6. The interaction between Monetary and Fiscal Policies

Since none of the variables is integrated of order two, cointegration can be investigated using the ARDL bounds test approach. The bounds test is conducted to determine the existence of a long run relationship between variables in the fiscal policy reaction equation (6) and the monetary policy reaction equation (7). Since we use annual data, we choose two as the maximal lag length in the bounds test. The results of the test are shown in Table below.

Table (7) : Bounds test for cointegration analysis

Fiscal Policy Reaction Function equation (10)		
Significance	Lower Bound Value I(0)	Upper Bound Value I(1)
10%	1.92	2.89
5%	2.17	3.21
2.5%	2.43	3.51
1%	2.73	3.9
Computed F Statistics 4.192155		
Monetary Policy Reaction Function equation (9)		
Significance	Lower Bound Value I(0)	Upper Bound Value I(1)
10%	1.92	2.89
5%	2.17	3.21
2.5%	2.43	3.51
1%	2.73	3.9
Computed F Statistics 4.967930		

As the calculated F-statistics (4.192155) and (4.967930) for the fiscal reaction model and the monetary reaction is greater than the upper bound at the ten percent level (2.89) , the five percent level (3.21), and the one percent (3.9) we conclude that there exists a long run relationship between the variables of two models.

Once a cointegrating relationship between the variables has been established, the estimate of the long run coefficients of the ARDL model can be obtained. The optimal lag order of each variable in the ARDL system is selected based on Akaike Information Criterion (AIC).

Table (8) Estimation Results of Long-Run Fiscal policy Reaction Function and Monetary Policy Reaction Functions

	Fiscal Policy Dependent Variable FB		Monetary Policy Dependent Variable INT
Selected Model	ARDL(1, 2, 0, 1, 2, 0, 1, 0)	Selected Model	ARDL(2, 2, 1, 0, 1, 1, 2, 2)
C	0.311963 (0.204690)	C	0.342774 (0.760934)
$FB(-1)$	0.398753 (2.862410)*	$INT(-1)$	0.943413 (6.889694)*
INT	0.575274 (0.3928)	$INT(-2)$	-0.310375 (-2.215115)*
INT(-1)	-0.040179 (0.9605)	INF	0.021677 (2.071604)*
INT(-2)	-0.708091 (0.2182)	GAP	-0.049523 (-0.895593)
GAP	0.094101 (0.514259)	GAP(-1)	0.181579 (2.658335)*
GAP(-1)	-0.384789 (-1.833229)*	GAP(-2)	-0.107580 (-1.805762)**
GAP(-2)	-0.356653 (-2.194665)*	REX	0.239903 (2.479438)*
REX	-0.745238 (-3.649293)	$REX(-1)$	-0.227210 (-2.268300)*
OIL	0.035446 (1.969851)*	OIL	-0.008207 (-1.875019)**
$OIL(-1)$	-0.051952 (-2.780157)*	$OIL(-1)$	0.014084 (3.056775)*
INF	0.016385 (0.365716)	FB	0.011714 0.268105
Debt	0.116083 (4.148923)	$FB(-1)$	-0.065668 (-1.680441)**
M	-0.059585 (-1.766628)*	$Debt$	-0.018396 (-1.334574)
$M(-1)$	-0.096365 (-2.237030)*	$Debt(-1)$	0.043811 (3.146930)
		$Debt(-2)$	-0.018508 (-2.586776)
		M	-0.001525 (-0.147323)
		$M(-1)$	-0.010633 (-0.848152)
		$M(-2)$	-0.017483 (-1.798859)**
R-Squared	0.951252	R-Squared	0.945854
Log-Likelihood	-66.02679	Log-Likelihood	2.847507
F-Statistics	43.20862	F-Statistics	26.20277
Prob(F-Statistics)	0.000000	Prob(F-Statistics)	0.000000

*, ** significant at 5 percent and 10 percent respectively.

Diagnostic Tests for The Long Run Fiscal Policy reaction Function

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.613446	Prob. F(2,28)	0.5486
Obs*R-squared	1.889019	Prob. Chi-Square(2)	0.3889

Since the null hypothesis is that the residuals are serially uncorrelated, the F-statistic p-value of 0.5486 indicates that we will fail to reject this null. We therefore conclude that the residuals are serially uncorrelated.

