Analysing the monetary policy in Egypt and its targets in the light of fiscal dominance through estimating adjusted Taylor rule

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Zásady pro vypracování

Introduction

Define the objectives and the application methods used in the Master thesis.

I. Theoretical part

- Compile the theoretical background about monetary policy in Egypt and inflation between 1974 and 2019 and compare Israel's situation to it.

II. Practical part

- Analyse inflation and inflation target in Egypt by building an econometric model based on Taylor rule.
- Forecast the economic situation for Egypt based on the adjusted inflation function.
- Provide policy and recommendation depending on the extracted results.

Conclusion

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Bernanke, Ben S., Thomas Laubach, Frederic S. Mishkin, and Adam S. Posen. *Inflation targeting: lessons from the international experience*. 2nd ed. Princeton University Press, 2018. ISBN 0-691-08689-3.

DeRosa, David F. *Central banking and monetary policy in emerging-markets nations*. 1st ed. Charlottesville, VA: Research Foundation of CFA Institute, 2009. ISBN 978-1-934667-23-1.

Hammond, Gill, SM Ravi Kanbur, and Eswar Prasad, eds. *Monetary policy frameworks for emerging markets*. 1st ed. Edward Elgar Publishing, 2009. ISBN 978-1-84844-442-3.

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ABSTRAKT

Inflace v Egyptě má značné dopady na ekonomiku, protože její kořeny jsou spojeny s významným účinkem rozpočtového deficitu financovaného inflačními měnovými metodami a domácím úvěrem vlád, který má dramatický vliv na dosažení cílů měnové politiky přijetím peněžních cílů. Cílem této studie je proto odpovědět na následující otázku: "Jak by mohla fiskální dominance ovlivnit účinnost dosahování cílů měnové politiky a přijímání inflačního cílení?". Tato studie se zaměřuje na kompilaci teoretického základu měnové politiky v Egyptě v letech 1974 až 2019 a na odhad funkce inflace a funkce reakce měnové politiky pomocí modelu ARDL. Zjištění této studie potvrdila nepopiratelnou existenci fiskální dominance v Egyptě, která má významný vliv na inflaci. Potvrzuje rovněž existenci několika cílů měnové politiky zaměřených na cenovou stabilitu, stabilitu směnného kurzu a stimulaci tempa růstu HDP.

Klíčová slova: Měnová politika, Inflace, Inflační cílení, Fiskální dominance, Taylorovo pravidlo, cílení směnných kurzů.

ABSTRACT

The inflation in Egypt has considerable effects on the economy since its roots are connected with the significant effect of the budget deficit financed through inflationary monetary methods and domestic credit to the governments, which has a dramatic effect on achieving the objectives of the monetary policy by adopting monetary target. Therefore, this study aims to answer the following research question: “How could the fiscal dominance impact the efficiency of achieving the monetary policy objectives and adopting inflation targeting?”. This study focuses on compiling the theoretical background about the monetary policy in Egypt from 1974 to 2019 and estimating inflation function and monetary policy reaction function by using ARDL model. The findings of this study confirmed the undeniable existence of fiscal dominance in Egypt, which has a significant effect on inflation. It also confirms the existence of multiple monetary policy objectives focusing on price stability, exchange rate stability, and stimulating the GDP growth rate.

Keywords: Monetary policy, Inflation, Inflation targeting, Fiscal dominance, Taylor rule, exchange rate targeting.

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CONTENTS

INTRODUCTION

This thesis's primary focus is to investigate the monetary policy and its targets in Egypt and how the fiscal dominance affects the efficiency of achieving the objectives of the central bank policies, which leads to answering the following research question: "How could the fiscal dominance impact the efficiency of achieving the monetary policy objectives and adopting inflation targeting?"

To be able to answer the aforementioned question, this thesis will cover sub-topics below:

1. What is inflation targeting? What are its pre-requisites of adoption? And what are its advantages and disadvantages?
2. Which emerging countries are adopting the inflation target? How the adoption of the latter impacted emerging economies like Israel?
3. How does monetary policy work in Egypt? what is the compatibility of Egypt to adopt inflation targeting policy?
4. How to use Taylor rule to estimate the monetary policy reaction function in Egypt? and what variables are included in the model?
5. How to estimate inflation dynamic function? and what recommendations can be provided to the current monetary policies in this country?

After compiling studies that have focused on monetary policy in Egypt, a shortage in studies has occurred that investigated the compatibility of Egypt to adopt inflation targeting as a framework for its monetary policy. Although the Central bank of Egypt announced the intention of adopting this framework in 2005 after achieving the implementation prerequisites, an implicit inflation policy was adopted at that time. Additionally, there are many serious steps that have been taken during those 15 years. The significance of this study stems from its attempt to clarify the ambiguity surrounding the selection of nominal anchors in Egypt by the central bank and to determine their preferences in the case of multiple anchors empirically.

In order to adopt successful inflation targeting in Egypt, a precise inflation dynamic should be estimated through estimating inflation function and monetary policy reaction function, which is an adjusted function of Taylor rule that is compatible with the case of Egypt.

The study period starts from 1974 till 2019. This period has been chosen because Egypt experienced unstable years since Nasser's coup in 1956 till the war of 1973. Also, the central

bank of Egypt started its operations in 1961, focusing mainly on printing the Egyptian Pound. Therefore, there was no clear monetary policy at this time to be studied.

The motivation behind deciding to study this topic is related to the harsh effect of the inflation on the Egyptian economy, since it became accustomed for Egypt to experience a substantial fluctuation in the inflation rate, which for instance, encourages capital outflows, decreases saving due to decrease in real interest rate, promotes money illusion, and leads to political instability. Moreover, countries that suffered high inflation rate during the 1980s economic recession have experienced a decline in economic growth which led to deteriorating the competitive position of those countries and suppressing employment. Therefore, the central banks started introducing inflation targeting that bailout the economies to stabilise the economic performance and control the price level's hectic increase.

This study has been divided into two parts, theoretical and empirical.

First, the theoretical part has been divided into seven sub-titles:

1- Monetary policy targets.

2- Monetary policy in emerging and developing countries.

3- Challenges to monetary policy in Egypt.

4- Monetary policy and choice of nominal anchors.

5- Inflation dynamic and fiscal dominance.

6- Monetary policy position in Egypt.

7- Price stability experience in Israel.

Second, the empirical part has been divided into two sub-titles:

1- Inflation function

2- Monetary policy reaction function (adjusted Taylor rule)

I. THEORY

1.1 Monetary policy targets

Inflation targeting can be described as a monetary policy framework that provides a nominal anchor to the economy through setting a target inflation rate which can be used to steer the actual inflation rate toward it to stabilize the price level (Bernanke et al., 2018). New Zealand was the pioneer in adopting inflation targeting in 1990, which successfully decreased long-term inflation and achieved price stability (McDermott & Williams, 2018). As a result, economic growth was one of the positive effects of adopting this new strategy. Henceforth, advanced countries like Canada, the United Kingdom, Sweden, Australia, Switzerland, and Finland adopted this framework. Emerging market economies started to embrace it, such as South Korea, South Africa, Israel, Brazil, Chile, Thailand. Also, some transition countries adopted it, for example, the Czech Republic and Poland. These counties showed positive economic indicators like low inflation rate and increasing economic growth compared to the results prior to adopting the inflation targeting. In Egypt, the central bank of Egypt's primary target is price stability by steering the interest rate during the transition period to adopting inflation targeting (Emad, 2019).

According to Taylor (2019), inflation targeting is a necessary condition for formulating and evaluating monetary policy's efficiency. Therefore, inflation targeting is considered as a benchmark for the policymakers to keep the actual inflation rate in harmony with inflation targeting to protect the economy from the economic shocks that may affect the real economic variables. Besides, a study by (Antonakakis et al., 2020) concluded that the developed and developing countries adopting IT regime showed that the inflation rate is less fluctuated than unadopted countries. Thus, IT could be beneficial for the Egyptian economy since the inflation rate in Egypt's last five years showed intense volatility (10.4% in 2015, 13.8% in 2016, 29.5% in 2017, 14.4% in 2018, and 10.8% in 2019). Furthermore, the interest rate works efficiently for keeping the inflation rate stable in low inflation countries (Conti, et al., 2017).

Nevertheless, by using the interest as a remedy for high inflation rate is a controversial instrument due to the effect of money illusion that emerges from the inaccurate estimation of the real interest rate in case of unstable expectation of the inflation rate. For example, the CBE changed the interest rate many times in the last five years (9.75% in 2015, 15.25% in

2016, 19.25% in 2017, 17.25% in 2018, 12.75% in 2019)[1] , which put obstacles In front of making rational long-term decisions.

In emerging and developing countries, targeting exchange rates, monetary aggregates or a combination of both policies are used to be the monetary policy guidelines for keeping inflation under control (Bernanke et al., 2018). Because of the significant contribution of high foreign exchange rates to inflation in these countries, monetary policymakers tended to use the foreign exchange rate target as a nominal anchor to preserve price level stability (Devereux, M.B. and Yu, 2019).

Fiscal dominance is profoundly integrated into the Egyptian economy by the monetary financing of the budget deficit and the substantial portion of the Central Bank's net domestic credit that the government absorbs every year (Bhanumurthy and Sarangi, 2019). Since the budget deficit entrenched in the Egyptian economy, which has been suffering from a high and persistent budget deficit as a ratio of GDP over the last decades, it reached 8.4% in 2019[2]. In order to finance such gap through the CBE, fiscal dominance occurs through direct monetisation or buying of government treasury bonds and bills. This tendency has dramatically affected public debt from domestic and foreign sources until it reached 90% and 35% of GDP in 2019, respectively[3]. Furthermore, the efficiency of using the interest rate is affected by this limitation that any increase in interest rate would increase the cost of servicing the domestic public debt and raising the budget deficit as a percentage of GDP, which threatens the public debt sustainability.

1.2 Monetary policy in emerging and developing countries

(Benlialper, and Cömert, 2016) explained why Turkey decided to implement an implicit inflation target scheme in 2002, instead of a full-fledged IT, because of the intense fiscal dominance caused by a high and unsustainable domestic debt, in addition to high pass-through of the foreign exchange rate. This implicit IT regime implied a monetary targeting to limit the central bank of Turkey's base money and net domestic and foreign assets. In such circumstances, raising the central bank's policy rate to deal with the expected inflationary

[1] Interest rate- Historical data- Central Bank of Egypt.
[2] World Bank, World development indicator- Egypt
[3] Summary of Public Domestic Debt 2019 - Ministry of finance- Egypt.

pressure would endanger public debt sustainability, especially if the market perceives the higher interest rate as a high-risk sign.

Afolabi and Atolagbe (2018) studied the presence of fiscal dominance in Nigeria between 1986 and 2013 by testing unidirectional causality, running from fiscal deficits to monetary base growth. They argue that in the case of fiscal dominance, governments are pressed to maintain the low interest rate relative to the inflation rate in order to reduce the cost of financing the budget deficit. Based on the empirical results, the study could not confirm Nigeria's fiscal dominance during the study period because it depended on a narrow fiscal dominance aspect, which is the budget deficit's monetisation.

Diallo and Mendy (2018) investigated the effect of fiscal dominance in the Democratic Republic of the Congo from 1981 to 2003. The researchers investigated the effect of monetary finance on inflation. The level of fiscal dominance was quantified by the development of the sum of seigniorage and inflation tax as a percentage of GDP. This hypothesis implies that budget deficit affects inflation through its impact on money growth rate or seigniorage. The empirical results confirmed strong and statistically significant long-run relationships between budget deficits and seigniorage, and between money creation and inflation. Besides, a long-run inflationary impact because of the budget deficit that occurred during the 1980s and 1990s. Disinflation has been attained in the early 2000s, mainly after controlling fiscal deficits and reducing the monetary expansion rate.

In Brazil, Barbosa-Filho (2015) established the link between real interest rates, real exchange rate, along with the probability of default on government debts. In a standard open economy model, the transmission from a high real interest rate to lower inflation is going through two ways. The first is through the negative impact of high interest rates on aggregate demand and output, which leads to a decrease in the inflation rate. The second through a real appreciation of the domestic currency. In the case of fiscal dominance, increasing the real interest rate as a remedy to inflationary pressures would increase the probability of default on government debt, particularly the dollar-denominated part. This policy leads to a significant depreciation and increasing inflation rate than decreasing it. As it happened in Egypt in 2016, when the CBE floated the Egyptian Pound partially that led to boosting the inflation rate to 33%. In this case, fiscal policy would be the right tool, instead of monetary policy, to decrease inflationary pressures (Ghosh, et al., 2016).

A study by Kumhof et al. (2010) investigated the feasibility of implementing aggressive monetary policy as a reaction to inflation in case of fiscal dominance. The results showed that adopting an aggressive monetary policy through raising the interest rate to alleviate the effect of high inflation would not be the best policy in this case as it may lead to significant volatile inflation. However, they concluded that eliminating fiscal dominance and achieving monetary stability in developing countries is more important than adopting inflation targeting.

Furthermore, Šoškić (2015) stressed the importance of the central bank's independence from fiscal and political dominance, which would be obstacles in front of adopting inflation targeting. This is particularly true since high budget deficit leads to public debt crises or pressures for monetisation of public debt, pressure on the exchange rate and an increase in inflationary expectations. Therefore, an absence of fiscal dominance over the macroeconomic environment and institutional development to ensure fiscal discipline are essential for inflation targeting to have a chance of success.

1.3 Challenges to monetary policy in Egypt

Hashem (2015) examined the development of monetary policy in Egypt from 1990 to 2010 and highlighted the quantitative monetary instrument's replacement with price instruments as an essential step towards adopting inflation targeting over the medium term. A study by (Domaç, 2003) investigated the inflation dynamics by estimating a money gap model based on domestic liquidity. Even though this model's simplicity depends on the deviation of the actual real money supply from its trend value to explain inflation behaviour, it dismisses important variables that directly affect inflation dynamics in Egypt, for example, real GDP, nominal exchange rate, along with other variables that reflect the occurrence of fiscal dominance. In order to investigate the willingness of the Egyptian economy to implement inflation targeting, the researcher compared the macroeconomic indicators of some emerging countries such as Chile, the Czech Republic, Turkey, Poland, South Africa, Israel, Mexico, and Brazil with the Egyptian Indicators. In this paper, the author concluded that despite the improvement in Egypt's readiness to implement inflation targeting, this would depend on its ability to eliminate the existence of fiscal dominance in the economy.

Regarding the fiscal dominance in the Egyptian economy, Youssef (2011) assessed how fiscal dominance is deeply rooted in the economy by using an error correction model to test the impact of the CBE credit to finance the government’s budget deficit with inflation

between 1960 and 2007. He included two additional independent variables to the model, the real GDP and M2/GDP ratio. Although there is no short-run relationship as the coefficients of independent variables in the short-run were found insignificant, and the error correction term showed a prolonged adjustment towards the long-run, the empirical results confirmed the presence of fiscal dominance through a statistically significant long-run relationship between Egypt's price level and the net claims on the government, M2/GDP, and real GDP.

