The Impact of Inflation Targeting Lite regime on Economic growth:

A case study of Uganda

Second year master's thesis

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ABSTRACT

Price stability is an element of macroeconomic stability that is necessary to achieve economic growth in any economy like Uganda. There is no doubt that Inflation Targeting Lite (ITL) regime as a monetary policy framework has helped to achieve price stability through reduced inflation rates and inflation volatility in Uganda and other countries (Nabbosa, 2017). The ultimate goal of a monetary policy framework is to transform the macroeconomic stability achieved into sustainable economic growth and development. This paper focuses on empirically analysing the short and long run impact of ITL on economic growth in Uganda using an econometric model- Vector Error Correction Model (VECM). The empirical findings of the study show that in the long run ITL has positively impacted economic growth by maximizing the positive impact of money supply while minimizing the negative impact inflation has on economic growth. However, in the short run ITL does not have any significant impact on economic growth.

Key words: Economic growth, Inflation Targeting Lite (ITL), Monetary policy.

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CHAPTER 1: INTRODUCTION

In the 1990s the world witnessed the birth of inflation targeting as a monetary policy framework and two and half decades later its popularity is undisputed. This approach was first adopted by industrialized economies as a practical response to the difficulties they found in conducting monetary policy using an exchange rate peg or some monetary aggregate as the main intermediate target (Masson et al, 1997). New Zealand was the first country to adopt inflation targeting in 1990 followed by Canada (1991), United Kingdom (1992), Australia (1993), Sweden (1993) among others. South Africa was the first African country to adopt the inflation targeting monetary policy frame work in 2000, followed by Ghana in 2007 and Uganda in 2011 (Roger, 2010).

Inflation targeting in its strict sense is defined as a monetary policy strategy that encompasses five main elements: 1) the public announcement of medium-term numerical targets for inflation; 2) an institutional commitment to price stability as the primary goal of monetary policy, to which other goals are subordinated; 3) an information inclusive strategy in which many variables, and not just monetary aggregates or the exchange rate, are used for deciding the setting of policy instruments; 4) increased transparency of the monetary policy strategy through communication with the public and the markets about the plans, objectives, and decisions of the monetary authorities; and 5) increased accountability of the central bank for attaining its inflation objectives (Mishkin, 2000).

The emergence of inflation targeting as a policy framework has seen scholars pick interest in the policy framework. Some scholars have mainly focused on describing the policy to help students, researchers, policy makers and Central banks to get a deeper understanding of its characteristics, potential pros and cons and how it can be implemented. Svensson (1999) discusses inflation targeting in the context of monetary policy rules, clarifies the essential characteristics of inflation targeting, compares inflation targeting to other monetary policy rules, and draws some conclusions for the monetary policy of the European System of Central Banks (ESCB). Inflation targeting is characterized by; an explicit quantitative inflation target-which can be an interval or a point target, operating procedure and an inflation-forecast targeting-which uses an internal conditional inflation forecast as an intermediate target variable (Svensson, 1999

However, other scholars have dedicated their studies to evaluating the effectiveness of inflation targeting as a monetary policy framework in achieving its key objectives; regulating inflation rates, lowering inflation volatility and enhancing economic growth. Nabbosa (2017) used a GARCH model to analyse the impact of inflation targeting on inflation volatility and inflation rates in Uganda, South Africa and Ghana. The empirical findings of the study show that inflation targeting has effectively reduced inflation rates and inflation volatility in Uganda and South Africa. The study also shows persistent supply shocks limit the efficiency of the policy as seen with Ghana. Mollick et al (2008) examines the impact of inflation targeting on industrial and emerging economies' output growth over the "globalization years" of 1986-2004. By controlling for trade openness and two indicators of financial globalization, the authors find systematic positive and significant effects of inflation targeting on real output growth.

Over time, empirical evidence has showed that applicability of inflation targeting requires relaxing some of its key elements especially for the emerging economies hence giving rise to the different inflation targeting regimes. There three main inflation targeting regimes, and these are; full-fledged inflation targeting, eclectic and inflation targeting lite (ITL) (Carare and Stone, 2006; Nabbosa, 2017). The institutional differences between the emerging economies like Uganda and developed economies are partly to blame for the emergence of these regimes for instance; the weak fiscal institutions, the weak financial institutions including government prudential regulation and supervision, low credibility of monetary institutions, Currency substitution and liability dollarization and vulnerability to sudden stops of capital inflows (Mishkin, 2000). Inflation targeting Lite (ITL) is viewed as a transitionally policy regime aimed at buying time for the implementation of structural reforms needed for a single credible nominal anchor (full-fledged inflation targeting) (Stone, 2003; Nabbosa, 2017).

In 2011, Uganda joined the inflation targeting economies moving away from money growth targeting monetary policy framework; opting for the most "relaxed" regime that is Inflation Targeting Lite (ITL) (Nabbosa, 2017). Inflation Targeting Lite (ITL) is a regime where the Central Bank or policy makers uses inflation targeting as the monetary policy framework but lacks the commitment to maintain the inflation target as the foremost policy objective (Stone, 2003). The Central bank of Uganda (Bank of Uganda) made price stability the main objective of monetary policy as it is the fundamental element of inflation targeting and the Central Bank Rate (CBR) was selected to be the monetary policy instrument. The Bank of Uganda sets a monthly Central Bank Rate which it uses to guide the 7-day interbank interest rates. Bank of Uganda also set a second objective of inflation targeting monetary policy; to align real output as close as possible with the estimated potential output of the economy (Mutebile, 2012; Nabbosa, 2017). Different studies have evaluated the impact of inflation Targeting Lite regime on its first objective that is price stability and the results are positive and promising (Nabbosa, 2017; Kumo, 2015) but less effort has made to evaluate the second objective that is its impact on economic growth.

This paper focuses on evaluating the short run and long run impact of inflation targeting in Uganda on economic growth. Inflation targeting as a monetary policy framework is intended to reduce inflation rates and inflation volatility hence ensuring macroeconomic stability which ultimately ignites economic growth. We begin by testing for cointegration in the variables using the Vector Auto Regression model (VAR) and when cointegration is confirmed, a restricted Vector Auto Regression model is used in the empirical analysis. The restricted Vector Auto Regressive model (also known as Vector Error Correction Model) combined with the IS-MP-PC framework and growth theories is used to analyse the short and long run impact of ITL on economic growth in Uganda. The analysis is conducted using Uganda's quarterly data from 1995Q2 to 2016Q4 on Standardized Consumer Price Index (CPI), Gross Domestic Product (GDP), government spending, money supply (M2)-which is used to model monetary policy and nominal exchange rate. The results show that inflation targeting has positively impacted economic growth in the long run by neutralizing the negative impact the shocks in inflation rates and inflation volatility would have on the Gross Domestic product. However, in the short run ITL does not have a significant impact on economic growth.

The rest of the paper is organized as follows; in chapter 2 a literature review about monetary policy and economic growth is presented clearly citing the theoretical and empirical views. In Chapter 3 the theoretical and econometric models are introduced, the empirical model is estimated, and the results are presented. In chapter 4, a general conclusion about the findings of the study are presented.

CHAPTER 2: LITERATURE REVIEW

MONETARY POLICY AND ECONOMIC GROWTH

Monetary policy refers to the actions of a central bank, currency board or other regulatory committee that determine the size and rate of growth of the money supply, which in turn affects interest rates. Economic growth generally refers to an increase in the production of goods and services in an economy over a specified period.

Prior to the late 1960s, economists believed that monetary policy had less or no direct impact on economic growth (Kumo, 2015). This was drawn from the Keynesian school of thought championed by John Maynard Keynes which proposes that the economy is best controlled by manipulating the demand for goods and services hence the terminology "demand-side economics". They believe that consumption, government expenditures and net exports change the state of the economy. It should be noted that these economists do not completely disregard the role money supply has in the economy and its effect on gross domestic product or economic growth. However, the Keynesian school believes that it takes a great amount of time for the economic market to adjust to any monetary influence; money supply impacts interest rates which then influences investments and later economic growth. During this time, the Fiscal policy was superior to monetary policy especially in the industrialized economies and was viewed as the main driver of economic growth.

The late 1960s saw the rise of the monetarists championed by Milton Friedman, this school of thought believes that "only money matters", they emphasize the role of money supply in explaining short- term changes in national income. The Keynesian theories faced criticism from the Monetarists such as Milton Friedman and Supply-siders who claimed that the ongoing government actions had not helped the economies avoid the endless cycles of below average Gross Domestic Product (GDP) expansion, recessions and volatile interest rates (Nabbosa, 2017). The monetarist school of thought propose that economic growth can be achieved through monetary policy. Friedman (1968) pointed out three things that monetary policy can do; monetary policy can prevent money itself from being a major source of economic disturbance**,** can provide a stable background for the economy and can contribute to offsetting major disturbances in the economic system arising from other sources**.** However, he pointed out that monetary policy cannot help in interest rate and unemployment rate pegging. Milton Friedman directly criticized the Keynesian school of thought for ignoring the role of money supply and blamed it for the 1930s Great economic depression in United States

Friedman (1968) further pointed out two requirements for the monetary policy authority to effectively implement monetary policy; firstly, a monetary policy authority should choose instruments it can control for instance Uganda may not use the nominal exchange rates as a monetary policy instrument as it has less control over these rates. Secondly monetary authorities should avoid sharp swings in policies that is the authority should know when and how to react when policy changes are required in the economy.