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.444428	Prob. F(14,30)	0.1934
Obs*R-squared	18.11935	Prob. Chi-Square(14)	0.2014
Scaled explained SS	38.99395	Prob. Chi-Square(14)	0.0004

Since the null hypothesis is that the residuals are homoscedastic, the F-statistic p-value of 0.1934 indicates that we will fail to reject this null even for a significance level of 10\%. We therefore conclude that the residuals are homoscedastic at 10\% significance.

Diagnostic Tests for the long run Monetary policy Reaction Function

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.501863	Prob. F(2,25)	0.2421
Obs*R-squared	4.826773	Prob. Chi-Square(2)	0.0895

Since the null hypothesis is that the residuals are serially uncorrelated, the F-statistic p-value of 0.2421 indicates that we will fail to reject this null. We therefore conclude that the residuals are serially uncorrelated.

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.723577	Prob. F(17,27)	0.7539
Obs*R-squared	14.08460	Prob. Chi-Square(17)	0.6611
Scaled explained SS	4.926203	Prob. Chi-Square(17)	0.9980

Since the null hypothesis is that the residuals are homoscedastic, the F-statistic p-value of 0.7539 indicates that we will fail to reject this null even for a significance level of 10\%. We therefore conclude that the residuals are homoscedastic at 10\% significance.

Table (9): Estimation Results of short-run Fiscal and Monetary reaction function

	Fiscal Policy Dependent Variable: D(FB)		Monetary Policy Dependent Variable: D(INT)
Selected Model	ARDL(1, 2, 0, 1, 2, 0, 1, 0)	Selected Model	ARDL(2, 2, 1, 0, 1, 1, 1, 2)
$D(INT)$	0.542345 (1.233596) [0.2269]	$D(INT(-1))$	0.309837 (3.280183) [0.0029]
$D(INT(-1))$	0.721763 (1.675761) {0.1042]	$D(GAP)$	-0.046502 (-1.348120) [0.1888]
$D(M)$	-0.060036 (-2.446755) [0.0205]	$D(GAP(-1))$	0.110055 (3.548285) [0.0014]
$D(GAP)$	0.093810 (0.771770) [0.4463]	$D(FB)$	-0.011659 (0.457290) [0.5611]
$D(GAP(-1))$	0.357696 (2.630529) [0.0133]	$D(OIL)$	-0.010986 (-3.508959) [0.0016]
$D(OIL)$	0.035446 (2.668920) [0.0120]	$D(REXVOL)$	-0.003160 (3.997625) [0.0004]
$ContEq(-1)$ *	-0.605292 (-6.796800) [0.0000]	$D(M)$	-0.014784 (-2.416394) [0.0227]
		$D(Debt)$	0.004856 (0.973121) [0.3391]
		$D(Debt(-1))$	00.024442 (5.069065) [0.0000]
		CointEq(-1)*	-0.330523 (-7.613093) [0.0000]
R-squared	0.571434	R-squared	0.746812
Log likelihood	-65.06985	Log likelihood	2.901117
Durbin-Watson stat	2.225852	Durbin-Watson stat	1.653377

Numbers in ( ) and [ ] are t-statistics and probability .

Diagnostic Tests for the short-run fiscal policy reaction function

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.613446	Prob. F(2,28)	0.5486
Obs*R-squared	1.889019	Prob. Chi-Square (2)	0.3889

Since the null hypothesis is that the residuals are serially uncorrelated, the F-statistic p-value of 0.5486 indicates that we will fail to reject this null. We therefore conclude that the residuals are serially uncorrelated.

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.444428	Prob. F(14,30)	0.1934
Obs*R-squared	18.11935	Prob. Chi-Square (14)	0.2014
Scaled explained SS	38.99395	Prob. Chi-Square (14)	0.0004

Similarly, testing for residual homoskedasticity, we chose Breusch-Pagan-Godfrey.

Since the null hypothesis is that the residuals are homoscedastic, the F-statistic p-value of 0.1934 indicates that we will fail to reject this null even for a significance level of 10\%. We therefore conclude that the residuals are homoscedastic at 10\% significance.

Diagnostic Tests for the short-run monetary policy reaction function

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.501863	Prob. F(2,25)	0.2421
Obs*R-squared	4.826773	Prob. Chi-Square(2)	0.0895

To verify whether the residuals from the model are serially uncorrelated, we select the Breusch-Godfrey Serial Correlation LM Test... and we select the number of lags. In our case, we chose 2.