Furthermore, Helmy (2009) tested the short-run dynamics and long-run relationship between the budget deficit, its financing sources and inflation in Egypt from 1981 to 2006. The empirical results showed a long-run and positive relationship between inflation, the budget deficit, net credit to the government, and money supply M2; and a negative correlation with real output growth and the nominal foreign exchange rate. The latter negative relationship between inflation and nominal foreign exchange rate contradicts that the Egyptian Pound's depreciation against the U.S. dollar always creates inflationary pressures. The paper concluded that the budget deficit and its financing sources are important factors causing inflationary pressures in Egypt and creating challenges to price stability.

Research by Awad (2008) attempted to answer whether to adopt the inflation targeting policy is necessary for the Egyptian economy; He measured the efficiency of the monetary targeting regime by testing the stability of the circulation velocity and the demand for money function from 1991 to 2007. The study found neither a short-run nor long-run relationship between the CPI and M2. Concerning the stability of the circulation velocity and the demand for money, the empirical results showed the instability of both variables between 2002 and 2007. The study concluded on the necessity of adopting inflation targeting after satisfying its prerequisites.

A study by Selim (2010) examined the change that happened to the monetary policy after the Egyptian Pound's devaluation in 2003. The scholar tested the long-run relationship between the foreign exchange rate and monetary fundamentals between 1981 and 2008. The empirical results showed no significant change in exchange rate determination after the float. The author investigated the correlation between foreign exchange rate stability and controlling inflation, especially when the Central bank of Egypt decided to avoid the Pound's depreciation and partially sterilise the high foreign capital inflows from 2005 to 2007; he

found that the unsterilised part of capital inflows raised money supply and increased inflation.

Noureldin (2005) evaluated the robustness of three alternative approaches to forecasting inflation in Egypt between 1980 and 2002. By using three econometrics models: the Output-gap model, a Money-gap model, and a Vector Autoregressive model. The empirical results demonstrated that the Money-gap model outperforms the other models that showed its ability to capture the dynamics of inflation in Egypt during the study period. On the other hand, the three models revealed poor forecast performance. Given that the CBE's inflation target is always unknown, the author depended on a very restricted assumption that the implicit inflation target depended on actual inflation in the U.S. due to the stability of exchanged rate during the chosen period.

1.4 Monetary policy and choice of nominal anchor

The main goal of monetary policy is to maintain law and a stable inflation rate that can be achieved through determining an efficient nominal anchor, which is an intermediate target that helps economic agents and policymakers to make a rational decision regarding expectations about inflation. Therefore, implementing monetary policy without a nominal anchor is inefficient because it may distract public expectations about the inflation rate that can drive economic recession or inflation (Bemanke, et al., 2018). There are three main regimes of nominal anchors for monetary policy; exchange rate targeting, monetary targeting, and inflation targeting.

Exchange rate targeting is one of the best nominal anchors that can be adopted by small developing countries with a simple financial system and controlled foreign capital flows through pegging the national currency to robust foreign currency or control the changes in the foreign exchange rate. This regime is advantageous in maintaining price level stability in developing countries with a high pass-through of foreign exchange rates (Davis, Fujiwara, and Wang, 2018).

The liberalisation of capital account in developing countries or emerging economies will cause complications to target the exchange rate, which is one of the impossible trinity because the monetary policy needs to control capital inflows to maintain foreign exchange stability and absorb domestic liquidity to avoid inflationary pressures. Besides, keeping the

exchange rate target would encourage speculative attacks on the currency with a significant cost in term of losing foreign international reserves. Panizza (2000) elaborated this problem in the context of free foreign capital flows; he found that the fixed exchange rate is one of the leading causes of severe currency and financial crises that create the black market in the economy. As a recommendation to solve these problems, some economists suggested the developing and emerging countries to adopt flexible exchange rate system, such as (Edwards, and Yeyati, 2005), Mishkin (2000), and Duttagupta et al. (2005). Moreover, this regime is adopted by the countries that are supported by the IMF as a precondition for stabilising the economy.

As far as monetary targeting is concerned, monetary policy would essentially restrict one or more monetary aggregates' growth rate. A low and steady level of inflation should be compatible with the chosen monetary aggregate's growth rate. The choice of a suitable monetary variable depends on its impact on forecasted inflation and actual inflation. Under the IMF's support programs, monetary aggregates are selected from central banks' balance sheet components, for example, base money, net domestic assets, or net foreign assets. In order for monetary targeting to be an effective nominal anchor, it should be public information. Compared to exchange rate and inflation rate targets, the effect of monetary target's information is typically insignificant, since the public is more familiar with inflation and exchange targets than the constraints put on the growth of money supply (Heise, 2019).

As a prerequisite for implementing monetary targeting policy, the central bank's credibility should be taken into consideration. Thus, it is only acceptable for developed countries with efficient capital markets and a competitive exchange rate structure. The reasoning for monetary targeting assumes a stable relationship between monetary aggregate and inflation; this means a steady velocity of circulation. In the developing and emerging market economies, the relationship between monetary aggregates and inflation is found to be unpredictable, and their central banks have weak control over their monetary aggregates; thus, monetary targeting is considered inefficient for these countries (Mishkin and Schmidt-Hebbel, 2002). Moreover, a regular overrun of the pre-announced monetary target in the developing and emerging market economies will be viewed by the public as an expansionary monetary policy that increases inflation perceptions and jeopardises monetary policy attempts to minimise inflation.

The third possible nominal anchor to be adopted is the inflation targeting regime (IT). This regime consists of four components (Bernanke, et al., 2018):

1. Explicit numerical target for the inflation rate in the future.
2. Targeting inflation is a central objective of monetary policy.
3. A model to forecast future inflation rate.
4. An operating procedure to adjust monetary instruments in case of the inflation rate forecasts differs from the targeted rate.

The prerequisites for successful implementation of inflation targeting include the central bank's independence from any fiscal dominance and any commitments to other nominal anchors (monetary targeting and exchange rate targeting). A slightly different prerequisite of inflation targeting adds an institutional commitment to price stability, policy instrument independence, and policy transparency and accountability (Svensson, 2010). Instead of independence targeting, central banks should have independence instruments, as it helps to prevent fiscal policy intervention in the conduct of inflation targeting.

Central banks should aim to compare headline or core inflation targets in order to avoid overreacting to transitory supply shortages or sudden fluctuations in food and energy prices. The drawback of targeting core inflation is its calculation, based on CPI adjustments, is less transparent and vague to the public relative to the headline (Bernanke et al., 2018).
Targeting inflation is a central objective of monetary policy that can be elaborated as the central bank can target other nominal anchors. However, inflation should override the other targets in case any conflict occurred. In the case of separate nominal anchors, central banks could allocate a short-run target and a long-run target, and in the case of a conflict, the central bank could overshoot or undershoot the subordinate target.

There will be a need for a transition phase for central banks in the developing and emerging market economies that have more than one exchange rate targeting with a high pass-through effect of foreign exchange, through using discretion during this period to determine which target should have the higher priority. Also, the Coordination between monetary policy and fiscal policy should focus on eliminating the burden of fiscal dominance and the removal of administrative control over domestic markets, in order to pave the way to adopt an efficient IT regime.

Accordingly, Taylor (2000) classified the government budget into two parts: the structural government budget and the cyclical budget. The government should restrict the automated stabilisers to the latter ones and substantially limit the former ones. He highlights the importance of reducing fiscal policy's pro-cyclical behaviour and tries to allow ample surpluses in the booming period to fund the need for expansionary policy during the recession period. In turn, this action can alleviate the pressure on monetary policy to produce adequate seigniorage by cash issuance.

The key drawback of inflation targeting lies in its strong focus on inflation stability, which would produce high costs in the form of large output variability. This is called strict inflation targeting, in which, regardless of all other objectives such as economic development or foreign exchange stabilisation, reducing inflation is the primary priority of monetary policy. Flexible inflation targeting involves a gradual approach to meeting the inflation target by considering the stabilisation of output and foreign exchange rates. Therefore, flexible inflation targeting can be introduced by the developing and emerging market economies with several targets to lower the cost of significant variations in the output and foreign exchange rate.

1.5 Inflation dynamics and fiscal dominance in Egypt

For the last four decades, the Egyptian economy has experienced an erratic record of annual inflation. The period of study (1974-2019) will be classified into four distinct phases according to different structural changes, first is (1974-1991), second is (1992-2003), third is (2004-2010), and fourth is (2011-2019).

In the early 1970s, inflation was at a low level, but after the first oil price shock in the mid-1980s, it moved to a moderate level. The annual inflation rate followed a quicker trajectory and reached around 19 % in the second half of the 1980s to the early 1990s (see figure 1). The Egyptian government recorded a high amount of expenditure in the second half of the 1970s and the 1980s; the deficit was an average of 22% and 21.5% of GDP, respectively (see Figure 2). In order to finance such a significant deficit, the government created seigniorage and inflation tax of which reached to 5% and 3%, of GDP respectively. In addition to a gross financial reached to 21% of GDP in 1980, which was a clear fiscal dominance sign (Helmy, 2009).

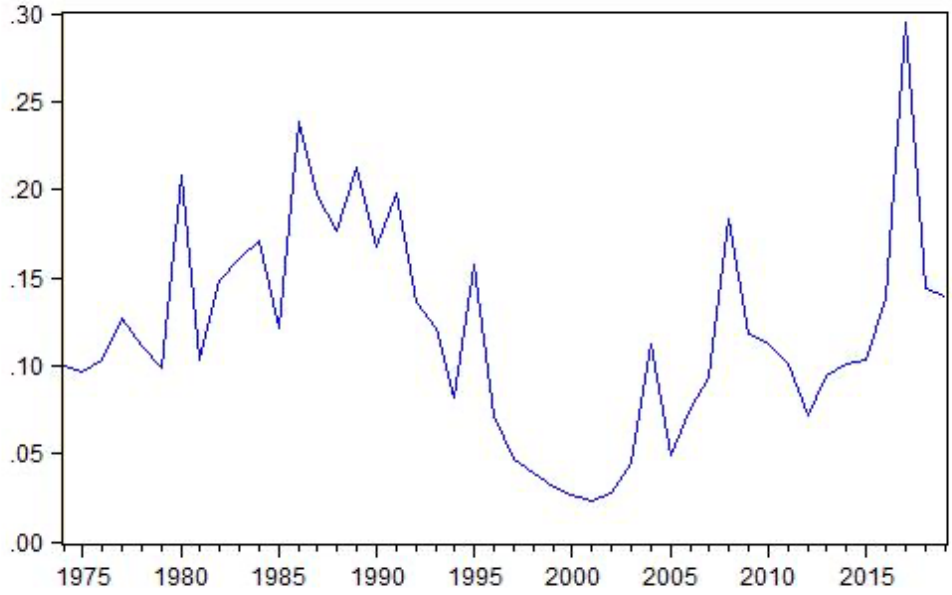


Figure 1: *Inflation in Egypt from 1974 to 2019*
Source: World Bank- World Development Indicators

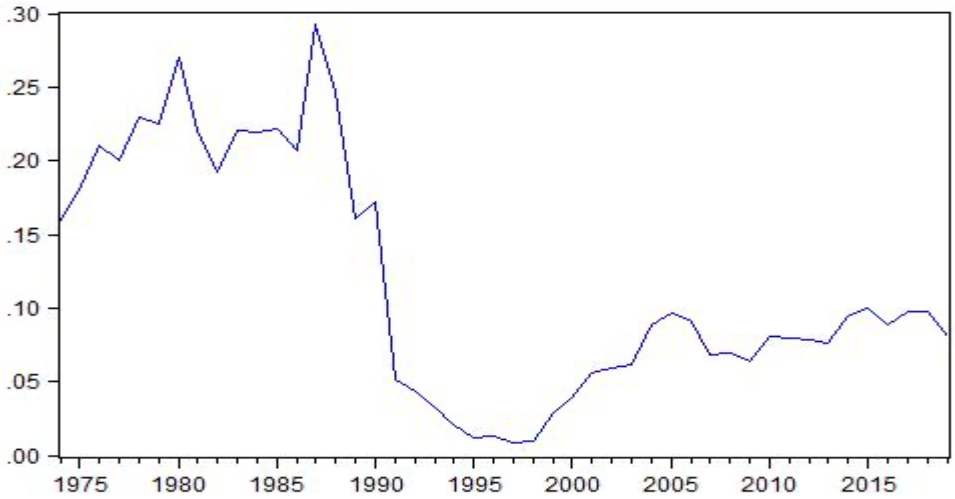


Figure 2: *Budget Deficit in Egypt from 1974 to 2019*
Source: Ministry of Finance of Egypt

In the second phase (1992-2003), which included the successful introduction of the IMF and WB's Economic Reform and Structural Adjustment Program (ERSAP) between 1992 and 1997, inflation was put under control and began to decline to the lowest level of 4% in 1997. Strongly conservative monetary and fiscal policies were included in the ERSAP. The

monetary interventions included the Egyptian Pound's devaluation, the rising of domestic interest rates above the inflation rate, and public and private sector credit limitation (see Figure 3). Furthermore, introducing sales tax to enhance the situation of government revenue along with issuing treasury bills to finance the budget deficit from real resources.

These measures assisted the Egyptian government to decrease its budget deficit to just 1% of GDP in 1997. Thus, seigniorage and inflation tax financing began to fall from 11% of GDP in 1990 to 3.5% in 1997.

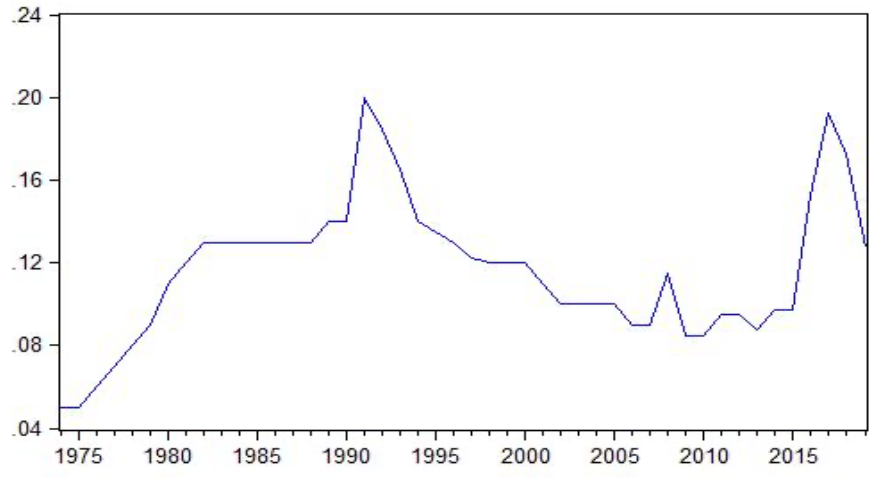


Figure 3: *Discount rate in Egypt from 1974 to 2019*
Source: IMF- International Financial Statistics

The central bank abandoned the use of foreign exchange rates as a nominal anchor in the third phase (2003-2010), with many devaluations of the Egyptian Pound against the U.S. in the early 2000s, which urged the rate of inflation to jump to 11 percent, the weakening of the Egyptian Pound was expressed in a higher level of inflation which confirmed that the foreign exchange rate had a high pass-through effect on inflation. At the same time, a high budget deficit of an average of 7.8 percent of GDP, with a peak of 11.25 percent of GDP in 2002, has led to stimulate inflation. Moreover, overall seigniorage and inflation tax recorded an average of 8 percent of GDP, with a peak of 13.5 percent of GDP in 2005, showing a resurgence of monetary pressure from fiscal dominance on inflation. Nevertheless, the inflation rate continued to grow to 18.3 percent in the second half of the 2000s, while the central bank kept the foreign exchange rate steady. This high inflation was triggered by a sharp increase in overall government finance of 15.5 percent of GDP in 2006 driven by seigniorage of 12.1 percent of GDP, and inflation tax of 3.4 percent of GDP, while the budget

deficit was 9% of GDP, and the domestic debt service was 7% of GDP in 2006 (Abou-Ali, and Kheir-El-Din, 2009).