Following the Monetarist arguments, in the mid-1970s monetary policy framework was embraced by industrial economies and later emerging economies as a key influencer of economic growth and money growth targeting was one of the instruments that were used to implement the policy. Under this approach Central banks sought to ensure price stability by aiming for intermediate targets for rates of monetary growth that for given assumptions about the demand for money, could be expected to deliver the desired rate of inflation (Nabbosa, 2017). Money growth targeting is based on the Friedman's Monetary Rule that inflation rate is equal to the difference between growth rate of the money supply (which is equal to the demand for money) and rate of growth of the physical volume of production (Dimitrijević et al, 2013). Under this rule, this implies that the monetary authority can increase money supply if production is falling below the target growth rate, but this comes at a higher cost of general price increase also termed as inflation. Although this policy was successful in guaranteeing economic growth in many industrialized and emerging economies, it was faced with two major problems; the persistent failures in hitting the monetary targets and persistent instability between the monetary growth and inflation (Nabbosa, 2017). It is these challenges that were encountered when implementing money growth targeting as a monetary policy framework that paved way for a new monetary policy framework; Inflation Targeting in the late 1990s.

The correlation between inflation and economic growth is a subject open to debate. Gomme (1993) Fisher (1993), Barro (1996), Andrés and Hernando (1999), Faraji K and Kenani M (2013) among other scholars found a negative correlation between inflation or an expansionary monetary policy and economic growth. Barro, 1996 analysed the relationship using panel data of 100 countries for a period of 30 years (1960-1990) and a major discovery in his results was that the negative relationship between economic growth and inflation became statistically significant when high inflation was included in the data set (Nabbosa, 2017). On the other hand, scholars like Vickrey (1955), Tobin (1965 and 1995), Mundell (1963), Ghosh and Phillips (1998), Mallik and Chowdhury (2001), have found a positive correlation between lower rates of inflation and economic growth. Following the empirical evidence, it can be concluded that lower inflation rates may lead to economic growth in the medium and long term but hyper-inflation in general is detrimental to economic growth; it erodes the rewards to labour and investments and increases the general cost of production in an economy. So far it is clear that there is a trade off between inflation and economic growth when implementing a monetary policy framework, but this may not be the case when using inflation targeting monetary policy framework as opposed to money growth targeting.

Inflation volatility as a second moment of inflation is also another challenge when implementing monetary policy and posses a greater threat to economic growth than hyper-inflation. Inflation volatility leads to uncertainty in the economy, irrational expects, frustrates long term investments and makes long term planning and budgeting impossible in the economy. This implies that a good monetary policy is one that ensures price stability by ensuring lower inflation rates and inflation volatility. In the past decade inflation targeting as a monetary policy framework has proved that it can control both inflation rates and inflation volatility. Kumo (2015) in a time series study carried out on South Africa, showed that the pre-inflation targeting period was characterised by higher inflation volatility and lower economic growth than the post-inflation targeting period. Nabbosa (2017) in a time series comparison study on Uganda, South Africa, Kenya and Ghana showed that inflation targeting countries generally experienced lower inflation rates and inflation volatility compared to their counterparts.

This chapter has clearly laid out a brief history, literature review and empirical findings about the correlation between monetary policy and economic growth. This discussion will help us in the next chapters when carrying out the empirical analysis and drawing conclusions about the study.

CHAPTER 3: EMPIRICAL ANALYSIS

Although studies have assessed the impact of inflation targeting in Uganda, most have focused mainly on analysing the impact of the policy on inflation rates and inflation volatility in the country (Nabbosa, 2017; Kumo, 2015). This study focuses on analysing the short and long run impact of Inflation Targeting Lite on economic growth. To empirically analyse the impact of inflation targeting lite on economic growth in Uganda, a theoretical framework of the IS-MP-PC model and an econometric method specifically the restricted Vector Autoregressive model (also referred to as the vector error correction model) are jointly used.

The IS-MP-PC is an acronym for Income-Spending/Monetary Policy/Phillips Curve. This means that the IS-MP-PC model has three elements; IS curve which describes how output depends upon interest rates, PC which describes how inflation depends on output and MP which describes how the central bank sets interest rates depending on inflation and/or output. The IS-MP-PC model is a short run macroeconomic model that shows how inflation impacts aggregate output (economic growth) in the economy taking into consideration how the Central bank sets the nominal interest rate. The IS-MP-PC shows a negative short run relationship between economic growth (aggregate output) and inflation, an increase in the general price levels reduces aggregate output in the economy. The model shows a positive short run relationship between nominal interest rates and inflation that is the Central Bank will increase the nominal interest rate when inflation increases and vice versa which implies a negative correlation between nominal interest rates and economic growth. It further shows that in the short run, an expansionary monetary policy leads to inflation which is detrimental to economic growth. Taking all these theoretical conclusions into account, this study embarks on showing how inflation targeting lite as a monetary policy framework impacts economic growth

The IS-MP-PC is limited to explaining only the short run correlation between economic growth, inflation and other macroeconomic variables and yet the purpose of the study is to investigate both the short and long run impact of ITL in Uganda. Analysing the long run impact of ITL on economic growth requires that the long run relationship among inflation, monetary policy and economic growth is identified. This long run relationship is explained by the theoretical growth theories like the classical growth theory, neoclassical growth theory, monetarist growth theory among others.

In the empirical analysis, an econometric model that is Vector Error correction model (VECM) is used to investigate the theoretical correlation among the macroeconomic variables portrayed by the IS-MP-PC model and the growth theories using Uganda's empirical data. The VECM is the most suitable model for such as a study because macroeconomic variables tend to have long run impact and reverse casual effect which is termed as cointegration (Enders, 2015). The VECM analyses both the long run and short run correlation among the macroeconomic variables hence it empirically analyses the short-term correlation among inflation, monetary policy and economic growth portrayed by the IS-MP-PC model and the long run correlation explained by the various economic growth theories.

The empirical analysis in this study starts with a theoretical review on the short run relationship between economic growth and monetary policy as presented in the IS-MP-PC model and the long run relationship between economic growth and inflation. These views presented in the theoretical analysis are later used to empirically investigate the short and long run impact of ITL on economic growth in Uganda using the VECM econometric model.

3.1: THEORATICAL ANALYSIS

3.1:1 IS-MP-PC MODEL

One way to model the real economic impact of inflation targeting is by using the Keynesian aggregate demand and supply framework which explains the correlation among economic growth, inflation and nominal interest rates as set by the Central Bank. In this study the IS-MP-PC model forms the theoretical framework which will later aid our empirical analysis. The IS-MP-PC model is also referred to as the "three-equation model" because it consists of three elements and these are; the Phillips curve, IS curve and the Monetary policy rule. Putting the three elements together, the IS-MP-PC is called as the Spending/Monetary Policy/Phillips Curve model. This 3-equation model is a stylised shortcut that encompasses supply and demand relations to determine how the three main macroeconomic variables of interest (the output gap, the inflation rate and the nominal interest rate) react to exogenous supply and demand shocks (Poutineau, et al 2015). The three elements of this model are explained as follows;

The first element is an expectations-augmented Phillips curve which is formulated as a relationship in which current inflation depends on inflation expectations, output gap and a temporary inflationary shock. This relationship can be represented using the equation below;

$$\pi_t = \pi_t^e + \gamma\,(y_t - y_t^*) + \mathcal{E}_t^\pi \qquad (1)$$

The coefficient γ describes exactly how much inflation is generated by a 1 percent increase in the gap between output and its natural rate (Whelan, 2015).

The second element in this model is the IS curve. The IS curve represents the relationship between output and real interest rates, not nominal rates. Real interest rates adjust the headline (nominal) interest rate by subtracting inflation ($\mathrm{r} = \mathrm{i} - \pi$) (Whelan, 2015). This relationship can be represented using the equation below;

$$y_t = y_t^* - \alpha\,(i_t - \pi_t - r^*) + \mathcal{E}_t^y \qquad (2)$$

The coefficient α describes the effect of an increase in the real interest rate on output (Whelan, 2015).

The third and last element of this model is Monetary policy. In the three-equation model, the monetary policy rule (MP) replaces the traditional LM curve by assuming the central bank sets nominal interest rates according to a certain rule for instance the Taylor rule (Taylor, 1993) has gained popularity as to how central banks can set nominal interest rates. The monetary policy rule is expressed as an equation below;

$$i_t = r^* + \pi^* + \beta_\pi(\pi_t - \pi^*) \qquad (3)$$

Where; $\beta_\pi > 0$, i_t is the nominal interest rate

The monetary policy rule in equation 3 can be interpreted as; the central bank adjusts the nominal interest rate, i_t , upwards when inflation, π_t, goes up and downwards when inflation goes down (we are assuming that $\beta_\pi > 0$) and it does so in a way that means when inflation equals a target level, π^*, chosen by the central bank, real interest rates will be equal to their natural level (Whelan, 2015).

The IS-MP-PC model is derived in two (2) steps, the first step is to combine the IS and MP equation to create the IS-MP curve and second step is to combine the IS-MP curve with the PC curve. It should be noted that MP replaces LM in the traditional IS-LM curve. There are three main justifications for this change and these are; firstly, modern central banks do not implement monetary policy by setting a specified level of the monetary base as implied by the LM curve. The assumption that the central bank follows an interest rate rule is more realistic than the assumption that it targets the money supply (Romer, 2000). Secondly, it is more realistic to set interest rates dependent on the prices as most modern central banks set interest rates with a very close eye on inflationary developments (Whelan, 2015). Lastly, for simplicity; in IS-MP model, output, inflation and interest rates are determined by a single model. This is a simpler approach compared to the IS-LM which requires two different sets of graphs (Whelan, 2015).