Since the null hypothesis is that the residuals are serially uncorrelated, the F-statistic p-value of 0.2421 indicates that we will fail to reject this null. We therefore conclude that the residuals are serially uncorrelated.

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.723577	Prob. F(17,27)	0.7539
Obs*R-squared	14.08460	Prob. Chi-Square(17)	0.6611
Scaled explained SS	4.926203	Prob. Chi-Square(17)	0.9980

Similarly, testing for residual homoskedasticity, we chose Breusch-Pagan-Godfrey.
Since the null hypothesis is that the residuals are homoscedastic, the F-statistic p-value of 0.7539 indicates that we will fail to reject this null even for a significance level of 10\%. We therefore conclude that the residuals are homoscedastic at 10\% significance.

The estimation results of the long-run fiscal policy reaction and monetary policy reaction functions are in Table (7). The regression equations (7) and (8) are individually estimated using the ARDL Model. The values of R^2 for the fiscal policy reaction function and the monetary policy reaction function are (0.95 and 0.94) respectively in the regression estimates and are relatively high.
The models indicate that the interaction equations adequately explain the influence of the explanatory variables on monetary and fiscal policies in Egypt.

The diagnostic tests for both the fiscal policy and monetary policy reaction functions show that their residuals are serially uncorrelated and homoscedastic.

The estimation result of long-run fiscal policy reaction function shows that the changes of output gap lagged one year and lagged two years, real exchange rate, current oil prices and oil price lagged one-year, current money and money supply lagged one year are significantly determining fiscal balance. Fiscal policy is not responsive to monetary policy during this period. It is supported by the coefficient of interest rate which is statistically non-significant in determining fiscal balance.

On the other hand, the variables which play significant role in determining monetary policy are inflation, growth of real money supply lagged two years, current oil price and oil price lagged one year, current and one year lagged real exchange rate and lagged values of total debt and output gap in Long-run. The fiscal balance which represents the fiscal policy does not play an important role in determining monetary policy.

At this period, the Central Bank of Egypt needs time to respond to changes in major macroeconomic variables especially output gap which represents the cyclical changes and unemployment and to total debt which is the accumulation of budget deficits.

Monetary policy instant response is to inflation, real exchange rate and oil price. Regarding interaction of monetary and fiscal policy, the Central Bank of Egypt considered one of the fiscal policy two indicators i.e., total debt but not the budget deficit. It is supported by the coefficients of lagged total debt which are statistically significant in determining interest rate while the coefficient of fiscal balance is not statistically significant.

As for the results of the short run fiscal policy reaction function and the monetary policy reaction function, the R^2 are 0.57 and 0,74 respectively and the value of Durbin-Watson (DW) statistic in the two regression results are 2.2 and 1.65 respectively.

The Error Correction Model outputs for the fiscal policy reaction function and the monetary policy reaction function include the short-run component of the ARDL specification (the differenced terms.). The estimated coefficient of the error correction term for the fiscal policy is negative, less than minus one and significant as shown by its t- statistics and probability.

$$-1 < -0.605292 < 0^{6}$$

The estimated coefficient of the error correction term measures the speed of adjustment toward long -run equilibrium. It shows the 60.5 percent deviations from long run equilibrium are corrected in one year gradually by the Error Correction Term through a series of partial short-run adjustments.

Since the coefficient of the error correction term is statistically significant, it also means that there is long – run Granger causality jointly running from the explanatory variables to the dependent variable.

There is a short-run negative causal effect running from the contemporaneous money growth to Fiscal balance since its coefficient is significant and negative. That means a one-unit change in money growth results in a -0.060038 unit decrease in fiscal balance.

There is a positive short-run causal effect running from lagged output gap to fiscal balance since its coefficient is significant and positive. That means a one-unit change in lagged output gap causes 0.357696 change in fiscal balance.

[6] Since the value is inside the range that means the model is stable.

There is also a positive causal short -run effect running from oil price to fiscal balance since its coefficient is significant and positive. A one-unit change in oil price causes 0.035446 units to change in fiscal balance.

There is no short-run causal effect running from contemporaneous interest ration and lagged interest to fiscal balance because their coefficients are insignificant.