Monetary policy could not prevent fiscal dominance from triggering high inflation in Egypt by pursuing foreign exchange rate stabilisation. Maintaining inflation stability was not the overarching priority of monetary policy during the 2000s, even after the 2005 announcement by the CBE of its plan to introduce full-fledged inflation targeting policy if the necessary prerequisites are fulfilled. However, no further details were mentioned about these fundamentals.

In the fourth phase (2011-2019), after the 25 January 2011 revolution, the foreign exchange market experienced significant pressure. The Egyptian economy suffered from external and internal imbalances caused by political and economic turmoil during the five years that followed the revolution. Thus, between 2010 and 2015, foreign reserves were steadily drained by more than $20 billion; the Egyptian Pound was devalued several times and lost 31 percent of its worth (see figure 4 and 5), which was also expressed in an average of 9.5 percent in inflation. A high budget deficit with an average of 12 percent of GDP added an additional 3.6 percent inflationary pressure in order to finance this deficit.

The Egyptian government agreed in November 2016 to adopt a three-year comprehensive program of $12 billion with the IMF. One of the new policy's key elements to address external imbalances and improve competitiveness through the implementation of a floating exchange rate mechanism.

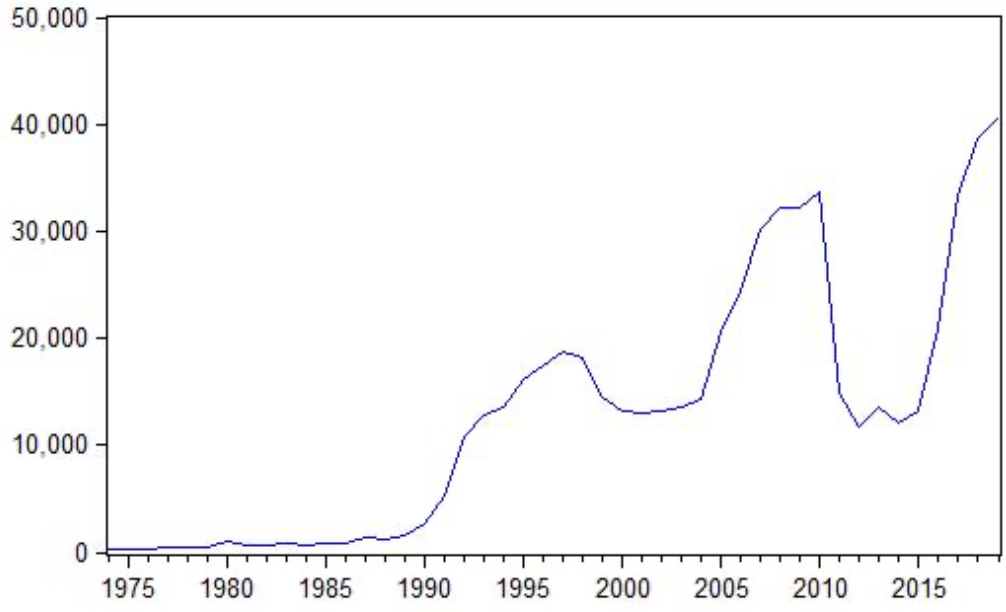


Figure 4: Total Foreign Reserve in million USD from 1974 to 2019
Source: World Bank- World Development Indicators

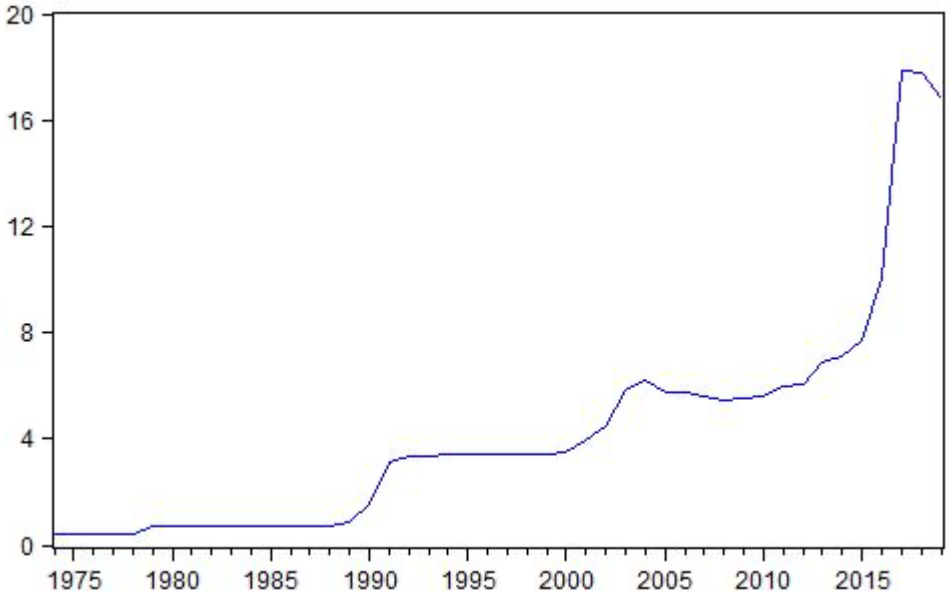


Figure 5: Foreign Exchange rate from 1974 to 2019
Source: Central Bank of Egypt

However, the U.S. dollar's market value hit LE18 and generated a massive surge of inflation in 2017 to an all-time peak of over 30 percent. The program also aimed to reduce the budget deficit to 12.5% of GDP to create a primary surplus of 2% of GDP to restore public debt sustainability. The program included measures to narrow the gap between government revenues and government expenditures. The latter was a challenging goal given that during the fourth phase, the government suffered from a high primary deficit of an average of 4% of GDP, replacing Sales Tax with Value Added Tax (VAT) and raising its rate to 14% in order to increase government revenue and to restrict wages and reduce energy subsidies to reduce government expenditure. All these measures contributed to the inflationary pressure created by foreign exchange rate pass-through.

Furthermore, one year after the introduction of the new free-floating regime, the foreign exchange rate showed an apparent lack of flexibility necessary to absorb the impact of the external shocks. The Egyptian Pound remained stable against the U.S. dollar despite a significant share of the foreign direct investment outflows. According to the IMF's fourth review of the EFF program, these outflows were absorbed by the repatriation mechanism of the Central Bank of Egypt without any effect on the exchange rate or the international reserves (IMF, 2019). Maintaining the stability of the foreign exchange rate is an indication of a third potential nominal anchor, which could be the targeting of international reserves or

foreign exchange targeting. In order to build the transparency and accountability of the Central bank of Egypt, the ambiguity surrounding the choice of the nominal anchor of monetary policy or the priority of each anchor in the case of multiple anchors must be clarified.

The accumulation of massive public debt from domestic and foreign sources, which hit 95 percent in 2016 and 16 percent of GDP, respectively, this high debt ratio restricted the monetary policy's ability to use its instruments, particularly domestic interest rates, in controlling inflation. In this circumstance, any rise in the domestic interest rate will increase the burden of servicing the domestic public debt and raising the budget deficit as a percentage of GDP at the same moment risks the public debt sustainability. Due to the high cost of domestic interest rate compared to foreign rate, the Egyptian government extend its borrowing from foreign sources, which increased from 16 percent of GDP in 2016 to 31.5 percent in 2018.

After analysing Egypt's inflation dynamics throughout the study, we can conclude that inflation is sustained by the fiscal dominance of monetary policy to finance the budget deficit through seigniorage and the inflation tax. External or internal shocks always cause the trigger. The nature of fiscal dominance changed after the 2011 revolution to take the form of excessive lending to government that has continued to rise from 74 percent of GDP to 119 percent between 2011 and 2016 (See figure 6). Therefore, the net credit to the government became a significant source of net domestic assets that the central bank of Egypt relies on to supply money, along with net foreign assets.

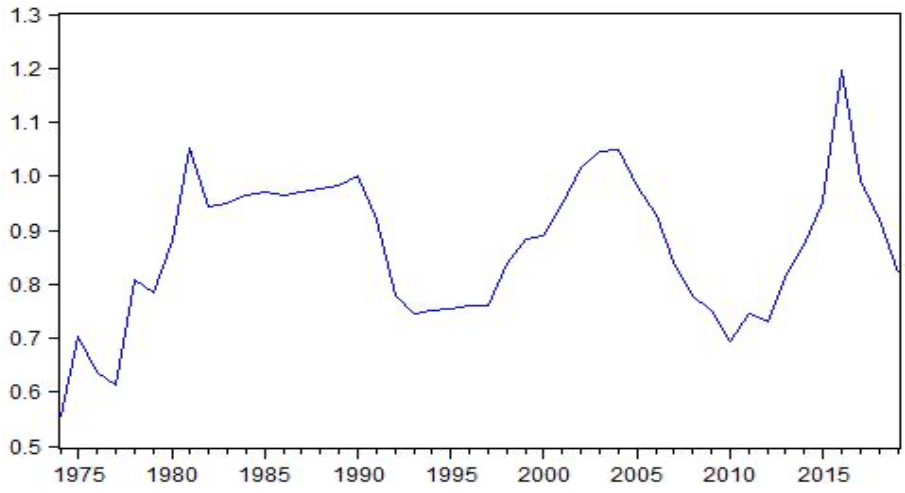


Figure 6: CBE's net credit to government % GDP from 1974 to 2019 (Annually)
Source: World Bank and own Calculations

1.6 Monetary policy position in Egypt

The monetary policy in Egypt did not have an obvious objective during the first phase (1974-1991), as it was responsible for supplying the government with ample seigniorage revenues to finance its budget deficit and retain low interest rates for cheap credit to the public sector. As a framework for increasing resources from the inflation tax to finance the budget deficit, a high reserve requirement of 25% was applied. The exchange rate was pegged to the U.S. dollar during this time, but multiple exchange rates were applied to numerous international transactions, causing a significant imbalance in the pricing mechanism.

The ERSAP program during the second phase (1992-2003) required to have strict conservative monetary policy, including high interest rates and a credit limit on private and public sector loans. The CBE agreed to use it as a nominal anchor after the foreign exchange rate's devaluation in 1992. For the first time, monetary policy has an explicit nominal anchor for preserving price level stability and reducing inflation expectations. At 3.33 Egyptian Pound per U.S. dollar, the foreign exchange regime became a robust pegged system (Al-Mashat, 2011).

The adverse effects on the economic growth have created a monetary policy issue between sustaining a lower inflation rate and boosting economic growth, since the decision between decreasing or increasing domestic interest rate became a dilemma (Hammond et al., 2009). In addition, the liberalisation of international capital flows in the late 1990s created an issue to keep the foreign exchange rate stable and to maintain a lower inflation rate. During this time, monetary policy was involved in sterilising the inflows of foreign capital to avoid the Egyptian Pound's appreciation.

The sterilisation policy was primarily carried out by issuing T-bills and T-bonds above the budget deficit financing requirement, which in turn led to the accumulation of domestic debt. The raising of interest rates to lower inflation encouraged foreign capital inflows and thus raised the pressure to appreciate the domestic currency. In the meantime, the CBE has modified some monetary policy tools from direct to indirect measures, such as adopting T-bills as a non-inflationary mechanism for financing the budget deficit and using repo operations to provide ample liquidity to sustain economic growth (Panizza, 2001). As the Asian crisis in 1997 and the Luxor terrorist attack in 1998 struck the Egyptian economy by generating an overall balance of payment deficits and shortage of foreign reserves. The CBE

attempted to bring stability to the exchange rate regime by adopting a crawling peg between 2001 and 2002, which was very challenging due to the pressure of devaluation of the Egyptian Pound. However, the system failed, and the Egyptian Pound lost 30 percent of its value. The CBE stopped the crawling peg system in January 2003 and permitted the Egyptian Pound to float (DeRosa, 2009).

Despite the de-jure floatation of 2004, in the third phase (2004-2010), monetary policy, which was reclassified into a de-facto managed floating, no longer had an explicit nominal anchor, but instead implicitly targeted money growth of 10 percent annually to preserve price stability. CBE used banks' excess reserves as its operational tool to monitor money growth, and M2 as its intermediate target, given its close linkage to inflation. In particular, during the time of capital inflows (2005-2007), during this period, the rate of money growth was higher than the 10 percent target, those targets could not be sustained. As a result, the rate of inflation increased to 20%. When monetary policy aimed to target both inflation and the exchange rate, this complication emerged (Al-Mashat, 2011).
More indirect monetary instruments have been introduced by the CBE, such as reverse monetary instruments, T-bills Repos, along with one-year CDs in 2004, and CBE's notes for one-year to two-year maturities in 2005; during this time, the CBE used the discount rate as a policy. CBE then agreed to use the overnight deposits and lending rates as the policy rate on CBE's standing facilities, the limit of which the market overnight rate would fluctuate were those two rates. Although this new short-run policy rate was considered an effective indirect tool, its real value was negative and, therefore, viewed as an expansionary policy, especially in high inflation periods. Although price stabilisation became a specific monetary policy objective in 2003 in the new banking law, it was not always the case, as the CBE is still committed to meeting the government's economic growth objective (Hassan, 2016). On the other hand, the new banking law stipulated that the CBE to lend an overdraft to the government with a cap of 10% of the annual budget revenue. However, CBE’s net credit provided to the government has always surpassed this limit.

In the fourth phase (2011-2018), particularly after the announcement of Monetary policy's first inflation target of 13 percent of the (± 3%) headline range in May 2017, the CBE agreed to adopt a contractionary monetary policy, which applied those three measures:

- Raising the overnight deposit and lending rates by 200 basis points to 18.75 percent and 19.75 percent, respectively.

- Increasing the required reserve ratio for banks at the CBE from 10% to 14%.
- Absorbing excess liquidity from the banking system by using deposits acceptance operations with maturities of 28 to 210 days.

As the annual headline inflation rate retreated to 14.4 percent at the end of June 2018, the implementation of this contractionary monetary policy succeeded in containing inflationary pressures (from 30 percent at the end of June 2017). As soon as the inflation rate hit the rate within the range of the target, in February and March 2018, the Monetary Policy Committee (MPC) agreed to lower overnight deposit and lending rates twice to 16.75 percent and 17.75 percent by 200 basis points respectively. This sudden return to expansionary monetary policy to stimulate economic growth is a direct sign that Egypt's monetary policy had dual goals in the fourth phase.; i.e., inflation and economic growth.