The IS-MP curve is represented by an equation;

$$y_t = y_t^* - \alpha(\beta_\pi - 1)(\pi_t - \pi^*) + \mathcal{E}_t^y \quad (4)$$

The IS-MP-PC model is derived by combining the IS-MP equation (4) and the PC equation (1) From the IS-MP-PC curve equilibrium output and inflation are derived at the point where the IS-MP curve cuts the PC curve. The IS-MP-PC curve can be expressed in terms of inflation or output, but the focus of this study is to determine the impact of inflation targeting on output hence we express the curve in terms of output.

$$y_t = y_t^* - \alpha\theta(\beta_\pi - 1)(\pi_t^e - \pi^* + \mathcal{E}_t^\pi) + (1 - \gamma\alpha\theta(\beta_\pi - 1)\mathcal{E}_t^y \quad (5)$$

Where; $\theta = \frac{1}{[1+\gamma\alpha(\beta_\pi - 1)]}$

Equation 5 represents the IS-MP-PC model, and this forms the theoretical framework of this study. The terms in the IS-MP-PC model are summarized below;

π_t is inflation at time t, π_t^e is the public's expected inflation, y_t is output, y_t^* is the natural output level, $(y_t - \boldsymbol{y_t^*})$ is the output gap, $\boldsymbol{\mathcal{E}_t^\pi}$ represents the temporary inflationary shocks (aggregate supply shocks), $\boldsymbol{\mathcal{E}_t^y}$ represents the aggregate demand shocks, , $\boldsymbol{r}^*$ is the real interest rate and π^* is the targeted inflation. In this study, the aggregate demand shocks ($\boldsymbol{\mathcal{E}_t^y}$) are factors beyond real interest rates that influence aggregate spending and/or may shift the IS curve for instance government expenditure, investment/savings, taxes, consumption, exports, imports among others. The inflationary shocks ($\boldsymbol{\mathcal{E}_t^\pi}$) are factors resulting from the supply side that influence inflation in the economy for instance an increase nominal interest rates, an increase in the imported petroleum products, increase in agricultural supplies due to poor harvest due to bad weather (as it was in Uganda in 2011) among other factors (Whelan, 2015).

According to IS-MP-PC model represented by equation (5) whether output is above or below target depends upon the gap between expected inflation and the inflation target as well as on the two temporary shocks $\mathcal{E}_t^\pi$ and $\mathcal{E}_t^y$. Provided that β_π>1, the combined coefficient $-\alpha\theta(\beta_\pi - 1)$ is negative. This means that increases in the public's inflation expectations relative to the inflation target end up having a negative effect on output (Whelan, 2015).

In the empirical analysis, the IS-MP-PC equation (5) is modified such that the inflation gap is replaced with lagged observed inflation (π_{t-1}) since time series data is employed, inflationary shocks are specified as the lagged nominal exchange rate (Ex) and money supply (M2) and an aggregate demand shock will be specified that is lagged government expenditure (govt). The output target is also assumed to be zero since Uganda has no specified output target. The empirical IS-MP-PC model is represented as;

$$y_t = (1 - \gamma\alpha\theta(\beta_\pi - 1)govt_{t-1} - \alpha\theta(\beta_\pi - 1)(\pi_{t-1} + M2_{t-1} + Ex_{t-1}) + \mathcal{E}_t \quad (6)$$

A simplified IS-MP-PC model is presented graphically under specific assumptions; $\beta_\pi > 1$ in the IS-MP curve, the aggregate demand and supply shocks are equal to zero ($\mathcal{E}_t^y = \mathcal{E}_t^\pi = 0$) and the public's expectation of inflation is equal to the central bank's inflation target ($\pi_t^e = \pi^*$).

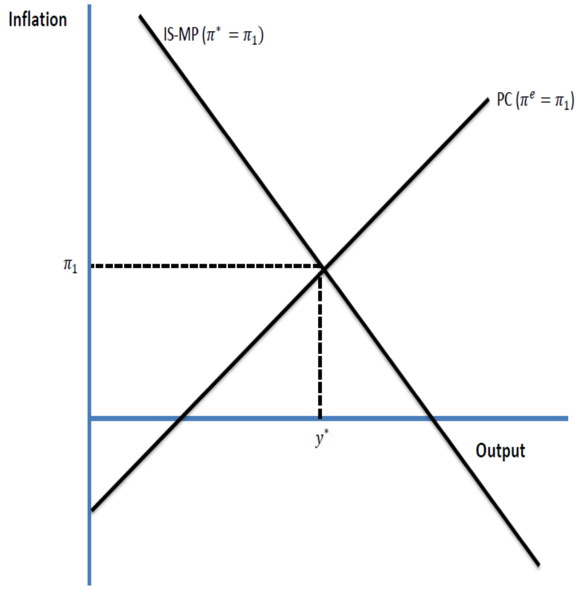

Figure 1: IS-MP-PC model (Source- Karl Whelan, Advanced Macroeconomics Notes (2015))

3.1:2 ECONOMIC GROWTH THEORY AND INFLATION

This study focuses on establishing the long and short run impact of inflation targeting on economic growth in Uganda. The IS-MP-PC model introduced in the previous subsection explains a short run theoretical correlation among economic growth, inflation and monetary policy but ignores the long run correlation. The IS-MP-PC model was introduced by the Keynesian economists. The long run correlation that is ignored by the Keynesians is explained by other schools of economics like the classical, neo-classical and monetarists. In this subsection the long run theoretical correlation among economic growth, inflation and monetary policy is investigated.

CLASSICAL THEORY

The classical economists were influential during the 18th and 19th century and the most prominent economists of the time included Adam Smith, Thomas Malthus, John Stuart Mill and David Ricardo. Adam Smith, also known as the "father of classical economic" assumed that economic growth is dependant on three key factors of production and these are land, labour and capital. According to Adam Smith economic growth was supply-driven and presented this argument in a simple production function;

$$Y = f(L, K, T)$$

Where Y is output, L is labour, K is capital and T is land. The classical economists believed that output growth (g_y) was driven by population growth (g_L), capital accumulation or investment (g_k), land growth (g_T) and increase in overall productivity (g_f). From this a growth model was developed:

$$g_y = \Phi\ (g_L, g_k, g_T, g_f)$$

The classical economists acknowledged the role of investments as a driver of economic growth and savings as the main determinant of investments; an increase in savings results into increased investment in capital which leads to increased productivity and output (Gokal and Hanif, 2004; Akinsola and Odhiambo, 2017). The quantity theory of money is another aspect that stands out in the classical growth theory; it states that that money does not affect real variables in the long run but can determine price levels in an economy. The quantity theory of money was made explicit in Say's law by Jean Baptiste Say, a French economist with classically liberal views. The Say's law implied that supply creates its own demand and money is only a medium of exchange (Akinsola and Odhiambo, 2017).

The long run relationship between the increase in price levels (inflation), and its "tax" effects on profit levels and output were not specifically articulated in classical growth theories. However, the relationship between the two variables is implicitly suggested to be negative, as indicated by the reduction in firms' profit levels through higher wage costs output (Gokal and Hanif, 2004; Akinsola and Odhiambo, 2017).

NEO-CLASSICAL THEORY

The classical theory progressively turned into a distinct theory-the neoclassicism, which, despite of having taken over the basic elements of the classics, was also subject to the influences of the Keynesian theory and of the changes occurred in the economic field (Hudea, 2015). Solow (1956) and Swan (1956) presented one of the earliest neo-classical models. The Solow-Swan model explained the long run economic growth by looking at capital accumulation, labour/population growth and an increase in productivity- technological progress.

In Neoclassicism the long run correlation between economic growth and inflation lacks a strong stand point as some scholars think it is negative while others think it is positive. Mundell (1963) and Tobin (1965) presented a positive relationship between economic growth and inflation. Mundell (1963) explained this positive correlation; when inflation occurs, or high inflationary expectations exist, people's wealth reduces - the rate of return on an individual's real money balances falls. To accumulate the desired wealth, people save more by switching to assets, increasing their price, thus driving down the real interest rate. Greater savings means greater capital accumulation and thus faster output growth (Gokal and Hanif, 2004). Tobin (1965) agrees with Mundell (1963) by explaining that when inflation occurs in the economy, households are forced to substitute current for future consumption by purchasing more assets which results into capital accumulation and economic growth in the long run.

Stockman (1981) on the contrary, presented a negative long run correlation between inflation and economic growth; an increase in the inflation rate results in a lower steady state level of output and people's welfare declines. In Stockman's model, money is a compliment to capital, accounting for a negative relationship between the steady state level of output and the inflation rate (Gokal and Hanif, 2004).

MONETARISTS THEORY

Milton Friedman (1912-2004) laid a foundation for this school of thought; which strongly criticised the Keynesian theory. The Monetarist argued that excessive expansion of the money supply is inherently inflationary, and that monetary authorities should focus solely on maintaining price stability. The monetarists emphasise the role of money as the principal cause of demand-pull inflation. The Monetarist Theory of Inflation asserts that the general price level rises only due to the increase in the supply of money, but not proportionally.

The Monetarist theory of inflation was an extension of the classical monetary theory; price level rises with a proportionate change in the supply of money. The monetarists explain inflation using the Quantity Theory of Money that was presented by Irving Fisher; a classical economist. He proposed that the increase in the stock of money is the sole cause of inflation and rise in the price is proportional to the money supply. This was expressed in a simple model;

$$MV = PT$$

and

$$P = \frac{MV}{T}$$

Where,

M is the money(currency), V is the velocity of money, MV is the money supply, P is the price level and T is the total number of transactions.

The monetarists also introduced the Neutrality of money theory; according to this theory, the equilibrium values of real variables -including the level of GDP, unemployment– are independent of the level of the money supply in the long-run. The neutrality theory was a direct criticism to the long run relationship among economic growth, inflation and unemployment portrayed by the Philips curve (Gokal and Hanif, 2004).