The estimated coefficient of the error correction term for the monetary policy is negative, less than minus one and significant as shown by its t- statistics and probability.

$$-1 < -0.330523 \quad < 0^{7}$$

The estimated coefficient of the error correction term measures the speed of adjustment toward long -run equilibrium. It shows that almost 33 percent deviations from long run equilibrium are corrected in one year gradually by the Error Correction Term through a series of partial short-run adjustments.

Since the coefficient of the error correction term is statistically significant, it also means that there is long – run Granger causality jointly running from the explanatory variables in the monetary policy reaction function to the dependent variable representing the monetary policy i.e., interest rate ratio.

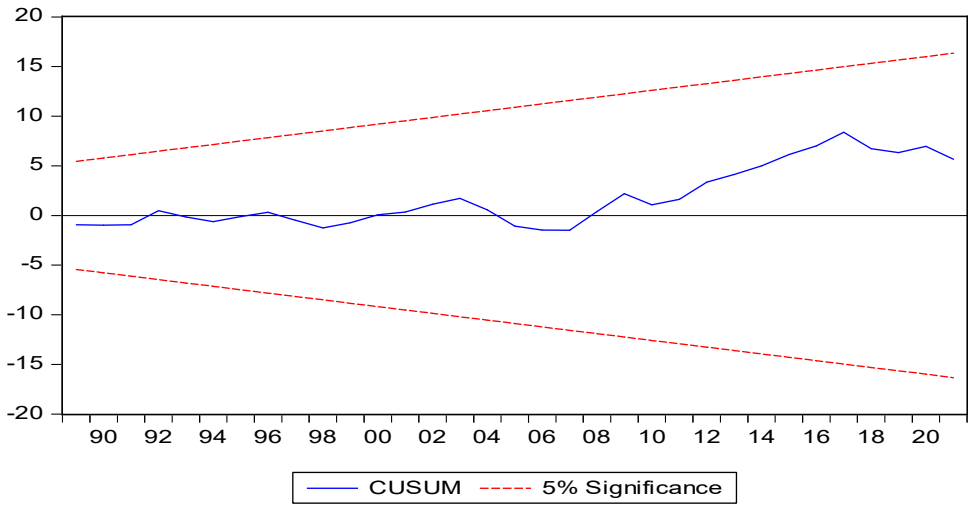
There are short-run positive causal effects running from lagged interest ratio, lagged output gap, and lagged total debt to the dependent variable interest rate ratio. A one-unit change in lagged interest ratio, lagged output gap, real exchange rate, and money growth causes 0.309837, 0.11055, 0.024442 units of change respectively in interest rate ratio.

There are negative short-run causal effects running from contemporaneous OIL price, exchange rate volatility and money supply growth to the dependent variable. A one-unit change in oil price, exchange rate volatility causes a 0.010980, -0.003160, -0.014784-unit change in interest ratio respectively.

The stability of the estimate model is examined using the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests. As shown in Figures 2 , and 3, the graphs of the CUSUM

[7] Since the value is inside the range that means the model is stable.