1.7 Price stability experience in Israel

Israel has an interesting economic and political history with Egypt that shaped the modern middle east, the incentive behind studying the monetary policy of one of the closest neighbours to Egypt is to understand how both countries managed their economies with respect to monetary policy after the 1973 war, and how this policy improved or worsened the economic situation regarding inflation.

At the beginning of the 1980s, Israel witnessed three-digit inflation rates as a result of a decade of expansionary fiscal and monetary policy. The government agreed in July 1985 to introduce the Economic Stabilisation Plan (ESP), which merged contractionary monetary and fiscal policies with a fixed exchange rate, after annual inflation had reached a level close to 450 percent (see Figure 7). The strategy resulted in reducing annual inflation to about 20% by the end of 1986 and signalled a new period in Israeli monetary policy, the core objective of which was price stabilisation.

Following the reduction process in inflation caused by the ESP, the governments' goal was to sustain inflation at the prevailing rates by using the exchange rate as a nominal anchor.

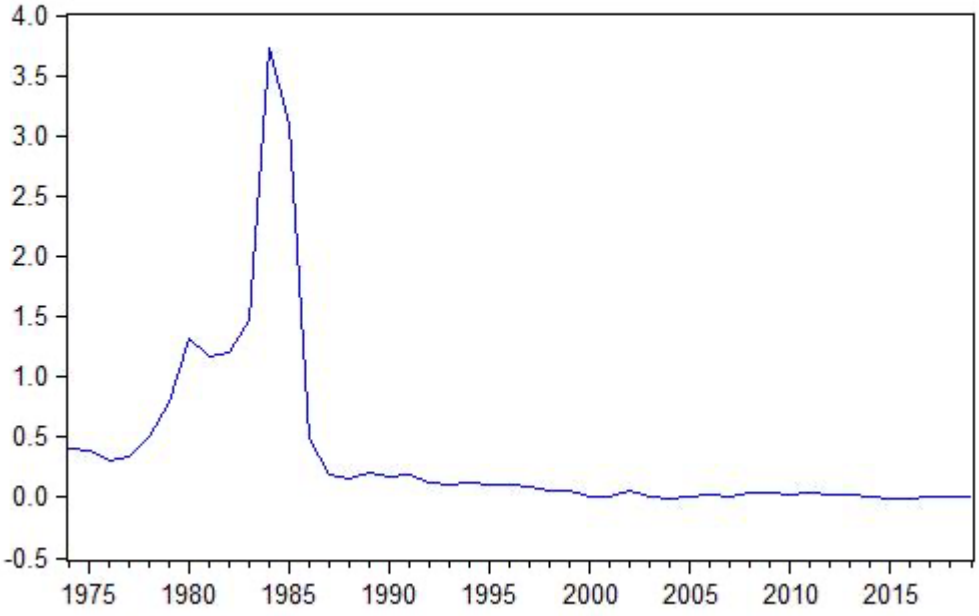


Figure 7: Inflation rate in Israel between 1974 and 2019
Source: World Bank- World Development Indicators

However, the adherence to a fixed exchange rate and the continued liberalisation of foreign exchange contributed to a real appreciation that undermined competition and promoted speculative attacks. Anxieties that could threaten the disinflation mechanism have led the policymakers to gradually encourage the exchange rate system to be more flexible. They agreed to devalue the fixed nominal exchange rate gradually. In 1989, the increased burden on the central bank's reserves led to the adoption of a band that allowed 3 percent volatility across the central parity; in 1990, after a temporary release, further appreciation of the exchange rate caused a rise in the band width to 5 percent (De Fiore, 1998).

These interventions may have led the market to consider a lack of commitment of the government to the exchange rate and anti-inflationary policies to induce sustainable inflationary expectations and to keep inflation from dropping to single-digit values. Although the authorities accomplished their objective of stability, the average inflation rate was around 18 percent through the five years after the stability program. Therefore, it became apparent that the overall plan would not lead to single-digit inflation rates.

At the end of 1991, after a more speculation attack, the authorities agreed to switch to an increasing exchange rate band, which was set annually on the basis of the difference between the newly adopted inflation target and the calculation of the average inflation rate of the key trading partners with Israel. On the one hand, this represented a transition from a system

in which monetary policy pursued exchange rate targeting to the new one in which monetary policy is driven primarily by inflation targeting. On the other hand, the existence of a crawling exchange rate band has been a restriction on the inflation objective since 1991 and, in some situations, the level of the interest rate needed to meet the declared inflation target has not been compatible with preserving the nominal exchange rate within the existing band. Additionally, once there is no conflict between inflation targeting and the exchange rate system, Israel's monetary policy has been dominated by inflation targeting (Sokoler, 2003). Although Israel was progressing towards a higher degree of flexibility in the exchange rate, there was also a slow phase of financial liberalisation, which began after the ESP of 1985 and persisted in the first half of the 1990s (see figure 8).

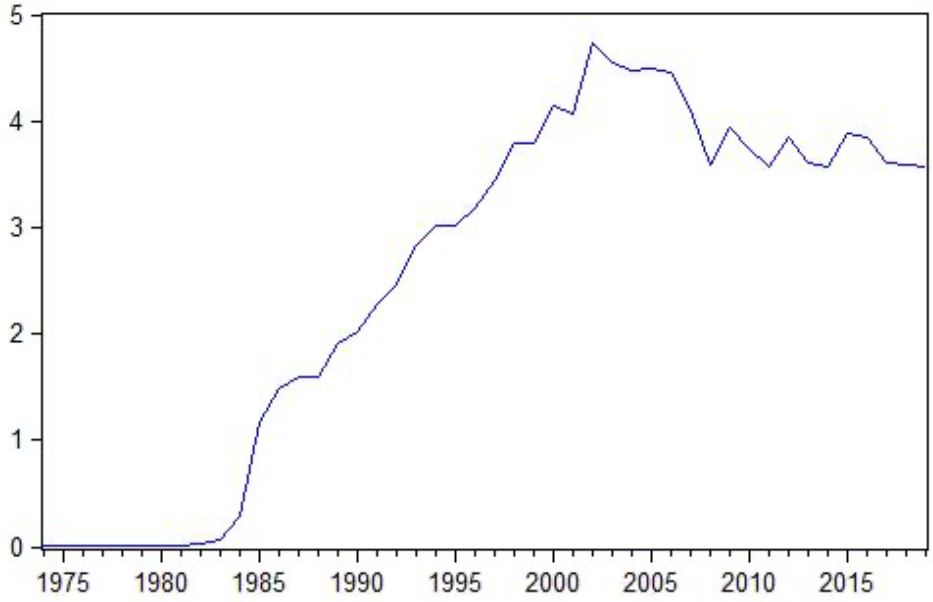


Figure 8: United State Dollar to Israeli New Shekel from 1974 to 2019
Source: Bank of Israel

Limits were lifted, first on the domestic stock market, then on the current account, and after that on the capital account, respectively. While the process of liberalisation was significant, certain rigidities continued to exist. The banking system remained highly centralised, and banking intermediation also accounted for a larger share of overall financial intermediation than in many other developed countries.

The fiscal policy is the final factor that was associated with monetary policy that influenced output. In 1991, a shrinking budget deficit law was issued by the authorities to ensure that the temporary rises in public spending required to cope with the arrival of immigrants would not result in persistent and unnecessary increases (Benchimol,2016). Nonetheless,

monetary policy was expansionary from 1994 to 1996, with the domestic budget deficit exceeded the required limit in 1995 and 1996. In fact, the domestic deficit in the public sector grew from 3.3 percent of GDP in 1994 to 4.4 percent in 1995. As the economy witnessed a decline in the unemployment rate to its normal level, this has resulted in boosting the domestic demand. In order to mitigate these inflationary pressures, tight monetary policy has been introduced.

1.7.1 Transition phases of Israeli economy to stabilize the prices

The stabilisation program, as highlighted in the previous section, corrected the fiscal and balance of payments imbalances and presented the central bank with a basic law to enforce an independent monetary policy. Nevertheless, while inflation declined sharply, high levels were not entirely treated. Inflation was trapped at around 20 percent between1986 and 1991, which is considered the first phase.

The stabilisation policy had to struggle with a serious lack of credibility. The elements of the program were identical to the adopted measure before initiating the program. However, the problem was not addressed by a collection of package deals. The basic adjustment of the fiscal and balance of payments deficits was not well understood and was received with cynicism which irritated the situation. Even with the tough starting conditions, the program resulted in reducing inflation from the peak of several hundred percent to about 20 percent in 1986 (Bruno et al., 1991).

The prevailing policy priority after the program's implementation was to contain inflation and avoid its escalation or a return to pre-stabilisation dynamics. Three key concerns were correlated with this policy, and preventing an increase in real wages was the first challenge.

The nominal compensation agreed on the implemented program in early 1986 was greater than the required compensation to regain the pre-stabilisation real wage level. As a result, inflation plummeted further than expected. Through strict agreements with the Histadrut and the employers' organisation, the increase in real wages stopped.

The second problem was the fall in the real exchange rate in a fixed exchange rate system induced by the continuity of inflation. The central bank dealt with the latter by limited devaluations followed by the establishment of an exchange rate band (first a horizontal band and then a diagonal band), which allowed the nominal exchange rate to rise.

The third problem was the abolition of price controls. The solution was to phase out the

controls, causing prices to increase at the pace of the inflation level without using subsidisation.

As the first phase in inflation stabilised and the fiscal and balance of payments situation became clear and easy to understand, the validation of the new level of inflation gained more credibility from the program. It is fair to say that the government and the Central Bank have not attempted to reduce inflation even further. Their primary objective was to take advantage of the initial success by stabilising the inflation rate at 20 percent and focusing on avoiding an adverse shock that could move the inflation rate to a higher and accelerating level.

In the second phase, the inflation rate reached 10% between 1991 and 1998. However, this was not a consequence of an anti-inflationary policy. It happened as a result of a natural supply shock triggered by the former Soviet Union's tremendous wave of immigration that began in 1990. Within five years, Israel absorbed 1 million immigrants, half of them between 1990 and 1992. Considering the increase in economic growth and the significant creation of jobs associated with it, there was an excess supply of labour that led to an increase in unemployment, placing downward pressure on wages. The prices decreased thanks to the fall in real wages, although these were favorable reasons for the fall in the rate of inflation. This excess supply of labour also affected the flexibility of the labour market. The immigrants from the former Soviet Union were unable to join Israel's labor union. They, thus, reduced the power of Histadrut, which enabled a major labor market reform (Liviatan and Sussman, 2002).

The monetary policy was opportunistic during that phase in taking advantage of the labour supply shock and concentrated on stabilising the inflation rate to a new lower level. On the fiscal side, the adoption of the balanced budget act was a significant step. This enabled a temporary increase in the fiscal deficit linked to the necessary increase in spending associated with the absorption of immigration without undermining the credibility of the government. On the balance of payments side, the U.S. has granted loan guarantees to finance the expected increase in the current account deficit associated with the absorption of new immigrants.

The first inflation target was declared in 1993. It was not a transition to a policy that targeted inflation, but rather an effort to maintain the recent lower inflation rate induced by the immigration shock. In addition, it was necessary to align the rate of inflation with the diagonal exchange rate band at a rate compatible with the disparity between foreign and domestic inflation.

In 1995, the first step towards an inflation targeting system was made. Although no effort has been made to further curb inflation, this signifies the start of Israel's new monetary regime. Inflation targeting, since it was in conflict with the diagonal exchange rate band, could not be entirely realised. In 1997, the disparity in interest rates between domestic and foreign rates created a significant inflow of foreign exchange capital. The exchange rate has reached the lower limit of the exchange rate band, requiring the Bank of Israel to buy and sterilise purchases of foreign currencies. The Bank's ability to implement the requisite restrictive inflation reduction policy was therefore limited.

At the beginning of 1999, the transition to the final and still prevailing phase occurred. The transformation to the low inflation period can be linked to the monetary policy adoption of the inflation-targeting system to maintain price stability, since resolving the tension between the inflation targeting and the exchange rate band, first, by expanding the band, and then, by removing it completely. Through two independent series, monetary policy in Israel gained credibility, thereby shifting inflationary expectations for price stability.

However, Inflation plummeted below the lower limit of the inflation target range, which is between 1 and 3%, since the beginning of 2014. The reasons behind this low inflation can be summarized in the following points;

1- the appreciation of shekel in 2017 due to the global weakness of US dollar: The shekel appreciated by 3.9 percent in terms of the nominal effective exchange rate in 2017, after increasing by 4.6 percent in 2016. The effective appreciation in 2017 was mainly the result of the shekel’s appreciation against the US dollar (8.5 percent), which was slightly offset by the shekel’s depreciation against the euro (2.7 percent).

2- Administrative decisions made by the government with the goal of reducing the cost of living." The Bank of Israel states that these decisions "continued to lead to lower prices, which contributed to a decline in inflation.

3- The increased level of competition in the economy, which was partly was the result of the increase in Internet purchases.

II. ANALYSIS

2 TAYLOR RULE, MONETARY POLICY REACTION FUNCTION AND INFLATION FUNCTION

The key component of inflation targeting is the reaction function of the monetary policy called Taylor Rule, presented by (Taylor, 1993), which is a policy rule that describes the short-term nominal interest rate as a function of the deviation of inflation from a target and the deviation of real GDP from potential GDP. The following formula can represent Taylor rule:

$$i_t = r + \pi_t + \alpha\,(\pi_t - \pi^*) + \beta\,(y_t - y^*)\ (1)$$

Where;

i_t: is short-term nominal interest rate.

r : is the real interest rate.

π_t: is the inflation rate.

π^* : is the inflation target.

y_t: is the real GDP.

y^*: is the potential GDP.

α: is the responsiveness of nominal interest rate if the inflation rate deviate from its target.

β: is the responsiveness of nominal interest rate if the real GDP deviated from potential level.

According to this function, the parameters (α and β) has positive magnitude, therefore, the central bank should increase the nominal interest rate if the inflation rate is more than its target and if the real GDP is more than the potential level, and vice versa.

Taylor rule in equation (1) is based on the axiom of a closed economy, (Svensson, 2000) and (Ambler, et al., 2004) created a basic open-economy model and illustrates a greater effect on inflation in an open economy than in a closed economy due to changes in the domestic interest rate. In a close economy, interest rate changes can only be transmitted to inflation through the output channel, but in an open economy, both the output and the foreign exchange channels will be transmitted.

For Egypt and the EMEs that suffer from high foreign exchange rate pass-through to inflation, The impact of adjustments in the foreign exchange rate on the monetary policy reaction feature should be added to equation (1) to incorporate it. Also, we have to add fiscal

variable to measure the effect of fiscal dominance on monetary policy (Asso, et al., 2007), therefore, the formula will change to look as follow;

$$i_t = r + \pi_t + \alpha\,(\pi_t - \pi^*) + \beta\,(y_t - y^*) + \gamma\,\Delta EX + \delta\,\Delta BD \quad (2)$$

Where;

ΔEX: is the change in nominal foreign exchange rate.