According to the Monetarists, in the long-run prices are mainly affected by the growth rate in money, while having no real effect on economic growth. If the growth in the money supply is higher than the economic growth rate, inflation will result.

The short run correlation proposed by the IS-MP-PC and the long run correlation proposed by the classical, neoclassical and monetarists form the theoretical framework on which the empirical analysis of this paper bases.

3.2 METHODOLOOGY

VECTOR ERROR CORRECTION MODEL

The IS-MP-PC model and growth theories discussed in the previous section have provided a theoretical framework which is empirically investigated using an econometric tool. To empirically analyse the short run and long run impact of ITL on economic growth in Uganda, a restricted Vector Auto Regression model (VECM) is used. The VECM model is the suitable econometric tool for this study because of two main reasons. Firstly, the study focuses on establishing correlation among macroeconomic variables which are characterised with a stylized fact of being cointegrated (Enders, 2015) – correlation among cointegrated variables can best be analysed using the VECM model. Secondly the VECM can detect both the short and long run correlation among macroeconomic variables which other econometric tools like the Ordinary Least Square (OLS) are unable to do.

The Vector Autoregressive (VAR) model is one of the multi-equation time-series models that is used to analyse correlation among stationary variables and under certain restrictions causality can be determined. In this model all variables are treated symmetrically. However, when the variables under scrutiny are nonstationary, the Vector Error Correction model (VECM) is used instead of the VAR. Regressing non-stationary variables may give spurious results which do not have any logical or economic interpretation, but this is not the case when cointegration exists. Cointegration refers to a linear combination of non-stationary variables in other words, two variables $(Y_t \; and \; X_t)$ may have a unit root but there may exist a linear combination of these two variables that is stationary (Enders, 2015).

The concept of cointegration was introduced in the econometrics literature by Engle and Granger (1987) and they defined cointegration in the following way;

The components of the vector $x_t = (x_{1,t}, x_{2,t}, \ldots, x_{n,t})'$ are said to be cointegrated of order d,b, denoted by $x_t \sim CI(d, b)$ if; all components of x_t are integrated of order d. Secondly if there exists a vector $\beta = (\beta_1, \beta_2, \ldots, \beta_n), \beta x_t = \beta_1 x_{1t} + \beta_2 x_{2t} + \ldots + \beta_n x_{nt}$ such that the linear combination is integrated of order $(d - b)$ where b>0 and β is the cointegrating vector (Enders, 2015). If two integrated variables share a common stochastic trend such that a linear combination of these variables is stationary, they are called cointegrated. In general, with $k > 2$ variables there may be as many as $r = k - 1$ linearly independent cointegrating relationships. When k > 2, for the EG test to be valid, there must be a single cointegrating vector. Note that simply taking first differences of all non-stationary variables eliminates the cointegration term which may well contain relations of great importance for an analysis (L$\ddot{u}$tkepohl, 2005).

Cointegrating relationships can be imposed by reparametrizing the VAR model as a Vector Error Correction model (VECM) (Kilian and L$\ddot{u}$tkepohl, 2016). If cointegration has been detected between series, we know that there exists a long-term equilibrium relationship between them characteristics of a series such as its mean and variance, so we apply VECM to evaluate the short run over time. A bivariant VEC model can be presented as;

$$\Delta y_t = \beta_{y0} + \beta_{yy1}\Delta y_{t-1} + \beta_{yx1}\Delta x_{t-1} + \lambda_y(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + u_t^y \qquad (6)$$
$$\Delta x_t = \beta_{x0} + \beta_{xy1}\Delta y_{t-1} + \beta_{xx1}\Delta x_{t-1} + \lambda_x(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + u_t^x$$

Where;

All the terms in both equations in (6) are I (0) if the variables are cointegrated with cointegrating vector (1, $-\alpha_0$, $-\alpha_1$), in other words, if $(y_t - \alpha_0 - \alpha_1 x_t)$ is stationary.

The λ coefficients are the error-correction coefficients, measuring the response of each variable to the degree of deviation from long-run equilibrium in the previous period. A negative and significant coefficient of the ECM (λ) indicates that any short-term fluctuations between the independent variables and the dependant variable will give rise to a stable long run relationship between the variables

Just like in the VAR model, Impulse Response Function (IRF) can be used to depict how the rate of a shock for a variable reacts toward the response of other variables in a VECM. It also attempts to determine the length of the impact of the shock from one variable to the other variables (Enders, 2015). When applying an IRF, we assume that the variables in the model are endogenous. The impulse responses of stationary, a VAR(*p*) processes can be shown as the coefficients of specific MA representations (Ender, 2015);

$$x_t = \mu + \sum_{i=0}^{\infty} \emptyset_i \varepsilon_{t-i} \quad (7)$$

$\emptyset_i = \emptyset_{jk,i}$ represents the response of variable *j* to a unit forecast error in variable *k*, *i* periods ago, if the system reflects the actual responses to forecast errors. The integrated or cointegrated VAR(*p*) process does not possess valid MA representations of the type. In stable processes the responses taper a zero as $i \to \infty$. This property does not necessarily hold in unstable systems where the effect of a one-time impulse may not die out asymptotically (Lütkepohl, 2005).

3.3 DATA

3.3:1 DATA DESCRIPTION

The macroeconomic data used to analyse the impact of inflation targeting on economic growth in Uganda is quarterly data from 1995Q2 to 2016Q4 which totals to 87 observations. It should be noted that although ITL was adopted in 2011 in Uganda, this study includes data from 1995 to 2016. This is because the study assumes that the economic conditions are the same throughout the period except the change in monetary policy. The data used in this paper was extracted from extracted from Thomson Reuters data stream. The data extracted includes; standardized Gross Domestic Product (GDP) expressed in USD, standardized government consumption (expenditure) expressed in USD, standardized Consumer Price Index (CPI) expressed in USD, standardized money supply (M2) expressed in USD, standardized nominal exchange rate index. The data on GDP, government consumption (expenditure) and CPI was originally compiled by the World Bank (World Development Indicators (WDI) while data on money supply (M2) and nominal exchange rate index was originally computed by the Uganda Bureau of Statistics (UBS).

In this study, GDP is the variable name for Gross Domestic Product and a proxy to economic growth. CPI is the variable name for Consumer Price Index and is used as the measure of inflation. Inflation is defined as a general increase in the prices of goods and services in an economy. Consumer price index is defined as a is a measure of the average change over time in the prices paid by consumers for a market basket of consumer goods and services. Based on these two definitions, CPI is an appropriate proxy of inflation in an economy. Govt is the variable name for government expenditure. Ex is the variable name for nominal exchange rate and M2 is the variable name for money supply which is the measure of monetary policy. It should be noted that all the variables in the empirical model are expressed as logarithms to simplify the interpretation of the results.

3.3:2 STATIONARITY TEST

In Time Series analysis, stationarity of variables is a very important phenomenon as it greatly influences the results and their interpretation. The process being stationary indicates that the mean, variance and autocorrelation functions are essentially constant and do not depend on time that is the first two moments are time invariant. Estimating non-stationary series using Ordinary Least Squares can result in a spurious regression. Series maybe stationary or nonstationary at level, non-stationarity in series can be removed by differencing the variables; to check for stationarity, two different tests were used: The Augmented Dickey Fuller (ADF), and the Philip-Perron (PP) test. Both the ADF and PP tests are constructed based on the same null and alternative hypotheses;

H_0: variable has no unit root

H_1: variable has a unit root

Based on the results in table 1, all the variables have a unit root at level since the P-values are greater than 5% (graphical representation of the series shown in figures 2 and 3) and the null hypothesis is rejected. The same variables are stationary at first difference with p-values less than 5% and in this case the null hypothesis is accepted (graphical representation of the series shown in figure 4)

Table 1: Stationarity Test Results (ADF and PP)

Level							
Variable	I(d)	ADF t-statistic	P-value	lags	PP t-statistic	P-value	lags
$\ln(CPI_t)$	1	0.886751	0.9949	2	0.70074	0.9916	3
$\ln(GDP_t)$	1	-0.29745	0.9198	2	2.73368	0.9984	3
$\ln(Govt_t)$	1	1.652902	0.9754	2	1.70224	0.9779	3
$\ln(M2_t)$	1	2.868936	0.9989	2	3.82486	1.0000	3
$\ln(Ex_t)$	1	1.840923	0.9837	2	2.07030	0.9905	3
First Difference							
Variable	I(d)	t-statistic	P-value	lags	t-statistic	P-value	lags
$\Delta\ln(CPI_t)$	0	-5.34344	0.0000	2	-7.56321	0.0000***	3
$\Delta ln(GDP_t)$	0	-3.11691	0.0022	2	-10.7892	0.0000***	3
$\Delta\ln(Govt_t)$	0	-5.21013	0.0000	2	-9.16515	0.0000***	3
$\Delta\ln(M2_t)$	0	-3.43521	0.0008	2	-7.50344	0.0000***	3
$\Delta ln(Ex_t)$	0	-5.25253	0.0000	2	-7.90985	0.0000***	3