Figure 2: Stability Test for the Monetary policy reaction function



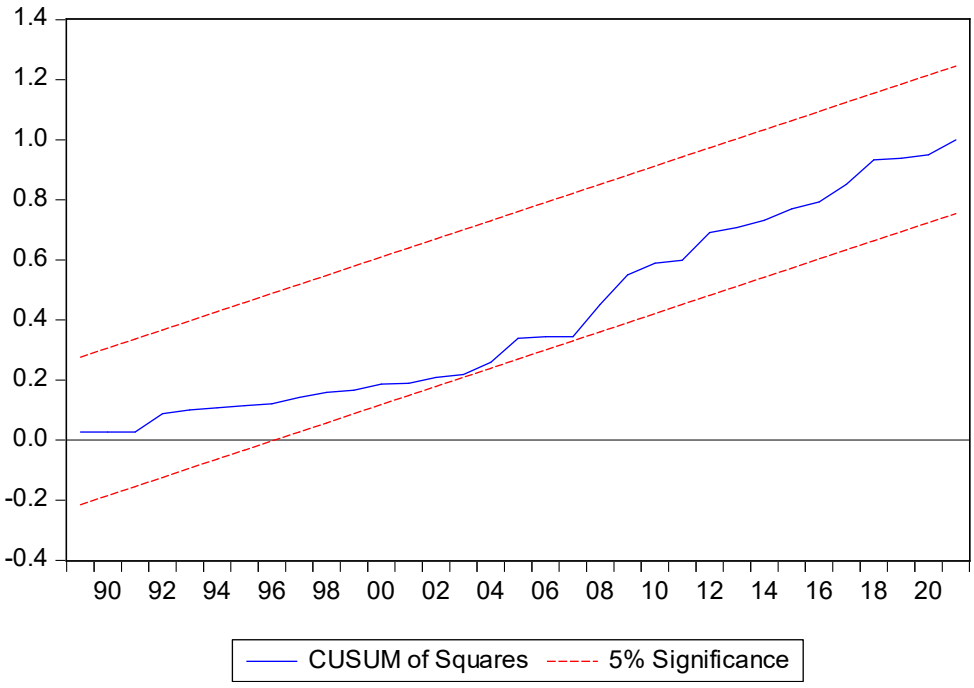
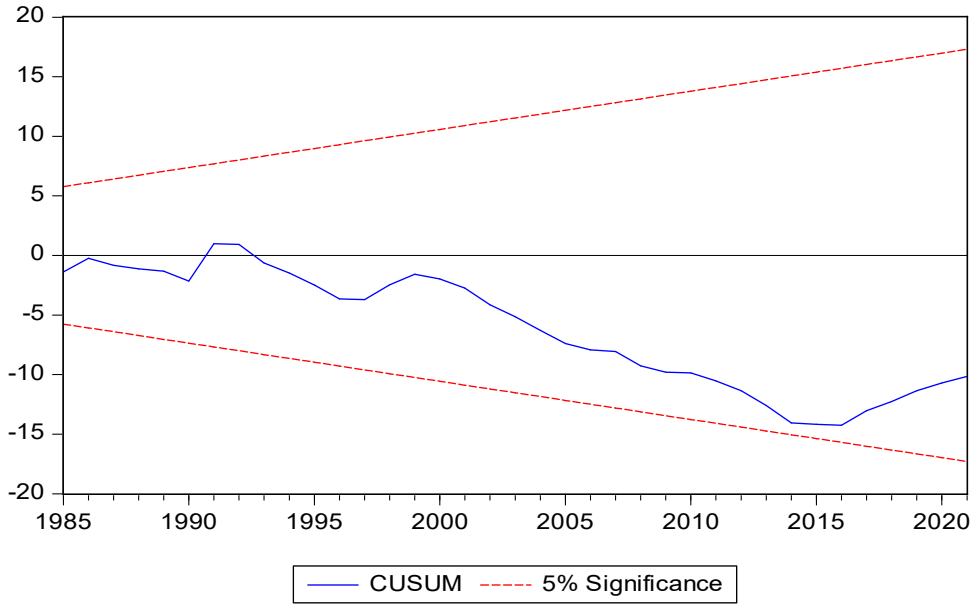


Figure 3; Stability Test for Fiscal policy Reaction Function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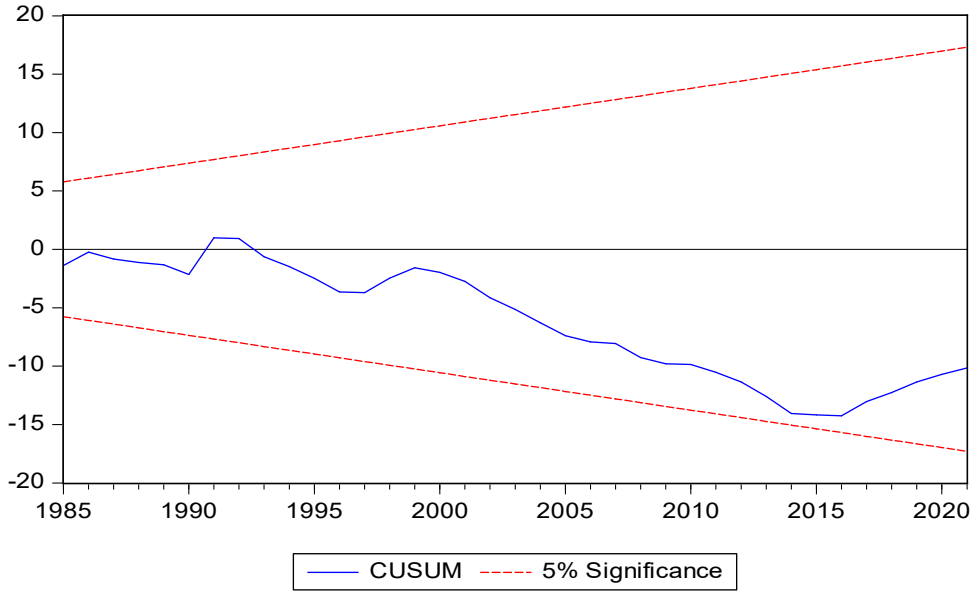
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CUSUM
5% Significance