ΔBD: is the change in budget deficit to GDP

γ: is the responsiveness of interest rate to change in nominal exchange rate

δ: is the responsiveness of interest rate to change in budget deficit ratio

According to the new parameters in equation (2), γ is supposed to be positive, that is, if the appreciation in the Egyptian Pound the central bank should react by decreasing the nominal interest rate to stabilise the foreign exchange market, and vice versa. Regarding δ, it will depend on how the monetary policy react to the fiscal dominance, if it is positive, it means there adoption of expansionary monetary policy when the budget deficit increase which indicates the existence of fiscal dominance and vice versa.

According to (Svensson, 2000), Conditional forecasts of inflation should be provided by the central bank and these conditional forecasts should be used as an intermediate target. Inflation targeting actually turns into inflation-forecasts targeting. In this case, the changes in policy variables would be driven by the difference between conditional forecasts and inflation targets (nominal interest rate). If the rate of inflation predicted is higher than the pre-announced inflation target, the policy rate should rise to lower inflation projected against the target. It is therefore necessary for the central bank to create a robust econometric model that matches high forecasting capabilities with domestic inflation dynamics. Based on depicted facts about inflation dynamics in Egypt, despite the change in its structure, fiscal dominance has played a major role in inflation sustainability. Thus, a fiscal variable, as a proxy for fiscal dominance, should be used in the inflation function as an independent variable. It can also be included in the inflation function to trace the behavior of imported inflation, considering the strong pass-through of the foreign exchange rate to domestic inflation. Moreover, Lax monetary policy has also led to inflation resistance, whether the lag has been triggered by the efforts to avoid the appreciation of the domestic currency, in order to achieve the objective of maintaining the stability of foreign exchange rates, or by the

efforts to avoid the additional cost of servicing domestic debt, as another evidence of fiscal dominance.

In order to comprehend the effect of other contradictory monetary policy targets on the inflation behavior, the policy rate can also be included in the inflation function. Therefore, for Egypt, the following inflation function is suggested, which takes into account the effect of monetary, fiscal and external variables. The inflation function can be specified as follows:

$$\pi_t = f(\, g_t, i_t, EX_t, BD_t) \quad (3)$$

Where;

π_t: the inflation rate.

y_t: GDP growth rate.

i_t: is short-term nominal interest rate.

EX_t: is the change in nominal foreign exchange rate.

BD_t: Government budget deficit.

From this function we can expect that there is a positive correlation between BD_t; the positive relationship between inflation and government budget deficit is considered as a fiscal dominance factor, because generally the government has to find a source of finance that fill the gap between expenditure and revenue which leads to the creation of money as a significant part of the net domestic assets. Due to the changing nature of fiscal dominance in Egypt during the study period, examining for the presence of fiscal dominance is challenging, from the emphasis on the seigniorage creation and monetisation of the deficit to the absorption of a large part of the net domestic assets. This suggested inflation function assumes that the budget deficit is financed mainly through CBE credit to the government which is a significant cause of the rise in the supply of money initiated by fiscal dominance.

3 EMPIRICAL ANALYSIS

3.1 Data and methodology

The data in this study covered the period between 1974 and 2019 gathered from World Bank, IMF, Ministry of finance of Egypt, and central bank of Egypt the variables in the model are annual inflation, budget deficit to GDP ratio, GDP growth rate, nominal foreign exchange rate, and discount rate. Also, by using the Hodrick-Prescott filter (Maravall, and Del Rio,2001), the inflation gap and real GDP gap are measured as the difference between their actual value and their trends (see figures 9 and 10).

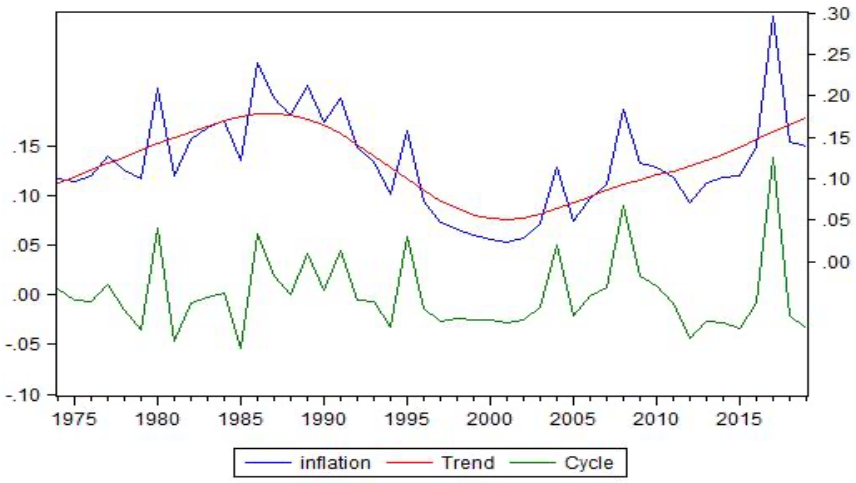


Figure 9*: Inflation Gap*
Source: Own processing

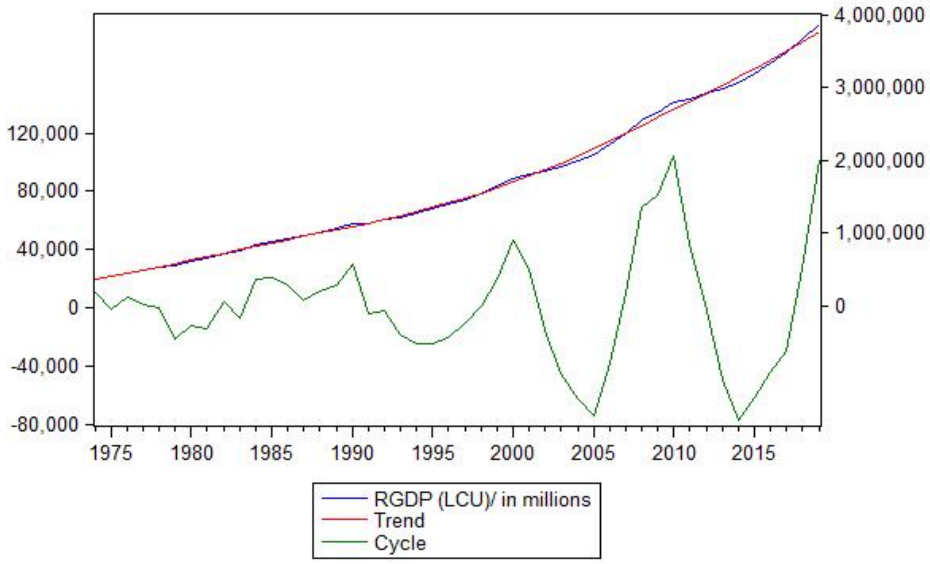


Figure 10*: GDP Gap*

Source: Own processing

3.2 Inflation Function

Regarding the inflation function, there are four independent variables that are the main components for inflation (INF) in Egypt which are GDP growth rate (G), discount rate (DR), exchange rate (EX), and government budget deficit (BD). Also, INF, and BD takes the logarithmic form to reflect the percentage change (Gujarati, Porter, and Gunasekar, 2012).
Therefore, the inflation function can be represented as follows,

$$INF = f(\mathrm{G}, DR, \mathrm{EX}, \mathrm{BD}) \quad (4)$$

First of all, I have to run the stationarity test for the variables to determine the most suitable econometric model that I have to use. Through running Augmented Dickey-Fuller test (ADF) (Dickey, and Fuller,1979) (see appendix 1).
The results of this test show that all variables there is one unit root, so it is an I(1) series. Except G which shows a stationary series I(0).
Therefore, due to the combination between order (0) and (1) the most appropriate econometric method is Autoregressive-Distribution lag (ARDL) (Pesaran, Shin, and Smith, 2001)
The ARDL approach has several advantages. Although traditional cointegration methods use a system of equations to estimate long-run relationships, ARDL uses only one equation for cointegration. ARDL makes it possible to provide separate lags for dependent and explanatory variables for improved dynamic efficiency, which is difficult for traditional approaches. The ARDL approach is also considered to be more stable and works well with a limited sample size of data.
Regarding the specification of ARDL, it can be shown as follows,

$$y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i}\, y_{t-i} + \sum_{j=1}^{m} \beta_j\, x_{t-j} + u_t \quad (5)$$

Where;
y_t: the dependent variable.
x_t: the vector of dynamic independent variables.
k: lag's number for the dependent variable.
m: lag's number for the independent variable.
u_t: error term.

Furthermore, we have to run Bounds testing, in order to investigate the cointegration between y_t and x_t, which can be applied through the following formula;

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i}\ \Delta y_{t-i} + \sum_{j=1}^{m} \psi_j\ \Delta x_{t-j} + \phi_0\ y_{t-1} + \phi_1\ x_{t-1} + \varepsilon_t\ (6)$$

Where;

$\alpha_{1i}\ and\ \psi_j$: short-run parameters.

$\phi_0\ and\ \phi_1$: long- run parameters.

For this test the null hypothesis will be:

$H_0: \phi_0 = \phi_1 = 0$

The cointegration test has three possibilities; first, if the F-statistic lies below the lower bound of the critical value, there will be no cointegration. Second, the cointegration exists, if the F-statistic approaches the upper limit of the critical value. Third, if the F-statistic lies between the lower and upper bounds, the test would be inconclusive. Since the assumptions of this test implies that all variables are integrated with I(0) and I(1) (Pesaran, Shin, and Smith, 2001)

The next step, in case of existing of cointegration, is to estimate error correction model

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i}\ \Delta y_{t-i} + \sum_{j=1}^{m} \psi_j\ \Delta x_{t-j} + \gamma_0\ z_{t-1} + \ \xi_t\ (7)$$

Where

$\gamma_0: the\ adjustment\ speed\ for\ shocks\ in\ short\ run\ towards\ long\ run$

Since, $z_{t-1}$is the derivation of the lagged value of the residual value of the following relationship.

$$y_t = \alpha_0 + \sum_{i=1}^{k} \varphi_1\ x_t + \ \omega_t\ (8)$$

$$\omega_{t-1} = y_{t-1} - \sum_{i=1}^{k} \varphi_1\ x_{t-1} = z_{t-1}\ (9)$$

3.2.1 Empirical analysis of Inflation function

3.2.1.1 Estimation of ARDL

Regarding the model specification of ARDL model can be represented as follows;

$$\ln(inf)_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} \ln(inf)_{t-i} + \sum_{j=1}^{m} \zeta_{1j} G_{t-j} + \sum_{j=1}^{m} \zeta_{2j} DR_{t-j} + \sum_{j=1}^{m} \zeta_{3j} EX_{t-j} + \sum_{j=1}^{m} \zeta_{4j} \ln(BD)_{t-j} + u_t \quad (10)$$

Firstly, in ARDL model, I have to determine lag selection using different information criteria, as can be displayed in the following table:

Table 1: Lag selection criterion

Endogenous variables: LN_INFLATION
Exogenous variables: C
Date: 01/25/21 Time: 20:18
Sample: 1974 2019
Included observations: 39

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-37.72590	NA	0.426594	1.985943	2.028599	2.001248
1	-19.73851	34.12991*	0.178531	1.114796	1.200106*	1.145404*
2	-18.64903	2.011351	0.177752*	1.110207*	1.238173	1.156120
3	-18.54591	0.185097	0.186196	1.156200	1.326822	1.217418
4	-18.50324	0.074386	0.195702	1.205295	1.418572	1.281817
5	-16.56300	3.283491	0.186684	1.157077	1.413009	1.248903
6	-16.49768	0.107191	0.196138	1.205009	1.503597	1.312140
7	-16.41157	0.136895	0.205955	1.251875	1.593119	1.374311

* 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

This table shows that most of the criteria reveals one lag for this variable except FPE and AIC that reveals two lags

After running ARDL model using Eviews with max two lags for the dependent variable, the result of the model can be shown in the following table;

Table 2: ARDL Empirical output of inflation function

Dependent Variable: LN_INFLATION
Method: ARDL
Date: 01/26/21 Time: 20:54
Sample (adjusted): 1978 2019
Included observations: 42 after adjustments
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Adjusted R-squared
Dynamic regressors (4 lags, automatic): GDP_GROWTH LN_BD USD_EGP DISCOUNT_RATE
Fixed regressors: C
Number of models evalulated: 1250
Selected Model: ARDL(2, 0, 4, 4, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LN_INFLATION(-1)	-0.270240	0.170705	-2.156467	0.0271
LN_INFLATION(-2)	0.137018	0.124736	1.098470	0.2834
GDP_GROWTH	4.714937	2.110905	2.233610	0.0355
LN_BD	0.230821	0.156393	2.004321	0.0435
LN_BD(-1)	-0.296803	0.196100	-1.513532	0.1438
LN_BD(-2)	0.064859	0.198456	0.326819	0.7468
LN_BD(-3)	0.423268	0.212842	2.023567	0.0487
LN_BD(-4)	0.462205	0.227733	2.029589	0.0541
USD_EGP	0.104051	0.049975	2.082058	0.0487
USD_EGP(-1)	-0.025916	0.061439	-0.421810	0.6771
USD_EGP(-2)	-0.017591	0.066821	-0.263250	0.7947
USD_EGP(-3)	-0.212420	0.166964	-1.272245	0.2160
USD_EGP(-4)	0.254424	0.139721	1.820945	0.0817
DISCOUNT_RATE	2.792394	3.321600	2.003345	0.0409
DISCOUNT_RATE(-1)	-6.508660	4.019238	-1.619376	0.1190
DISCOUNT_RATE(-2)	-0.691636	4.506507	-0.153475	0.8794
DISCOUNT_RATE(-3)	4.551874	4.283440	1.062668	0.2990
DISCOUNT_RATE(-4)	6.133889	3.481376	1.761915	0.0914
C	-1.707772	0.473832	-3.604171	0.0015

R-squared	0.925855	Mean dependent var	-2.282393
Adjusted R-squared	0.867829	S.D. dependent var	0.631230
S.E. of regression	0.229485	Akaike info criterion	0.196632
Sum squared resid	1.211261	Schwarz criterion	0.982720
Log likelihood	14.87074	Hannan-Quinn criter.	0.484764
F-statistic	15.95583	Durbin-Watson stat	2.490354
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

This table shows that according to Adjusted R^2 the selected ARDL model is (2, 0, 4, 4, 4) which is assigned to ln (inf), G, ln (BD), EX, and DR, respectively. Also, it shows a quiet high goodness of fit, as adjusted R^2 reaches to 86%

3.2.1.2 ARDL Bounds test

Regarding cointegration test between the dependent variable and explanatory variables, it shows that F-statistic is higher than the upper bounds, therefore, the null hypothesis can be rejected at 1% significant level, which indicates the existence of the long-run relationship (see table 3).