***, **, * represents statistical significance at 1%,5% or 10%, I(d) is the order of integration.

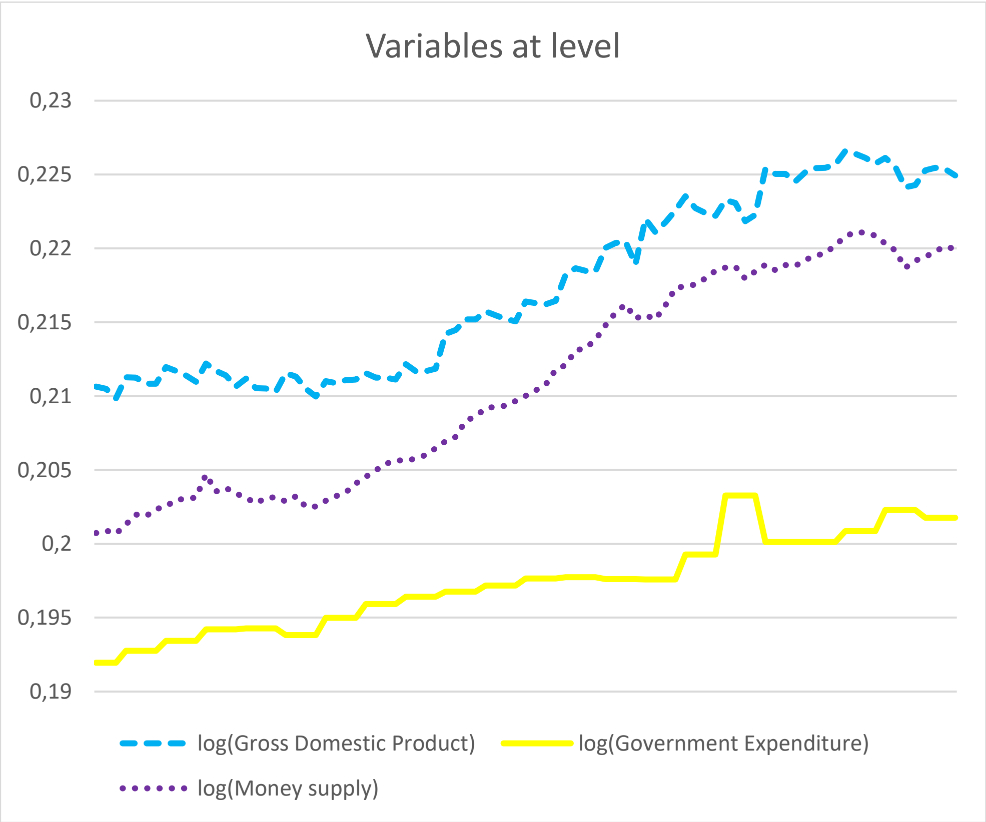

Figure 2. Graphical representation of logged variables at level

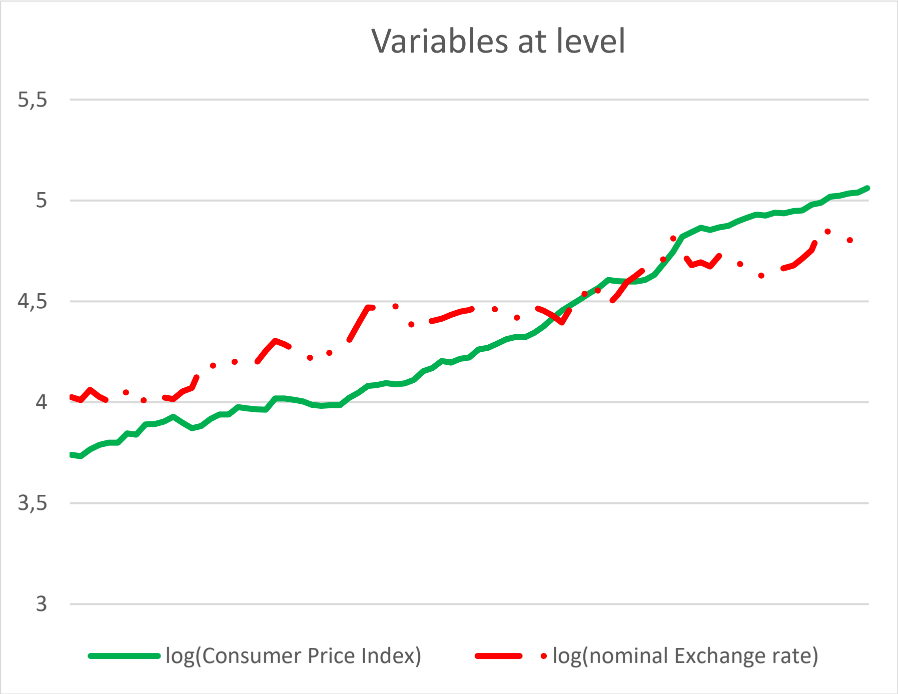

Figure 3. Graphical representation of logged variables at level

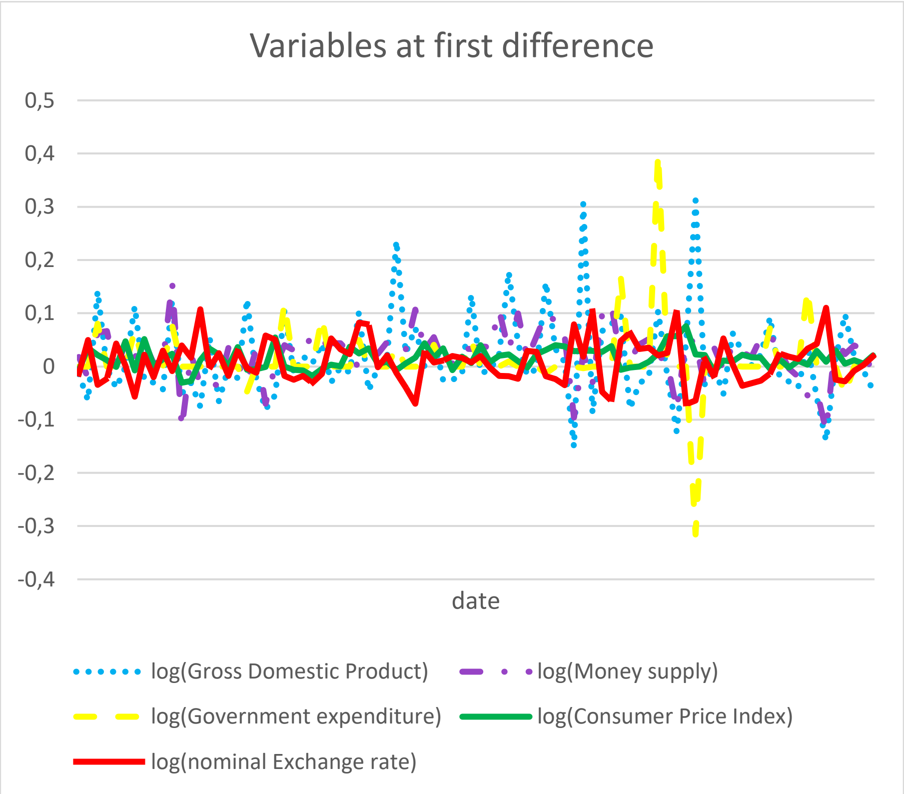

Figure 4. Graphical representation of logged variables at first difference

3.4 EMPIRICAL MODEL SPECIFICATION, ESTIMATION AND RESULTS

In this subsection, an empirical VECM(p) is estimated to analyse the impact of inflation targeting lite in Uganda by establishing the long and short run equilibrium in Uganda's GDP, money supply (M2), inflation (CPI), nominal exchange rate and government expenditure. First, the number of lags to include in the empirical model is selected and the cointegration test is performed to confirm the econometric model choice before the empirical model is estimated.

3.4:1 LAG LENGTH SELECTION

In time series analysis, AR models are built in a way that the dependant variable depends on its own lags and/or other explanatory variables' lags. This is therefore very important to select the number of lags that shall be included in our model in the next section. Liew (2004) presented five (5) commonly used lag selection criteria in econometrics and these include; Final Prediction Error (FPE) (Akaike, 1969), Akaike Information Criterion (AIC) (Akaike, 1973), Hannan-Quinn Criterion (HQ) (Hannan and Quinn, 1979) and Schwarz information criterion (SIC) (Schwarz, 1978).

To determine the optimal lag length to use in the cointegration test and in the empirical model, a $VAR_{(P)}$ is estimated at level using EViews package where p=2 is the lag length (set by default). The variables included in the VAR model include GDP, CPI, nominal exchange rate, money supply (M2) and government consumption. An inbuilt in function of lag selection criteria is used to determine the optimal lag length and the minimum values of each criteria are given. The results are presented in table 2;

Table 2: VAR Lag order selection Criteria

Lag	LL	LR	FPE	AIC	SIC	HQ
0	282.9372	NA	8.49e-10	-6.697282	-6.551569	-6.638742
1	782.0057	925.9825	9.930e-15	-18.12062	-17.24634^*	-17.76938*
2	803.5405	37.36158	1.02e-14	-18.03712	-16.43427	-17.39319
3	831.3693	44.92848	9.67e-15	-18.10528	-15.77387	-17.16865
4	871.0594	59.29599^*	59.29599^*	-18.45926^*	-15.39928	-17.22993

*Lag order selected by the criterion.

According to results in table 2, three out of the five criteria (LR, FPE and AIC) show that p=4 is the optimal lag length while two out of five criteria (SIC and HQ) show p=1 is the optimal lag length. According to Liew (2004) AIC and FPE are superior than the other criteria in small sample studies and since the empirical model has only 87 observations, lag length suggested by LR, FPE and AIC is chosen. The lag length selected by a VAR model at level is equivalent to less one in a VECM ((Lütkepohl, 2005) and since the VAR model in this study suggests p=4, then the cointegration test and empirical VECM model will be estimated with lag length p=3.

The lag length in the empirical model is three that is p=3 based on the lag selection criteria in subsection 5.3.