The Fiscal policy and the Monetary Policy Deviations from their Targets

Despite the modifications that have been made, both policies will always deviate from the intended target in accomplishing the primary purpose. The negative deviation indicates that the policy is too far away from the aim (expansive). A positive divergence, on the other hand, indicates that the strategy was pursued too low (contractively) from the aim. If there is no variation, the policy is deemed to be appropriate and optimal. Figure 2 and figure 3 display a plot of fiscal policy deviations from target (RES01) and monetary policy deviations from target (RES02) during the period of the study.

Figure 4 the deviations of Fiscal Policy from Its Target

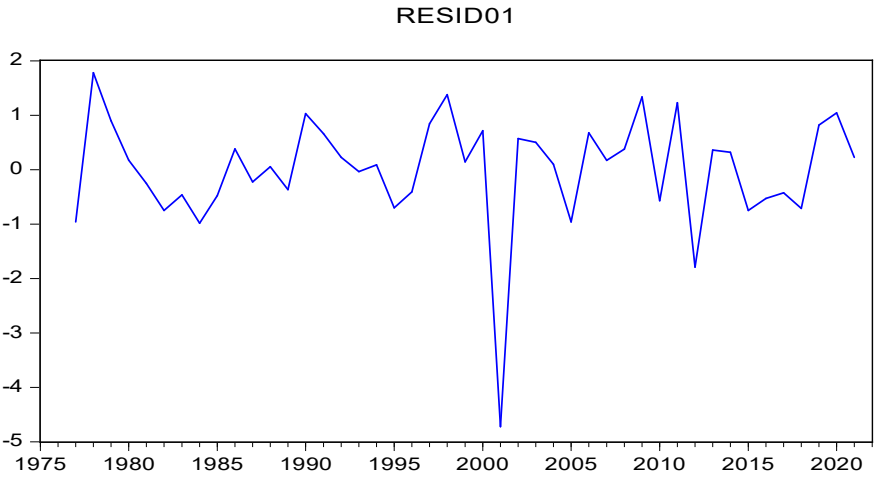

Figure 5: The Deviations of Monetary Policy from Its Target

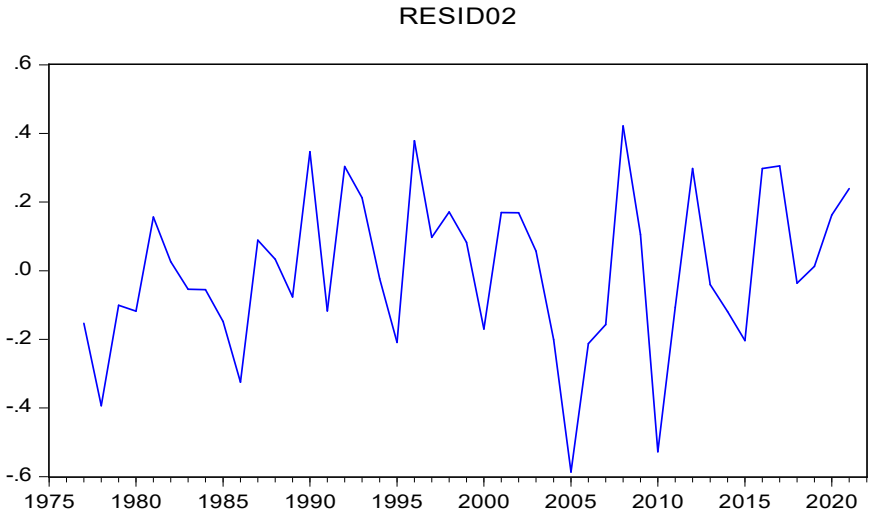

Figure 5 illustrates that monetary policy fluctuates more than fiscal policy. Since interest rates can be modified relatively quickly, whereas changes in government expenditure may take longer to take effect, monetary policy typically has a quicker impact than fiscal policy.