Table 3: Bounds test

ARDL Bounds Test
Date: 01/26/21 Time: 17:35
Sample: 1978 2019
Included observations: 42
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	8.028838	4

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

3.2.1.3 Estimation of long-run parameters

Regarding the extracted results, the long-run estimated equation is as following (see table 4);

$$\ln inf = -1.51 + 0.0026\, G - 0.07\, DR + 0.004\, EX + 2.78 \ln (BD) \quad (11)$$

All parameters are significant. Moreover, the magnitude of all variable follows the theories, since according to the theory there should be a negative relationship between discount rate and inflation rate, GDP growth, exchange rate and budget deficit contribute positively to inflation (Mishkin, 2007). This model can be explained as real GDP growth increases by 1% this lead to increase the inflation by 0.2%, 1% increases in budget deficit contribute to 2.7% in inflation, 1% increases in exchange rate leads to 0.4% in inflation, and an increase in discount rate by 1% helps to mitigate the inflation by 3%.

Table 4: long-run parameters

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP_GROWTH	0.002647	1.994733	2.085816	0.0483
LN_BD	2.780385	0.070362	11.091080	0.0000
USD_EGP	0.004048	0.024869	3.638872	0.0014
DISCOUNT_RATE	-0.038340	2.354630	2.352741	0.0276
C	-1.507006	0.333786	-4.514889	0.0002

Also, the relationship between inflation and its explanatory variables in the short run can be expressed by using ECM which shows that the parameter of error correction is significant at 1% with a value of (-85%) which indicates that the ability to absorb and adjust for short-term shock and can be corrected very fast within one year (see table 5).

Table 5: Error Correction Model

ARDL Cointegrating And Long Run Form
Dependent Variable: LN_INFLATION
Selected Model: ARDL(2, 0, 4, 4, 4)
Date: 01/26/21 Time: 20:59
Sample: 1974 2019
Included observations: 42

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LN_INFLATION(-1))	-0.137018	0.124736	-1.098470	0.2834
D(GDP_GROWTH)	4.714937	2.110905	2.233610	0.0355
D(LN_BD)	0.230821	0.156393	2.897564	0.0035
D(LN_BD(-1))	-0.064859	0.198456	-0.326819	0.7468
D(LN_BD(-2))	-0.423268	0.212842	-1.988650	0.0588
D(LN_BD(-3))	-0.462205	0.227733	-2.029589	0.0541
D(USD_EGP)	0.104051	0.049975	2.082058	0.0487
D(USD_EGP(-1))	0.017591	0.066821	0.263250	0.7947
D(USD_EGP(-2))	0.212420	0.166964	1.272245	0.2160
D(USD_EGP(-3))	-0.254424	0.139721	-1.820945	0.0817
D(DISCOUNT_RATE)	2.792394	3.321600	2.675575	0.0043
D(DISCOUNT_RATE(-1))	0.691636	4.506507	0.153475	0.8794
D(DISCOUNT_RATE(-2))	-4.551874	4.283440	-2.346778	0.0049
D(DISCOUNT_RATE(-3))	-6.133889	3.481376	-1.761915	0.0914
CointEq(-1)	-0.853221	0.190707	-5.942211	0.0000

3.2.2 Robustness Analysis

3.2.2.1 Serial Autocorrelation

By Using Breusch-Godfrey Serial Correlation LM-test statistic for testing serial correlation showed that the null hypnosis of no-serial correlation cannot be rejected with the p-value of 0.1303 indicates that the residuals are not serially correlated (see table 6).

Table 6 : Breusch-Godfrey Correlation LM Test

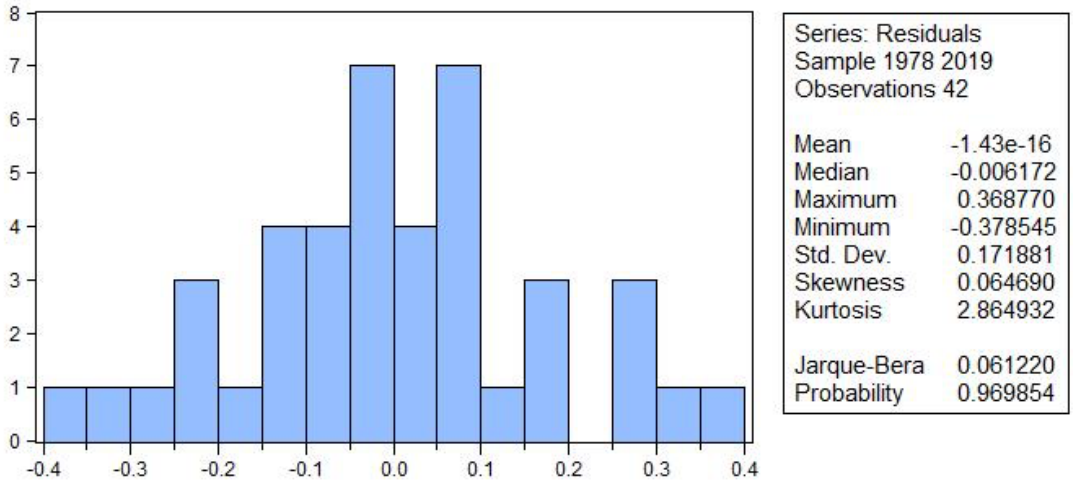
Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.033536	Prob. F(4,19)	0.1303
Obs*R-squared	12.59056	Prob. Chi-Square(4)	0.0135

3.2.2.2 Normality test

By Using Jarque-Bera test statistic for testing normal distribution showed that the null hypnosis of normal distribution cannot be rejected with the p-value of 0.96985 indicates that the residuals are normally distributed (see table 7).

Table 7: Jarque-Bera test



3.2.2.3 Hetroscedasticity

By Using Breusch-Pagan-Godfrey test statistic for testing Hetroscedasticity showed that the null hypnosis of Homoscedasticity cannot be rejected with the p-value of 0.1697 indicates that the residuals are Homoscedastic (see table 8).

Table 8: Breusch-Pagan-Godfrey Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.518861	Prob. F(15,26)	0.1697
Obs*R-squared	19.61512	Prob. Chi-Square(15)	0.1872
Scaled explained SS	5.217103	Prob. Chi-Square(15)	0.9901

3.2.2.4 Stability Test

By Using cumulative sum of the recursive residuals CUSUM test shows that the cumulative sum and cumulative sum of squares are located between the 5% critical values which means no structure breaks in the regression model and the parameters of the model are stable over time (See Figure 11 and 12).

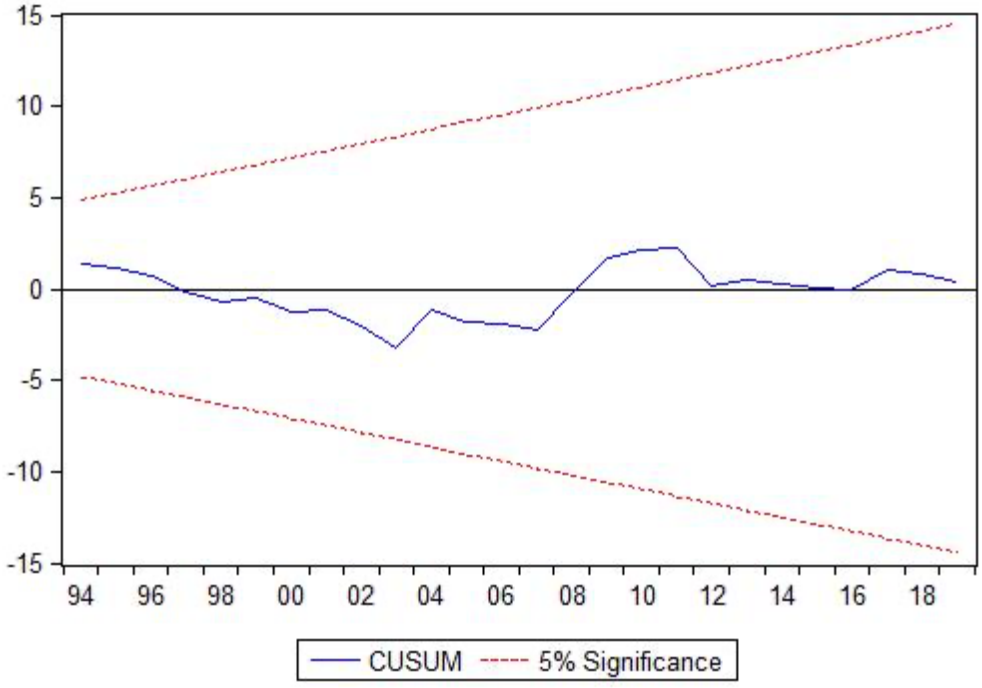


Figure 11: CUSUM Test of inflation function

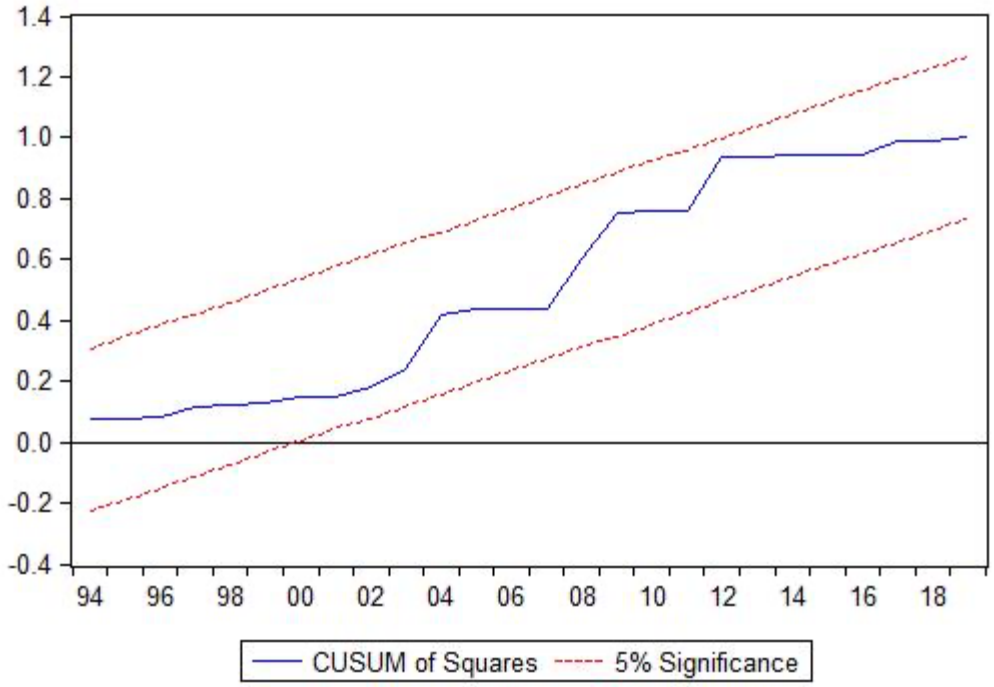


Figure 12: CUSUM of Squares test of inflation function

3.3 Monetary policy Reaction Function (Adjusted Taylor Rule)

As mentioned above, the adjusted Taylor rule for Egypt should takes into account the effect of fiscal dominance which can be represented through government budget deficit. In addition to the effect of exchange rate. Therefore, Monetary policy reaction function can take the following function;

$$DR = f(GDP.G, INF.G, EX, BD) \quad (12)$$

Where;

DR: the discount rate.

GDP.G: Real GDP gap.

INF.G: inflation gap.

EX: nominal exchange rate.

BD: budget deficit.

Regarding testing the stationarity for all variables with ADF test which reveals that all variables are integrated with I(1) level except INF.G and GDP.G are integrated with I(0) (see Appendix 2). thus, ARDL is the most appropriate method in estimation.

The specification of ARDL model for monetary policy function can be expressed in the following formula;

$$DR_t = \delta_0 + \sum_{i=1}^{k} \delta_{1i} DR_{t-i} + \sum_{j=1}^{m} \omega_{1j} GDP.G_{t-j} + \sum_{j=1}^{m} \omega_{2j} INF.G_{t-j} + \sum_{j=1}^{m} \omega_{3j} EX_{t-j} + \sum_{j=1}^{m} \omega_{4j} BD_{t-j} + u_t \quad (13)$$

3.3.1 The empirical analysis of Monetary policy reaction function

The analysis can start with through selecting the optimal number of lags according to different criteria for DR. Table (9) depicts that the best number of lags are two for most of the criteria except for SC and LR are one lag. So we can move to the next step of analysis that related to estimating the parameters of the model using ARDL method and Eviews to produce the output.

After running the ARDL model with a maximum of 2 lags for the dependent variable. Depending on adjusted R-squared criteria the chosen model is (2, 2, 0, 2, 2) which are related to DR, GDP.G, INF.G, EX, and BD respectively. Regarding adjusted R^2, it shows that this model has a high level of fitting the data with around 93% (see table 10).

Table 9: selected lag criteria

VAR Lag Order Selection Criteria
Endogenous variables: DISCOUNT_RATE
Exogenous variables: C
Date: 01/26/21 Time: 17:18
Sample: 1974 2019
Included observations: 39

Lag	LogL	LR	FPE	AIC	SC	HQ
0	82.90424	NA	0.000878	-4.200217	-4.157562	-4.184913
1	101.1520	34.62393*	0.000362	-5.084717	-4.999406*	-5.054108
2	102.8389	3.114239	0.000350*	-5.119942*	-4.991975	-5.074029*
3	102.8585	0.035164	0.000368	-5.069664	-4.899043	-5.008447
4	103.0288	0.297067	0.000384	-5.027120	-4.813842	-4.950598
5	103.1397	0.187608	0.000403	-4.981523	-4.725590	-4.889696
6	103.1766	0.060545	0.000424	-4.932133	-4.633545	-4.825002
7	103.3868	0.334147	0.000442	-4.891630	-4.550386	-4.769194

* 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 10: ARDL Empirical results of the Monetary policy reaction function

Number of models evaluated: 162
Selected Model: ARDL(2, 2, 0, 2, 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DISCOUNT_RATE(-1)	0.474373	0.178017	2.664762	0.0121
DISCOUNT_RATE(-2)	0.217386	0.158547	2.371114	0.0180
GDP_GAP	-6.18E-08	1.12E-07	-3.553717	0.0003
GDP_GAP(-1)	1.06E-07	1.66E-07	2.640558	0.0265
GDP_GAP(-2)	-1.39E-07	1.13E-07	-1.229923	0.2280
INFLATION_GAP	0.049033	0.061799	0.793434	0.4336
USD_EGP	0.007823	0.002170	3.604528	0.0011
USD_EGP(-1)	-0.004021	0.002912	-1.380637	0.1773
USD_EGP(-2)	-0.005440	0.002453	-2.217224	0.0341
BD__GDP	-0.168547	0.064269	-2.622526	0.0134
BD__GDP(-1)	0.098729	0.085461	2.155249	0.0023
BD__GDP(-2)	0.099441	0.074962	1.326556	0.1943
C	0.036001	0.010473	3.437389	0.0017

R-squared	0.953576	Mean dependent var	0.119295
Adjusted R-squared	0.932380	S.D. dependent var	0.031197
S.E. of regression	0.011986	Akaike info criterion	-5.769414
Sum squared resid	0.004454	Schwarz criterion	-5.242267
Log likelihood	139.9271	Hannan-Quinn criter.	-5.573922
F-statistic	31.69070	Durbin-Watson stat	2.133497
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

3.3.1.1 ARDL Bounds Test

Regarding cointegration test between the dependent variable and explanatory variables, it shows that F-statistic is higher than the upper bounds, therefore, the null hypothesis can be rejected at 1% significant level, which indicates the existence of the long-run relationship (see table 11).