3.4:2 COINTEGRATION TEST

Economic theory often suggests that certain subset of variables should be linked by a long-run equilibrium relationship. However, the variables under consideration may drift away from equilibrium for a while and economic forces or government actions may be expected to restore equilibrium. In econometrics, this long run equilibrium relationship is defined as Cointegration in the variables. In a univariate series, cointegration can be tested using the Engel-Granger (1987) test in two steps. The first step is to estimate the long run equilibrium in the variables using OSL, If the variables are cointegrated, the OLS regression yields "super consistent" estimator of the cointegrating parameters (Enders, 2015). In the second step, the estimated OLS residuals are extracted and tested for unit root and if a unit root is found then the variables are not cointegrated. In multivariate series, the Engel-Granger test is insufficient to establish the cointegration in the variables and the Johansen test is recommended (the Johansen's test, named after a Danish Statistician and Econometrician Søren Johansen).

Unlike the Engel-Granger test, the Johansen test is performed in a single step and is aimed at determining the number of cointegrating relationships (r) in detrended data. The Johansen test is performed by estimating an unrestricted VAR(q) model where q=3 based on the lag selection criteria in the previous subsection. In the VAR(q) model, main interest is placed on the covariance matrix (Π) which is the product of a matrix containing the cointegrating vectors (β) and the and a matrix containing the speed of adjustment coefficients (α) (error correction terms). The parameters β and α are unknow but are estimated using maximum likelihood.

The Johnsen test relies heavily on the relationship between the rank of the matrix (Π) and its characteristic roots hence it can be interpreted as a multivariant generalization of the Dickey-Fuller test (Ender, 2015). This cointegration test is based on two test statistics and these are the trace test and the maximum Eigen value test. The trace of matrix (Π) is the sum of the diagonal elements of this matrix. The hypotheses tested differ in both test statistics.

Trace test:

$\mathrm{H_0(r_0): rank(\Pi) = r_0}$

$\mathrm{H_1(r_0): rank(\Pi) > r_0}$

$$\lambda_{trace}(r_0) = -T \sum_{i=r_0+1}^{n} ln(1 - \hat{\lambda}_i) \qquad (15)$$

Maximum Eigen Value test:

$\mathrm{H_0(r_0): rank(\Pi) = r_0}$

$H_1(r_0 + 1): rank(\Pi) = r_0 + 1$

$$\lambda_{max}(r_0, r_0 + 1) = -T\, ln(1 - \hat{\lambda}_{r_0+1}) \qquad (16)$$

Where; r_0= 0,1, …, k-1, k is the number of variables, Π is the covariance matrix, r is the cointegrating rank and $\hat{\lambda}_i$ is the i^{th} eigen value estimated using the Johansen procedure (15) (L$\ddot{u}$tkepohl, 2005).

The Johansen test is based on a precondition; variables must be non-stationary at level but stationary at first difference meaning that the variables are integrated of the same order (I(1)). Based on the results in table 1, the variables in this study meet this precondition, the Johansen test is performed at lag length p=3 and the results are presented in table 3 below;

Table 3: Johansen cointegration Test

Trace Test				
$H_0: rank(\Pi) = r_0$	$H_0: rank(\Pi) > r_0$	$\lambda_{trace}(r_0)$	Critical value (5%)	Prob
0	0	83.39806^{*}	69.81889	0.0028
1	1	48.30631^{*}	47.85613	0.0453
2	2	20.59635	29.79707	0.3833
3	3	9.642458	15.49471	0.3093
4	4	1.494960	3.841416	0.2214
Maximum Eigen value Test				
$H_0: rank(\Pi) = r_0$	$H_0: rank(\Pi) = r_0 + 1$	$\lambda_{max}(r_0)$	Critical value (5%)	Prob
0	0	35.09175^{*}	33.87687	0.0357
1	1	27.70996^{*}	27.58434	0.0482
2	2	10.95389	21.13162	0.6519
3	3	8.147498	14.26460	0.3639
4	4	1.494960	3.841466	0.2214

*reject the null hypothesis.

In the Johansen cointegration test, the null hypothesis in both tests is rejected when the estimated trace or maximum eigen value is greater than its corresponding critical value. Alternatively, the null hypothesis is rejected when the probability corresponding to a given estimated trace or maximum value is less than 5%.

From the results in table 3, in both the trace and maximum eigen value tests the null hypotheses are rejected at $r_0 = 0 \; and \; r_0 = 1$ which means that there are two (2) cointegrating equations at 5% level.

3.4:3 MODEL SPECIFICATION

After confirming cointegration in the macroeconomic variables, a Vector Error Correction model is also confirmed to be the suitable model to use in the empirical analysis of the short and long run impact of inflation targeting on economic growth in Uganda and the empirical model specification is as follows;

VEC Equation (1)

$$\Delta \mathrm{lnGDP}_{1t} = \mu_{1t} - \emptyset_1(\mathrm{lnGDP} - \gamma_0 - \gamma_1 \mathrm{lnCPI} - \gamma_2 \mathrm{lnGovt} - \gamma_3 \mathrm{lnEx} - \boldsymbol{\gamma_4} \mathrm{lnM2})_{t-1} + \sum_{i=1}^{j} \beta_{1,j} \Delta \mathrm{lnGDP}_{1t-i} + \sum_{i=1}^{j} \beta_{2,j} \Delta \mathrm{lnCPI}_{1t-i} + \sum_{i=1}^{j} \beta_{3,j} \Delta \mathrm{lnGovt}_{1t-i} + \sum_{i=1}^{j} \Delta \mathrm{lnEX}_{1t-i} + \sum_{i=1}^{j} \Delta \mathrm{lnM2}_{1t-i} + \varepsilon_{1t}$$

VEC Equation (2)

$$\Delta \ln CPI_{2t} = \mu_{2t} - \emptyset_2(\ln GDP - \gamma_0 - \gamma_1 \ln CPI - \gamma_2 \ln Govt - \gamma_3 \ln Ex - \gamma_4 \ln M2)_{t-1} + \sum_{i=1}^{j} \Delta \ln GDP_{2t-i} + \sum_{i=1}^{j} \Delta \ln CPI_{2t-i} + \sum_{i=1}^{j} \Delta \ln Govt_{2t-i} + \sum_{i=1}^{j} \Delta \ln Ex_{2t-i} + \sum_{i=1}^{j} \Delta \ln M2_{2t-i} + \varepsilon_{2t}$$

VEC Equation (3)

$$\Delta \ln Govt_{3t} = \mu_{3t} - \emptyset_3(\ln GDP - \gamma_0 - \gamma_1 \ln CPI - \gamma_2 \ln Govt - \gamma_3 \ln Ex - \gamma_4 \ln M2)_{t-1} + \sum_{i=1}^{j} \Delta \ln GDP_{3t-i} + \sum_{i=1}^{j} \Delta \ln CPI_{3t-i} + \sum_{i=1}^{j} \Delta \ln Govt_{3t-i} + \sum_{i=1}^{j} \Delta \ln Ex_{3t-i} + \sum_{i=1}^{j} \Delta \ln M2_{3t-i} + \varepsilon_{3t}$$

VEC Equation (4)

$$\Delta \ln M2_{4t} = \mu_{4t} - \emptyset_4(\ln GDP - \gamma_0 - \gamma_1 \ln CPI - \gamma_2 \ln Govt - \gamma_3 \ln Ex - \gamma_4 \ln M2)_{t-1} + \sum_{i=1}^{j} \Delta \ln GDP_{4t-i} + \sum_{i=1}^{j} \Delta \ln CPI_{4t-i} + \sum_{i=1}^{j} \Delta \ln Govt_{4t-i} + \sum_{i=1}^{j} \Delta \ln Ex_{4t-i} + \sum_{i=1}^{j} \Delta \ln M2_{4t-i} + \varepsilon_{4t}$$

VEC Equation (5)

$$\Delta \ln Ex_{5t} = \mu_{5t} - \emptyset_5(\ln GDP - \gamma_0 - \gamma_1 \ln CPI - \gamma_2 \ln Govt - \gamma_3 \ln Ex - \gamma_4 \ln M2)_{t-1} + \sum_{i=1}^{j} \Delta \ln GDP_{5t-i} + \sum_{i=1}^{j} \Delta \ln CPI_{5t-i} + \sum_{i=1}^{j} \Delta \ln Govt_{5t-i} + \sum_{i=1}^{j} \Delta \ln Ex_{5t-i} + \sum_{i=1}^{j} \Delta \ln M2_{5t-i} + \varepsilon_{5t}$$

Where;

μ_{it} is the intercept , $\emptyset_i$ is the cointegration coefficient, γ_i is error-correction coefficient, ε_{it} is the error term and i= 1,…,5

3.5 GRANGER CAUSALITY TEST

In this subsection, the Granger causality test is performed to determine the direction of the causality. The Granger causality test is carried out to verify statistically if one of the independent variables is useful for forecasting the dependent variable (Enders, 2015). The Granger causality test is constructed on the null hypothesis (H_0): the explanatory variable does not cause the dependent variable against the alternative hypothesis (H_1): the explanatory variable causes the dependent variable. The results of the granger causality test are presented in table 8 (Appendix B).

Inflation and government spending granger cause economic growth (GDP) as their p-values are less than 5% (0.0373 and 0.003 respectively) which means the null hypothesis can be rejected. On the other hand, money supply and nominal exchange rate do not granger cause economic growth (GDP) as their p-values are greater than 5% and the null cannot be rejected. However, jointly all the four explanatory variables granger cause GDP as the null hypothesis is rejected 1% level of significance.

GDP and money supply granger cause inflation as their p-values are statistically significant at 5% (0.0018 and 0.0192 respectively) and the null hypothesis can be rejected. Jointly, GDP, money supply, government spending and nominal exchange rate cause inflation as the null hypothesis is rejected at 5%. Government spending and nominal exchange rate do not granger cause inflation. It should be noted that the granger causality relationship between inflation (CPI) and economic growth goes in both directions.