The interval between an action being conducted and an effect becoming apparent is known as the effect lag. The duration between a change in monetary policy and its ultimate impact on private investment may be one to two years; this is because monetary policy requires lengthier delays than fiscal policy. Despite this delay, monetary policy can be adjusted more quickly and easily than taxes or government spending, and is therefore a useful instrument in stabilizing the economy.

Overall, the deviation of interaction between monetary and fiscal policies is summarized in Table (10) It includes four scenarios of an active monetary/fiscal policy (expansive) and passive fiscal/monetary policy (contractionary). Of the 45 sample observations, monetary policy occurs 23 times as a passive policy and contractionary policy and occurs 22 times as an active expansionary policy. The fiscal policy was active/ expansionary 20 times and a passive /contractionary policy 25 times. The four combinations of fiscal policy and monetary policy are: active monetary policy and active fiscal policy occurs 10 times, and both policies are passive/contractionary 13 times. Active fiscal policy and passive monetary policy occurs 10 times. Passive fiscal policy and active monetary policy occurs 12 times. The optimal pay-off is 10 times based on the mini-max and maxi-min criteria. The Payoff 10 is in the active column where both policies are active. In general, monetary policy is more dominant for the case in Egypt. Therefore, the optimal interaction is when both monetary and fiscal policies are active (expansionary). In this case , the reasonable monetary policy followed by an appropriate fiscal policy would probably be the best choice of an optimal policy mix in Egypt.

Table 10

		Monetary Policy		Total	Max-Mini criteria
Fiscal Policy	**Pay Off**	**Active /expansionary**	**Passive/ contractionary**		
	Active /expansionary	**10**	**10**	**20**	**10**
	Passive /contractionary	**12**	**13**	**25**	**13**
	Total	**22**	**23**	**45**	**-**
Mimi/Max Criteria		**10**	**10**	**-**	**10**

7. The Extent of Coordination Between Fiscal Policy and Monetary Policy in Egypt During 1975-2022

a. Granger Causality Test between Money supply and budget deficit

The pair-wise Granger test of causality as reported in the following table (11) shows that neither the ratio of high power money to GDP caused budget deficit/GDP nor budget deficit /GDP caused it.

Table 11
Pairwise Granger Causality Tests
Sample: 1975 2022
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
OVERALLFB does not Granger Cause M2GDP	46	0.63795	0.5335
M2GDP does not Granger Cause OVERALLFB		0.46174	0.6334

b. When estimating the cointegration relationship between The computed F-statistic falls for ARDL Bound Test shows lies below the lower bound when FB was the dependent variable and we conclude that the variables are I(0), so no cointegration is possible, by definition. When Interest variables was the dependent variable, the F-statistic 6.266737exceeds the upper bound at all levels of significance, we conclude that we have cointegration.

c. The Results of The Set Theory

Macroeconomic performance Matrix (1)

Macroeconomic Target		**Inflation (deviation from threshold)**	
		Positive P	**Negative N**
Growth (deviation from sample mean	**Positive P**	**75,76,78,80,81,82,84,85,88,90,06,07,08,18,19**	**97,98,99,00**
	Negative N	**79,83,86,87,89,91,92,93,94,95,96,04,09,10,11,12,13,14,15,16,17**	**01,02,03,05,20,21,22**

Policy Response Matrix (2)

		Monetary Policy	
		Conservative	Expansionary
Fiscal Policy	Conservative	75,76,82,92,95,96,97,99,04,07,09,10,11,12	84,86,88,90,00,01,05,15,20
	Expansionary	89, 94,08,17,18,19	77,78,80,81,83,85,87, 91,93,98,02,03,06,13,14,16, 21,22

From the distribution of years as revealed in Matrices, the extent of coordination between the monetary and fiscal policies conditional upon the specific economic environment can be measured

as follows:

n (PP ∩ CC) / n(PP) = 4 / 15 = 0.266

n (PN ∩ CE) / n(PN) = 1 / 4 = 0.250

n (NP ∩ EC) / n(NP) = 3 / 21 = 0.142

n (NN ∩ EE) / n(NN) = 2 / 7 = 0.285

$\mu = 0.21$

Years of Coordination	75,76,82.89,94,00,07,17,21,22
Years of no-coordination	77,78,79,80,81,82.83.84,85,86,87,88,90,91,92,93,95,96,97,98,99,01,02,03,04,05,06,08,09,10,11,12,13,14,15,16,18,19.20

The results show that the extent of monetary and fiscal policies coordination as revealed by changes in policy indicators conditional upon economic shocks has only been 0.21 during the sample period. The coordination between the two policies was the lowest (0.14) when the real GDP growth was low, and inflation was high while it was the highest (0.28) when both growth and inflation were low. Table shows the years when the coordination between monetary and fiscal policies was observed, and the years when the movements in the two policy indicators were not in accordance with economic circumstances.