Table 11: ARDL Bounds test

ARDL Bounds Test
Date: 01/26/21 Time: 19:05
Sample: 1976 2019
Included observations: 44
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	17.00935	4

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

3.3.1.2 Estimation of long-run parameters

Regarding the extracted results, the long-run estimated equation is as following (see table 12);

$$DR_t = 10.44 + 0.60\ GDP.G + 0.69\ INF.G + 2.31\ EX + 0.32BD \quad (14)$$

Table 12: Long-run Coefficients

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP_GAP	0.595542	0.186456	3.654643	0.0004
INFLATION_GAP	0.685454	0.208621	2.155455	0.0214
USD_EGP	2.314546	0.002815	3.254889	0.0002
BD__GDP	0.315486	0.105004	2.985423	0.0012
C	10.44786	0.018692	6.248472	0.0000

All parameters are significant. Moreover, the magnitude of all variable following the theory since all should have a positive relation in accordance with discount rate. The output can be explained as the GDP gap increases by one billion the central bank should increase the discount rate with 0.60%, the inflation gap increases by 1% the central should increase the discount rate by 0.69%, if the Egyptian Pound devaluated by one Pound the central bank should increase the discount rate by 2.3%, and if the budget deficit increase by one billion the central bank should increase the discount rate by 0.31%.

Regarding ECM (see table 13), the relationship between inflation and its explanatory variables in the short run can be expressed by using ECM which shows that the parameter of error correction is significant at 1% with a value of (-30%) which indicates that the ability to absorb and adjust for short-term shock and can be corrected in relatively slow pace (see table 13).

Table 13**: Error correction model**

ARDL Cointegrating And Long Run Form
Dependent Variable: DISCOUNT_RATE
Selected Model: ARDL(2, 2, 0, 2, 2)
Date: 01/26/21 Time: 19:23
Sample: 1974 2019
Included observations: 44

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DISCOUNT_RATE(-1))	0.217385	0.158547	2.874526	0.0012
D(GDP_GAP)	0.254578	0.125453	3.984454	0.0000
D(GDP_GAP(-1))	0.344684	0.012454	2.874631	0.0095
D(INFLATION_GAP)	0.049033	0.061799	2.631854	0.0034
D(USD_EGP)	0.007823	0.002170	3.604528	0.0011
D(USD_EGP(-1))	0.005440	0.002453	2.217224	0.0341
D(BD__GDP)	0.168547	0.064269	2.622525	0.0134
D(BD__GDP(-1))	0.099440	0.074962	2.561121	0.0254
CointEq(-1)	-0.308241	0.073320	-6.204062	0.0000

3.3.2 Robustness Analysis

3.3.2.1 Serial Autocorrelation

By Using Breusch-Godfrey Serial Correlation LM-test statistic for testing serial correlation showed that the null hypnosis of no-serial correlation cannot be rejected with the p-value of 0.3714 indicates that the residuals are not serially correlated (see table 14).

Table 14: Breusch-Godfrey Serial Correlation LM-test

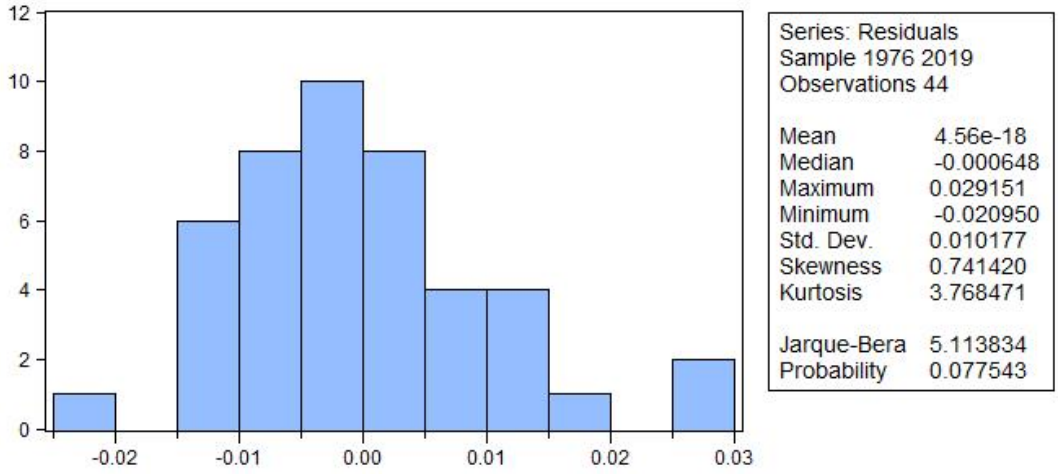
Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.025038	Prob. F(2,29)	0.3714
Obs*R-squared	2.905091	Prob. Chi-Square(2)	0.2340

3.3.2.2 Normality test

By Using Jarque-Bera test statistic for testing normal distribution showed that the null hypnosis of normal distribution cannot be rejected with the p-value of 0.077543 indicates that the residuals are normally distributed (see table 15).

Table 15: Jarque-Bera Test



3.3.2.3 Hetroscedasticity

By Using Breusch-Pagan-Godfrey test statistic for testing Hetroscedasticity showed that the null hypnosis of Homoscedasticity cannot be rejected with the p-value of 0.3316 indicates that the residuals are Homoscedastic (see table 16).

Table 16: Breusch-Pagan-Godfrey Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.191478	Prob. F(12,31)	0.3316
Obs*R-squared	13.88812	Prob. Chi-Square(12)	0.3079
Scaled explained SS	9.542704	Prob. Chi-Square(12)	0.6560

3.3.2.4 Stability Test

By Using cumulative sum of the recursive residuals CUSUM test shows that the cumulative sum and cumulative sum of squares are located between the 5% critical values which means no structure breaks in the regression model and the parameters of the model are stable over time (See Figure 13 and 14).

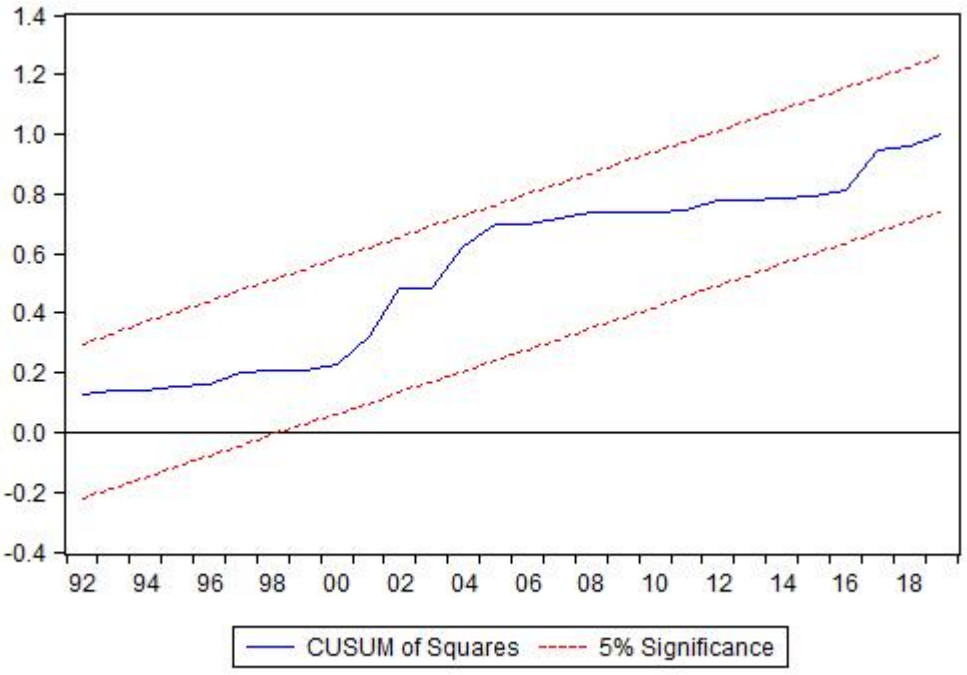


Figure 13: CUSUM of Squares test of monetary policy reaction function

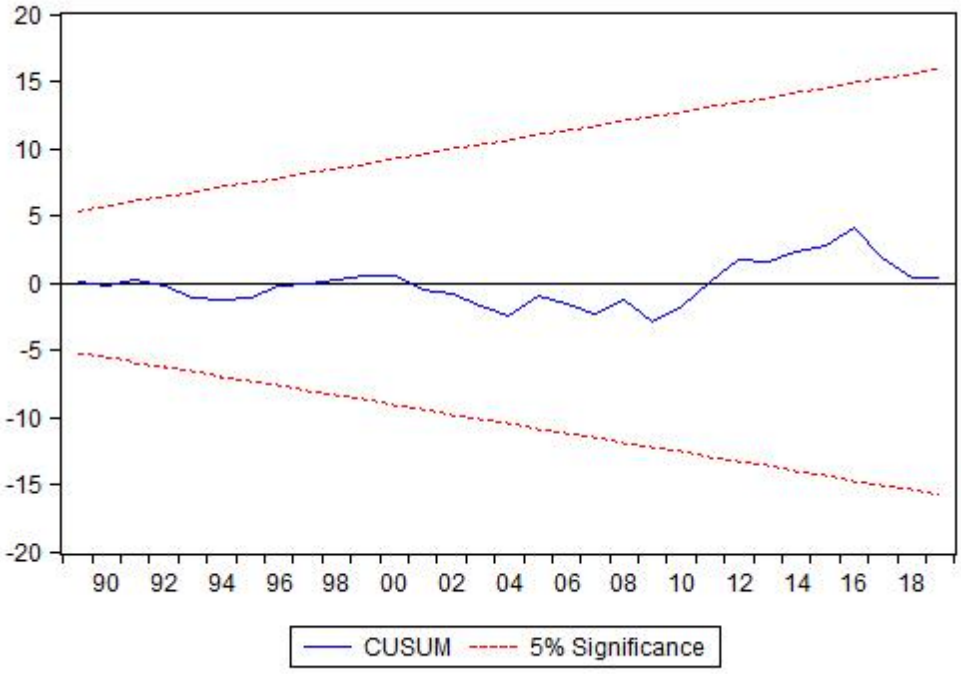


Figure 14: CUSUM test of monetary policy reaction function

CONCLUSION

The empirical findings show the presence of contradiction between multiple targets, for foreign exchange rate, inflation rate, and real GDP growth rate, amid the uncertainty concerning the selection of the nominal anchor of monetary policy in Egypt. Regarding the inflation model, it shows that the inflation can be stimulated through a significant devaluation in the local currency which is a single shock with a strong pass-through effect. However, the fiscal shock is persistent and leads to continuity in inflation which can be treated by decreasing CBE's lending to the government which can decrease the fiscal dominance in the economy. Also the findings of monetary policy reaction function are compatible with the findings of inflation function and the theoretical background covered above regarding the prioritising using exchange rate as a nominal anchor. Central Bank of Egypt, amid the de jure of floating exchange rates between 2003-2010 and 2016-2018, favored stability in its monetary policy over foreign exchange rate flexibility. Therefore, the explicit target for the monetary policy in during this period is to stabilise the foreign exchange rate and keeping the inflation and real GDP and implicit targets.

This study showed how the fiscal dominance profoundly entrenched in the economy, although the modification in its forms like seigniorage and the budget deficit monetisation. Moreover, the empirical findings of inflation function showed the significant effect of the budget deficit on inflation in the long run. After studying the monetary policy in Egypt in details, the answer to the research question, which is "How could the fiscal dominance impact the efficiency of achieving the monetary policy objectives and adopting inflation targeting?" can be discussed. I can conclude that Egypt still has time to adopt inflation targeting as a monetary policy since it has not fulfilled the prerequisites, which can be summarised as follows:

1- The independence of the Central Bank is a crucial point, which does not exist in the meantime due to the existence of government representatives in the MPC and excessive finance of CBE to the government deficit.

2- The conflict of targets that may exist due to combining between more than one target, which occurred when the central bank explicitly adopted inflation target but at the same time implicitly targeting the foreign exchange rate.

3- Regarding poor data quality in Egypt, it will be considered as an obstacle in front of adopting this regime.

There are three recommendations that can be extracted from this study:

1- Considering foreign exchange rate target in Egypt is not the optimal monetary policy since it did not stabilise the inflation to reach a significant level. Therefore, the CBE should prioritise the inflation targeting and taking a serious step toward satisfying its pre-requisites, since this system proved its efficiency in many developing and emerging countries.

2- The independence of CBE is a far-reaching goal. However, decreasing net credit to the government will be a significant step toward decreasing the fiscal dominance, which will lead to decrease in the inflation rate rather than depending on contractionary monetary policy, which has an adverse effect on the whole economy.

3- Allowing free-floating exchange rate will help the economy to mitigate the effect of external shocks and paving the way to adopt inflation targeting regime.

BIBLIOGRAPHY

ABOU-ALI, Hala and KHEIR-EL-DIN, Hanaa. 2009.*Inflation and Growth in Egypt: is there a Threshold Effect?* 1, s.l. : Taylor & Francis, 2009, Middle East Development Journal, Vol. 1, pp. 59-78. ISSN 1793-8171.

AFOLABI, Joseph Olarewaju and ATOLAGBE, Oluwafemi. 2018. *Empirical analysis of fiscal dominance and the conduct of monetary policy in Nigeria.* s.l. : MPRA, 2018.

AL-MASHAT, Rania. 2011. The evolution of monetary policy in Egypt and steps towards inflation targeting. *Inflation Targeting in MENA Countries.* London : Palgrave Macmillan, 2011, pp. 230-255.

AMBLER, Steve, DIB, Ali and REBEI, Nooman. 2004. *Optimal taylor rules in an estimated model of a small open economy.* Working Paper 2004-36, s.l. : Bank of Canada, 2004. ISSN 1192-5434.

ANTONAKAKIS, Nikolaos, et al. 2020. *Inflation-Targeting and Inflation Volatility: International Evidence from the Cosine-Squared Cepstrum.* s.l. : University of Pretoria, 2020. Working papaer 202021.

ASSO, Pier Francesco, KAHN, George Arnett and LEESON, Robert . 2007. *The Taylor rule and the transformation of monetary policy.* s.l. : Hoover Institute Press Publication, 2007. Vol. 1st ed. ISBN 978-0817914042.

BARBOSA-FiLHO, Nelson H. 2015. *Monetary policy with a volatile exchange rate: the case of Brazil since 1999.* 3, s.l. : Springer, 2015, Comparative Economic Studies, Vol. 57, pp. 401–425. ISSN 1478-3320.

BENCHIMOL, Jonathan. 2016. *Money and monetary policy in Israel during the last decade.* 1, s.l. : Elsevier, 2016, Journal of Policy Modeling, Vol. 38, pp. 103-124. ISBN 0161-8938

BENLIALPER, Ahmet and CÖMERT, Hasan. 2016. *Implicit asymmetric exchange rate peg under inflation targeting regimes: the case of Turkey.* 6, s.l. : CPES, 2016, Cambridge Journal of Economics, Vol. 40, pp. 1553–1580.