Money supply and nominal exchange rate granger cause government spending while inflation (CPI) and GDP do not granger cause government spending. Jointly, all four explanatory variables granger cause government expenditure as the null hypothesis can be rejected at 5% significance level.

In equation 4, economic growth (GDP), inflation (CPI), government spending and nominal exchange rate do not granger cause money supply as all their p-values are greater than 5% and statistically insignificant. Unlike with the other equations, the explanatory variables jointly do not granger cause money supply as the null hypothesis cannot be rejected.

In equation 5, government spending granger causes nominal exchange rate as the p-value is less than 5% which means that the null hypothesis can be rejected. A weak granger causality running from money supply to nominal exchange is found with a p-value greater than 5% but less than 10% (0.0944) which means that the null is rejected at 10% significance level and accepted at 5%. On the other hand, inflation and economic growth (GDP) do not granger cause nominal exchange rate. Jointly, all the four explanatory variables granger cause nominal exchange rate as the null is rejected at 1% level of significance.

3.6 EMPIRICAL RESULTS

The empirical VECM (3) is estimated using the EViews package and the results are presented in tables 4 below and 5 (appendix A). The Granger causality test is performed first before the estimation results are presented to ease with the interpretation.

3.6:1 LONG RUN - COINTEGRATING VECTOR

Table 4: Cointegrating vector Estimates

Variables	Coefficients	Standard Error	t-statistic
LnGDP (-1)	1		
LnCPI (-1)	0.717814	0.29236	2.45522
LnGovt (-1)	-0.390691	0.25947	-1.50571
LnM2 (-1)	-1.225936	0.14696	-8.34181
LnEx (-1)	0.336248	0.29563	1.13741
C	7.242275		

Table 4 presents the empirical results of the cointegration coefficients from which inference is drawn about Uganda's long run relationship between economic growth and some of the key economic factors like inflation, government expenditure, money supply and the nominal exchange rate.

In the long run, inflation is detrimental to economic growth since its cointegration coefficient is positive that is (0.717814); 1% increase is inflation reduces GDP (economic growth) by 0.72% and this relationship is statistically significant as the t-statistic is above two (2) that is 2.45522. This long run equilibrium agrees with the long run relationship presented by the Neo-Classical economists like Mundell (1963), Tobin (1965) and Monetarists like Friedman Milton as presented in the theoretical analysis in chapter 3.1.

In the long run, government expenditure has a positive impact on economic growth (GDP) and this is shown by a negative cointegration coefficient (-0.390691); 1% increase in government expenditure increases economic growth by 0.39% but the relationship is statistically insignificant with a t-statistic less than two in absolute terms (-1.50571).

In the long run, money supply (M2) has a positive impact on economic growth (GDP) as presented by a negative cointegration coefficient for M2 (-1.225936) and the relationship is statistically significant with a t-statistic above two (2) in absolute terms that is (8.34181). The relationship suggests that a 1% increase in money supply increases economic growth (GDP) by 1.29%. This empirical finding agrees with the long run impact of an expansionary monetary policy on economic growth proposed by the Monetarist as discussed in chapter 3.1.

In the long run, nominal exchange rate negatively impacts economic growth (GDP) and this is shown by a positive cointegration coefficient (0.336248); an increase in nominal exchange rate by 1% reduces economic growth (GDP) by 0.336248%. However, this relationship is statistically insignificant with a t-statistic less than two (2) in terms (1.13741).

The empirical VECM (3) estimates five equations but the discussion is mainly based on two equations that is Equation 1 ($\Delta \ln GDP_{1t}$) and Equation 2 ($\Delta \ln CPI_{1t}$). This is because the main purpose of this paper is to analyse the impact of inflation targeting on economic growth and this relationship is represented by equation 1. Equation 2 is used to analyse the factors that may influence inflation in Uganda's economy. The Error correction term ($\emptyset$) shows the long run causality or the speed adjustment to long run equilibrium in the general equations. The VECM (3) model results are presented in detail in table 5 (Appendix A). The short run causality is established by performing the Wald coefficient test and the results are presented in appendix A (table 6). Parameter (μ) is interpreted as the trend or mean in the equations.

In Equation 1 ($\Delta \ln GDP_{1t}$), long run causality exists in this model running from lagged GDP, inflation, government expenditure, money supply and nominal exchange rate. This relationship is represented by error correction coefficient $\emptyset_1$ = -0.158414 which is statistically significant at 10% significance level with p-value 0.0688. This means that in the long run, economic growth (GDP) will adjust to equilibrium in case of any shocks in the economy. Short run causality is evidenced in economic growth (GDP) equation running from lagged GDP, inflation and government expenditure as shown in table 6 (appendix A). The empirical results show that GDP at currently time (t) is highly dependent on the GDP in the previous three quarters this is shown by all the lagged GDP coefficients significant at 1%. Inflation in the previous first and third quarters negatively influences economic growth (GDP) and this is shown by the significant coefficients. Government expenditure in the previous second quarter negatively impacts economic growth (GDP) at a 1% level of significance. It has also been found that there is no short run equilibrium with money supply (M2) and nominal exchange rate.

In Equation 2 ($\Delta \ln CPI_{1t}$), there is long run causality running from lagged inflation, GDP, government expenditure, money supply and nominal exchange rate. This relationship is represented by error correction coefficient $\emptyset_2$ = -0.058483 which is statistically significant at 1% significance level with p-value 0.0084. A short run relationship also exists in this equation with GDP, lagged inflation, government expenditure and nominal exchange rate. There is no short run equilibrium running from money supply (M2) to inflation (CPI). It is noted that government expenditure is highly significant in this equation at 1% level of significance (99% critical level) compared to the other explanatory variables.

In Equation 5 ($\Delta \ln Ex_{5t}$), there is long run causality running from lagged nominal exchange rate, inflation, GDP, government expenditure and money supply. This relationship is represented by error correction coefficient $\emptyset_5$ = -0.081075 which is statistically significant at 10% significance level with p-value 0.0915.

In equations 3 and 4 ($\Delta \ln Govt_{3t}$ and $\Delta \ln M2_{4t}$) no long run causality is observed running from the models' respective exogenous factors. This is shown by the positive error term coefficients 0.103479 and 0.055663 respectively which are also statistically insignificant. The economic interpretation of these results is that government expenditure and money supply (M2) do not return to equilibrium in the long run.

The VECM (3) results also show that all the five models have a mean approximately equal to zero, this is expected since the variables are integrated of order one (1). However, it is should be noted that the mean is only statistically significant in equations 2 and 5 (inflation and nominal exchange rate equations respectively).

3.6:2 SHORT RUN - IMPULSE RESPONSE

From the estimated VECM (3) the short run correlation among the macroeconomic variables under study is analysed using the respective Impulse response functions. The analysis of the impulse-response functions aims at analysing the response of a variable to shocks or innovations from system variables. If two variables are correlated over time and there is a stable relationship between them, it is expected that a shock in one variable spreads over the other variable. The ideal vector autoregressive econometric model is one that enables the researcher to trace out the effects of pure shocks of the variables, but this is impossible as the variance/covariance matrix (Π) is unknow. The solution to this problem is for researchers/econometricians to impose additional restrictions on the vector autoregressive model to identify the impulse responses and imposing the recursive ordering or Cholesky decomposition is one of the recommended restrictions (Ender, 2015). The Cholesky composition requires that one variable does not have a contemporaneous effect on the other variable and hence the ordering of the variables is very important when conducting an impulse response. The impulse or innovation takes the size of two standard deviations (±2 s.d.) of each variable and the results are presented in figure 7 (Appendix B).

From the impulse response results in figure 7, we note that a shock in a specific variable has a positive impact on itself through the entire period that is ten quarters although the effects are statistically insignificant, and this relationship is represented by the graphs on the diagonal in figure 7.

The first row of graphs represents the response of GDP to shocks in GDP, inflation (CPI), government expenditure, money supply and nominal exchange rates. Individual shocks in inflation (CPI), government spending, money supply and nominal exchange rate receive no significant response in GDP in the first quarter. This result is expected since GDP of an economy is driven by many factors ranging from micro-economic factors like household income, spending, savings to macro-economic factors like the fiscal policy, Terms of Trade and sometimes non-economic factors like the location of the country for example Uganda is a landlocked country; impact of a shock in one variable can only be realized in a long term if the shocks persist otherwise may be insignificant.

A shock in Uganda's inflation (CPI) receives oscillating positive response in GDP through the second to sixth quarter, in the seventh quarter the response dies out (becomes zero) and in the eighth to tenth quarter a negative response in GDP is registered but still significantly close to zero. This contradicts the IS-MP-PC theory that predicts a negative short run impact of inflation on economic growth but agrees with the Keynesian school of thought that proposes a positive impact of inflation on economic growth. The positive response of GDP to a shock in inflation can be attributed to the inflation targeting policy which focuses on neutralizing the negative impact inflation by keeping inflation within a specified bound and regulating its volatility. Empirical studies have showed that inflation volatility is more detrimental to economic growth than inflation in absolute form (Nabbosa, 2017; Kumo, 2015).