Conclusion

The present study provides quantitative evidence to explore the monetary and fiscal policy interactions in Egypt between 1975 and 2022. First, we propose the reaction function between monetary and fiscal policies and examined the nature of fiscal policies in Egypt using a bivariate vector Autoregression (VAR) model for the overall budget deficit[8] and the total debt.

[8] We could not obtain a Compete time series for primary budget balances for the study period.

In a non-Ricardian regime, the Treasury would not commit itself in the future to match completely new government debt with future taxes, since some part of the new debt is to be financed through money. In a Ricardian regime, the opposite would be true, with future fiscal revenues being expected to pay for current outstanding government liabilities. In other words, in a Ricardian fiscal regime, primary budget balances are expected to react to government debt, in order to ensure fiscal solvency.

Since some of the new debt is going to be financed with money under a non-Ricardian system, the Treasury would not make the commitment to match all future revenues with -new government debt. In the Ricardian system, on the other hand, future fiscal receipts would be expected to cover all outstanding public debt obligations at the time of payment. In other words, in a Ricardian fiscal system, primary budget balances are anticipated to respond to the level of public debt in order to maintain fiscal stability. The results show a negative and insignificant relationship between budget deficit and total debt. Therefore, the results could not provide evidence of a Ricardian fiscal policy in Egypt (a positive correlation between fiscal balances and government debt).

According to these findings, the fiscal theory of price level determination, which holds that price fluctuations are influenced by fiscal policies and that the price level must adjust to guarantee balance in private sector wealth and governmental solvency, we could not judge its invalidity.

In the second exercise, we introduced the policy reaction function of the Central Bank of Egypt (Interest Rates equation) and Egyptian Ministry of Finance (equation). The ARDL Bounds Test was used to determine whether we have a long run relationship between each policy indicator and the chosen explanatory variables in the two policies reaction equations.

The ARDL Bounds test for cointegration shows that there exists a long run relationship between the variables of the two models. The calculated F-statistics) are greater than the upper bound at all the level of significance and the cointegrating relationship between the variables has been established.

The movement of inflation, output gap lagged one year, total debt lagged on year , oil prices and lagged values of interest ratio are the main positive determinants of monetary policy in Egypt over the period 1975-2022. The Central Bank of Egypt seems to be concerned about the output gap but with a one-year delay. Regarding the interaction of monetary policy and fiscal

policy, the coefficient of the overall fiscal balance lagged two years is statistically significant in determining the interest rate ratio.

In the short run changes in in lagged values of output gap, total debt and interest rate ratio positively cause changes in monetary policy. Changes in oil prices, real exchange rate volatility, and broad money supply growth cause negative changes in monetary policy.

The reaction function between fiscal and monetary authorities indicates that fiscal policy is not responsive to monetary policy during this period and monetary policy is not responsive to the fiscal policy as measured by total debt but negatively responsive to fiscal policy as measured by overall fiscal balance lagged two years. Money supply growth, lagged values of output gap, real exchange rate, and lagged values of oil price negatively fiscal policy. The coefficient of total debt is positive and statistically significant in the fiscal policy reaction function. Fiscal policy does not respond to Changes in monetary policy in the short run.

Also, we test the deviation of both policies (i.e., active, or passive policies) from the intended target. The results show that fiscal policy has less deviations than monetary policy. Therefore, the optimal interaction is when both monetary and fiscal policies are active.

The study uses a set theoretic technique using time series data between 1975 and 2022 to assess the degree of coordination between Egypt's monetary and fiscal policies. For the study period, the degree of policy coordination was evaluated at 0.21 based on changes in policy variables in response to economic shocks (21 percent). A thorough analysis of the findings further revealed that there was coordination during periods of low GDP growth and high inflation as well as when both indicators were at low levels. The period of low growth and low inflation saw the highest level of coordination, at 28 percent.

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