BERNANKE, Ben S, et al. 2018. *Inflation targeting: lessons from the international experience.* Princeton, New Jersey : Princeton University Press, 2018. ISBN 0-691-086889-3.

BRUNO, Michael, et al. 1991. *Lessons of economic stabilization and its aftermath.* London : MIT Press, 1991. Vol. 2nd ed. ISBN 0-262-02324-5.

CHRISTOPHER, John and WILLIAMS, Rebecca. 2018. *Inflation Targeting in New Zealand: An Experience in Evolution.* s.l. : Reserve Bank of Australia, 2018.

CONTI, Antonio Maria, NERI, Stefano and NOBILI, Andrea. 2017. *Low inflation and monetary policy in the euro area.* s.l. : European Central Bank, 2017. ISBN 978-92-899-2727-7.

DAVIS, J. Scott, FUJIWARA, Ippei and WANG, Jiao. 2018. *Dealing with time inconsistency: Inflation targeting versus exchange rate targeting.* 7, s.l. : Wiley, 2018, Journal of Money, Credit and Banking, Vol. 50, pp. 1369-1399. ISSN 1538-4616.

DE FIORE, Fiorella. 1998. *The Transmission of Monetary Policy in Israel.* WP/98/1114, s.l. : International Monetary Fund, 1998. ISBN 9781513539997.

DEROSA, David F. 2009. *Central Banking and Monetary Policy in Emerging-Markets Nations.* Charlottesville, VA : Research Foundation of CFA Institute, 2009. Vol. 1st ed. ISBN 978-1-934667-23-1.

DEVEREUX, Michael B. and YU, Changhua. 2019. *Evaluating the role of capital controls and monetary policy in emerging market crises.* 1, s.l. : Elsevier, 2019, Journal of International Money and Finance, Vol. 95, pp. 189-211.

DIALLO, Ibrahima and MENDY, Isatou. 2018. *Fiscal Dominance In The West African Monetary Zone: An Empirical Investigation.* 1, s.l. : West African Monetary Institute , 2018, West African Journal of Monetary and Economic Integration, Vol. 18.

DICKEY, David A. and FULLER, Wayne A. 1979. *Distribution of the estimators for autoregressive time series with a unit root.* 366a, s.l. : Taylor & Francis, 1979, ournal of the American statistical association, Vol. 74, pp. 427-431. ISSN 0162-1459.

DOMAÇ, İlker. 2004. *Explaining and forecasting inflation in Turkey.* s.l. : World Bank Policy Research, 2004. Working Paper 3287.

EDWARDS, Sebastian and YEYATI, Eduardo Levy. 2005. *Flexible exchange rates as shock absorbers.* 8, s.l. : Elseiver, 2005, European Economic Review , Vol. 49, pp. 2079-2105.

EMAD, Maha. 2019. *Is Egypt willing to embrace Inflflation Targeting as a framework for its monetary system?* s.l. : AUC Knowledge Fountain, 2019.

GHOSH, Atish R., OSTRY, Jonathan D. and CHAMON, Marcos. 2016. *Two targets, two instruments: Monetary and exchange rate policies in emerging market economies.* 1, s.l. : Elsevier, 2016, Journal of International Money and Finance, Vol. 60, pp. 172-196. ISSN 0261-5606.

GUJATRI, Damodar N. and PORTER, Dawn C. 2012. *Basic econometrics.* s.l. : McGraw-Hill Education, 2012. ISBN 978-0-07-337577-9.

HAMMOND, Gill, KANBUR, SM Ravi and PRASAD, Eswar. 2009. *Monetary policy frameworks for emerging markets.* s.l. : Edward Elgar Publishing, 2009. Vol. 1st ed. ISBN 978-1- 84844-442-3.

HASSAN, Sherif Maher. 2016. *A Historical Retrieval of the Methods and Functions of Monetary Policy.* 75648, s.l. : MPRA, 2016.

HEISE, Michael. 2019. *Inflation targeting and financial stability: monetary policy challenges for the future.* s.l. : Springer International Publishing, 2019. Vol. 1st ed. ISBN 978-3-030- 05078-8.

HELMY, Omneia A. 2008. *The impact of budegt deficit on inflation in Egypt.* s.l. : The Egyptian Center for Economic Studies (ECES), 2008. Working Paper 141.

HELMY, Omneia A. 2009. he impact of budget deficit on inflation in Egypt. [book auth.] Hanā Khayr al-Dīn. *What Drives Prices in Egypt?: An Analysis in Light of International Experience.* Cairo : The American University in Cairo Press, 2009.

KARACADAG, Cem, Duttagupta, Rupa and Fernandez, Gilda. 2005. *Moving to a Flexible Exchange Rate: How, When, and How Fast?* s.l. : International Monetary Fund, 2005, Vol. 38. ISBN 978151353999.

KUMHOF, Michael, NUNES, Ricardo and YAKADINA, Irina. 2010. *Simple monetary rules under fiscal dominance.* 1, s.l. : Wiley Online Library, 2010, Journal of Money, Credit and Banking, Vol. 42, pp. 63-92. ISSN 1538-4616.

LIPTON, David. 2019. Egypt—IMF Executive Board Completes Fourth Review under the Extended Fund Facility (EFF). *IMF.* [Online] February 5, 2019. https://www.imf.org/en/News/Articles/2019/02/05/pr1933-egypt-imf-exec-board-completes-4th-review-extended-fund-facility.

LIVIATAN, Nissan and SUSSMAN, Nathan. 2002. *Disinflation process in Israel in the past decade." The Israeli Economy, 1985–1998: From Government Intervention to Market Economics.* s.l. : Bank of Israel, 2002. pp. 56-129. ISBN 1138376922.

MARAVALL, Agustín and del Río, Ana. 2001. *Time aggregation and the Hodrick-Prescott filter.* s.l. : Banco de España, 2001. No. 0108.

MISHKIN, Frederic S. 2000. *Inflation targeting in emerging-market countries.* 2, s.l. : American Economic Association, 2000, American Economic Review, Vol. 90, pp. 105-109. ISSN 1944-7981 .

MISHKIN, Frederic S. 2007. *The economics of money, banking, and financial markets.* s.l. : Pearson education, 2007. ISBN 9781292268859.

MISHKIN, Frederic S. and Schmidt-Hebbel, Klaus. 2001. *One decade of inflation targeting in the world: What do we know and what do we need to know?* s.l. : National Bureau of Economic Research, 2001. Working Paper 8397.

PANIZZA, Ugo. 2000. *Monetary and fiscal policies in emerging markets.* s.l. : The Egyptian Center for Economic Studies (ECES), 2000. Working Paper 50.

PANIZZA, Ugo. 2001. *Macroeconomic policies in Egypt: An interpretation of the past and options for the future.* Cairo : Egyptian Center for Economic Studies, 2001. Working Paper 61.

PESARAN, M. Hashem, SSHIN, Yongcheol and SMITH, Richard J. . 2001. *Bounds testing approaches to the analysis of level relationships.* 3, s.l. : Wiley, 2001, Journal of applied econometrics, Vol. 16, pp. 289-326. ISSN:1099-1255.

SELIM, Hoda. 2010. *Has Egypt's Monetary Policy changed after the float.* s.l. : Economic Reseaerch Forum, 2010. Working Paper 543.

SOKOLER, Meir. 2003. T*he interaction between fiscal and monetary policy in Israel.* s.l. : Bank for International Settlements, 2003. BIS Paper No. 20.

SVENSSON, Lars EO. 2000. *Open-economy inflation targeting.* 1, s.l. : Elseiver, 2000, Journal of international economics, Vol. 50, pp. 55-183. ISSN 0022-1996.

SVENSSON, Lars EO. 2010. *Inflation targeting.* 1, s.l. : Elsevier, 2010, Handbook of monetary economics, Vol. 3, pp. 1237-1302. ISBN 9780080932705.

TAYLOR, John B. 1993. *Discretion versus policy rules in practice.* 1, North-Holland : Carnegie-Rochester conference series on public policy, 1993, Vol. 39, pp. 195-214. ISBN 0444852131.

TAYLOR, John B., 2000. *Reassessing discretionary fiscal policy.* 3, s.l. : American Economic Association, 2000, Journal of economic Perspectives, Vol. 14, pp. 21-36. ISSN 1944-7965.

TAYLOR, John B. 2019. *Inflation targeting in high inflation emerging economies: Lessons about rules and instruments.* 1, s.l. : Journal of Applied Economics, 2019, Vol. 22. ISBN 1667-6726.

ŠOŠKI Ć, Dejan. 2015. *Inflation targeting challenges in emerging market countries: The case of Serbia.* 204, 2015, Economic annals, Vol. 60, pp. 7-30. ISSN 00133264.

LIST OF ABBREVIATIONS

ARDL	Auto-Regressive Distributed Lag Model
CBE	Central Bank of Egypt
CDs	Certificate of Deposits
CPI	Consumer Price Index
EFF	Extended Fund Facility
ERSAP	Economic Reform and Structural Adjustment Program
ESP	Economic Stabilisation Plan
GDP	Gross Domestic Product
IMF	International Monetary Fund
IT	Inflation Targeting
M2	Money Supply
MPC	Monetary Policy Committee
VAT	Value Added Tax
T-bills	Treasury Bills
T-bonds	Treasury Bonds

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APPENDICES

APPENDIX P I: AUGMENTED DICKEY-FULLER (ADF) TEST-INFLATION FUNCTION

Null Hypothesis: LN_BD has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.257321	0.6411
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

Null Hypothesis: LN_BD has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.153502	0.9079
Test critical values:	1% level	-4.175640	
	5% level	-3.513075	
	10% level	-3.186854	

Null Hypothesis: DISCOUNT_RATE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.455500	0.1330
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

Null Hypothesis: DISCOUNT_RATE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.906014	0.1706
Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

Null Hypothesis: USD_EGP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.207447	0.9978
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

Null Hypothesis: USD_EGP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.790012	0.6926
Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

Null Hypothesis: GDP_GROWTH has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.896932	0.0044
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

Null Hypothesis: GDP_GROWTH has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.746362	0.0297
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

Null Hypothesis: LN_INFLATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.386250	0.1512
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

Null Hypothesis: LN_INFLATION has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.371530	0.3888
Test critical values:	1% level	-4.175640	
	5% level	-3.513075	
	10% level	-3.186854	

*MacKinnon (1996) one-sided p-values.

APPENDIX P 2: AUGMENTED DICKEY-FULLER (ADF) TEST-MONETARY POLICY REACTION FUNCTION

Null Hypothesis: BD__GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.311093	0.6164
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

Null Hypothesis: BD__GDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.675291	0.7458
Test critical values:	1% level	-4.175640	
	5% level	-3.513075	
	10% level	-3.186854	

Null Hypothesis: DISCOUNT_RATE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.455500	0.1330
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

Null Hypothesis: DISCOUNT_RATE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.906014	0.1706
Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

Null Hypothesis: USD_EGP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.207447	0.9978
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

Null Hypothesis: USD_EGP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.790012	0.6926
Test critical values:	1% level	-4.180911	
	5% level	-3.515523	
	10% level	-3.188259	

Null Hypothesis: GDP_GAP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.687359	0.0000
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	
	10% level	-2.603944	

Null Hypothesis: GDP_GAP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.512058	0.0000
Test critical values:	1% level	-4.186481	
	5% level	-3.518090	
	10% level	-3.189732	

Null Hypothesis: INFLATION_GAP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.944777	0.0000
Test critical values:	1% level	-3.584743	
	5% level	-2.928142	
	10% level	-2.602225	

Null Hypothesis: INFLATION_GAP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.861466	0.0000
Test critical values:	1% level	-4.175640	
	5% level	-3.513075	
	10% level	-3.186854	

APPENDIX P 3: GDP TREND AND GAP

	GDP_GAP	GDP_TREND
1974	10256.22	352516.8
1975	-1527.930	396729.8
1976	6638.120	441045.3
1977	2437.884	485550.7
1978	-303.5982	530399.5
1979	-21566.91	575770.0
1980	-12150.81	621837.0
1981	-14070.58	668559.8
1982	3554.172	715776.5
1983	-7207.665	763183.9
1984	19137.01	810514.9
1985	20271.26	857430.0
1986	15562.87	903781.1
1987	4957.164	949623.0
1988	11546.93	995165.9
1989	15582.11	1040670.
1990	29600.14	1086510.
1991	-4546.599	1133217.
1992	-2464.811	1181619.
1993	-19138.34	1232498.
1994	-25041.14	1286609.
1995	-24384.00	1344520.
1996	-20550.87	1406545.
1997	-10637.70	1472755.
1998	620.5226	1543018.
1999	19990.50	1617091.
2000	46622.61	1694741.
2001	26991.70	1775933.
2002	-15081.55	1861100.
2003	-45972.73	1950943.
2004	-63090.00	2046013.
2005	-74807.10	2146402.
2006	-38197.54	2251569.
2007	10024.44	2360226.
2008	69167.15	2470706.
2009	77139.71	2581437.
2010	103878.0	2691541.
2011	43832.70	2800914.
2012	-2409.988	2910486.
2013	-49998.07	3021629.
2014	-77408.32	3135690.
2015	-61523.98	3253514.
2016	-44440.33	3375175.
2017	-30129.52	3500130.
2018	27009.23	3627391.
2019	101829.7	3755670.

APPENDIX P 4: INFLATION TREND AND GAP

	INFLATION_TREND	INFLATION_GA
1974	0.093863	0.006380
1975	0.101716	-0.005019
1976	0.109634	-0.006460
1977	0.117629	0.009693
1978	0.125650	-0.014869
1979	0.133744	-0.034700
1980	0.141807	0.066385
1981	0.149390	-0.046217
1982	0.156707	-0.008477
1983	0.163510	-0.002711
1984	0.169466	0.000897
1985	0.174216	-0.053148
1986	0.177407	0.061236
1987	0.178159	0.018777
1988	0.176200	0.000435
1989	0.171448	0.041171
1990	0.163825	0.003738
1991	0.153666	0.043819
1992	0.141341	-0.004967
1993	0.127659	-0.006762
1994	0.113381	-0.031839
1995	0.099198	0.058225
1996	0.085483	-0.013612
1997	0.073194	-0.026937
1998	0.063148	-0.024422
1999	0.055898	-0.025103
2000	0.051748	-0.024910
2001	0.050755	-0.028058
2002	0.052724	-0.025352
2003	0.057181	-0.012103
2004	0.063397	0.049309
2005	0.070524	-0.021830
2006	0.078205	-0.001760
2007	0.085867	0.007323
2008	0.092916	0.090252
2009	0.098836	0.018799
2010	0.104009	0.008643
2011	0.109007	-0.008358
2012	0.114489	-0.043371
2013	0.121029	-0.026331
2014	0.128768	-0.028066
2015	0.137584	-0.033879
2016	0.147074	-0.008938
2017	0.156496	0.138570
2018	0.165020	-0.021005
2019	0.173198	-0.034448