Uganda's GDP responds negatively to a shock in the government expenditure; the relationship is variant throughout the ten quarters; the response tends towards zero in the fifth and stabilizes close to zero in the tenth quarter. This contradicts the IS-curve predicted positive impact of government expenditure on GDP. There are two possible explanations of this impulse response; the first could be that the government of Uganda is investing is long term projects like infrastructure developments whose impact may be realised a decade from today. The second interpretation could be Uganda's government expenditure that is directed to sectors, good or services that have less or on impact on economic growth for instance in Uganda's financial budget 2017/8 presented on 22 May 2017, 12% of the total budget that is 725.6 billion Uganda shillings was to pay interest on the external debt (Nabbosa, 2017). The government of Uganda has also been criticized for holding very a large legislative body. The tenth Parliament (2016-present) consists of 426 members and each is paid approximately $8,715 that is taxed, however they have additional allowance which are tax free that amount to $ 5,714 that include subsistence allowance of Shs 4.5m, town running allowance (Shs 1m), gratuity (Shs 1m), medical allowance (Shs 500,000), committee sitting allowance (Shs 50,000), plenary sitting allowance (150,000), as well as a mileage allowance from Parliament to the furthest point of an individual MP's constituency (The Observer, 2016).

Shocks in money supply and nominal exchange rate results in variant response in GDP, the relationship oscillates between positive and negative and remains positive in the tenth quarter. There is no sign of GDP returning to equilibrium when the Ugandan's economy faces shocks in money supply and/or nominal exchange rate. The explanation for this is that money growth has no trend but depends on the aggregate demand for money.

The second row in figure 7 represents the response of inflation (CPI) to shocks in GDP, inflation (CPI), government expenditure, money supply and nominal exchange rates. In the first quarter, individual shocks in GDP, government expenditure, money supply and nominal exchange rate receive no response from inflation which implies a lagged impulse response. However, on the other hand a shock inflation (CPI) receives an instant positive response to inflation (CPI). A shock in GDP results into a negative response from inflation in the second quarter throughout the seventh quarter when the response tends to zero and positive but significantly close to zero in the eighth to the tenth quarter. A shock in the government expenditure receives a positive response from inflation in the second throughout the sixth quarter and negative in the seventh to the tenth quarter. Inflation in Uganda responds negatively to a shock in money supply from the second quarter to the sixth quarter and from the seventh to tenth quarter a positive response is realized with no sign of returning to long run equilibrium. There is no significant response of inflation to a shock in nominal exchange rates in from the first to the sixth quarter and in seventh quarter is realized with no sign of returning to equilibrium. Shocks in inflation, money supply and nominal exchange rate lead to disequilibrium and may require government intervention to restore equilibrium in the economy.

The third row in figure 7 represents the response of government expenditure to shocks in GDP, inflation (CPI), government expenditure, money supply and nominal exchange rates. In the first quarter, government expenditure does not respond to shocks on inflation, money supply and nominal exchange rates. Government expenditure responds negatively to a shock in economic growth (GDP) from the first to fourth quarter. In the fifth quarter the response becomes positive throughout the tenth quarter when it stops responding. The economic interpretation is clear as the government spends as much as the economy can produce, a reduction in output (GDP) reduces government expenditure in the short run. In the long run the government adjusts its budget to fit in its available resources hence a positive relationship and returning to equilibrium. Government expenditure responds negatively to a shock in inflation (CPI) from the first to the tenth quarter, however throughout the eighth to the tenth quarter the response stabilizes but does not become zero. A shock in government expenditure gives a positive but declining response in the actual government expenditure, the response approaches zero in the eight quarter but slowly increase in the ninth and tenth quarters. Government expenditure positively responds to a shock in money supply from the second to the ninth quarter and zero in the tenth quarter. Government expenditure responds negatively to a shock in nominal exchange rate from the second to the tenth quarter without any sign of returning to equilibrium.

The fourth row in figure 7 represents the response of money supply to shocks in GDP, inflation (CPI), government expenditure, money supply and nominal exchange rates. Money supply responds positively to individual shocks in economic growth (GDP), money supply and nominal exchange with no return to equilibrium. Money supply responds negatively to a shock in government expenditure with no return to equilibrium. This implies that the Ugandan government must intervene to restore equilibrium in the economy in case of shocks results from GDP, M2, government expenditure and nominal exchange rates to money supply. There is no significant response in money supply resulting from a shock in inflation (CPI). This is not surprising because the Bank of Uganda abandoned money targeting for inflation targeting in 2012 with the Central Bank Rate (CBR) as the monetary policy tool as opposed to M2.

The fifth row in figure 7 represents the response of nominal exchange rate to shocks in GDP, inflation (CPI), government expenditure, money supply and nominal exchange rates. In the first quarter, nominal exchange rate does not respond to individual shocks in inflation (CPI) and government expenditure. Nominal exchange rate responds negatively to individual shocks in economic growth (GDP) and inflation (CPI) and this tends to zero in the tenth quarter hence returning to equilibrium. A positive response in nominal exchange rate is observed in response to shocks in government expenditure and nominal exchange rate. However, it should be noted that in the tenth quarter, response to government expenditure shocks tends to zero hence returning to equilibrium while response to nominal exchange rate stabilizes but different from zero hence no return to equilibrium.

3.7 DIAGONSTIC TESTS

To examine the effectiveness or validity of the empirical model, the residuals of the VECM (3) model have also been tested for normality, autocorrelation and heteroskedasticity the results have been presented in table 7.

Table7: Model Validity test

	Normality test		Serial Correlation LM test		Heteroskedasticity test	
Equation	J.B stat	Prob	R-squared	Prob. Chi-square	R-squared	Prob. Chi-square
1: $\Delta \ln GDP_{1t}$	21.99740	0.0000	5.587217	0.0612	29.06757	0.0864
2: $\Delta \ln CPI_{2t}$	0.611605	0.7365	0.464486	0.7928	25.36861	0.1877
3: $\Delta \ln Govt_{3t}$	408.9744	0.0000	2.172526	0.3375	22.31398	0.3237
4: $\Delta \ln M2_{4t}$	5.672227	0.0587	4.034042	0.1331	23.04729	0.2865
5: $\Delta \ln Ex_{5t}$	3.211782	0.1909	3.666756	0.1599	20.11131	0.4510

Each equation in the VECM model is estimated independently using OLS and the residues are tested for normality using the histogram normality test. The normality test is constructed on the null hypothesis; residuals are normally distributed against the alternative hypothesis; residuals are not normally distributed. The residuals in equations 1 and 2 that is the GDP and government expenditure equations, the null hypothesis is rejected at 5% meaning that the residuals in these equations are not normally distributed. The residuals in equations 2, 4 and 5 that is inflation, money supply and nominal exchange rate equations respectively are normally distributed as the null hypothesis can be rejected at 5% in all the respective equations.

The Breusch-Godfrey LM test is performed to check for serial correlation in residuals of each of the five VECM equations. The test is based on the null hypothesis; there is no serial correlation against the alternative hypothesis; there is serial correlation. The results in table 7 show that the residuals in all the five VECM equations are not serially correlated as the null hypothesis cannot be rejected at 5%

The Breusch-Pagan-Godfrey test is performed to check for heteroskedasticity in the residuals of each of the five VECM equations. First the respective equations are estimated using OLS using the EViews package and an inbuilt in function of the Breusch-Pagan-Godfrey test is used to check for heteroskedasticity. The test is based on the null hypothesis; “no heteroskedasticity” against the alternative hypothesis; “heteroskedasticity exists”. The results in table 7 show that there is no heteroskedasticity in the residuals of the individual VECM equations as the null cannot be rejected at 5%.

The residuals of the individual VECM equation are represented graphically in figure 5 below

Figure 5: Residuals

In addition to the validity diagnostic tests, a recursive CUSUM test is performed on all the five equations in the VECM model to confirm stability of the model and the results are graphically presented in figure 6 (Appendix B). The results prove that the VECM (3) model is dynamically stable since all the CUSUM test show that all the equations are stable at 5% significance level.

CHAPTER 4: CONCLUSIONS

In this paper, the short and long run impact of inflation targeting on economic growth in Uganda is analyzed considering the key drivers of growth in the economy (inflation, government expenditure, money supply M and nominal exchange rate). In Nabbosa (2017) it was established that Inflation Targeting Lite regime in Uganda has helped to reduce the inflation rate (currently at 5.6 %) and inflation volatility hence achieving price stability in Uganda. However, it should be noted that although price stability is a key goal for a monetary policy framework, it is not the final goal. The final goal of a monetary policy is to transform the price stability into economic growth and sustainable development and this forms the basis for this study. The study investigates if the price stability portrayed in Nabbosa (2017) has had any impact on Uganda's economic growth.

The VECM model is used to analyze the impact of inflation targeting; the model was specifically selected for its ability to establish long and short run correlation that exist in macroeconomic variables. In a theoretical perspective, inflation and monetary policy may impact the economy differently in the long and short run; based on this theoretical framework, this paper focus on establishing an empirical analysis.

The empirical results presented in chapter 3.6 show that in the long run government expenditure and money supply have positively impacted economic growth while inflation and nominal exchange rates have impacted economic growth negatively in Uganda. The results also so that economic growth, inflation and nominal exchange rates return to long run equilibrium incase of any shocks in the economy. It should be noted that economic growth (GDP) returns to long run equilibrium faster than inflation (CPI) and nominal exchange rates (Ex) as it has the highest value for the speed of adjustment parameter in absolute terms; $\emptyset_1 = -0.158414$. The results show that nominal exchange rates return faster to long run equilibrium than inflation (CPI) as seen from the error correction coefficients in absolute terms. However, on the other hand government expenditure and money supply do not return to long run equilibrium in case of disturbances in the economy. This implies that the authorities in Uganda must closely monitor and regulate government expenditure and money supply to ensure long run stability.

In the short run, inflation has positively impacted economic growth in Uganda while government spending is detrimental, although the effects are statistically insignificant in this case. The empirical results show that economic growth (GDP) in Uganda returns to short run equilibrium in case shocks in inflation (CPI), government expenditure, nominal exchange rates and/or money supply (M2). This implies that in the short run, state intervention due to a disequilibrium in economic growth is unnecessary or may be detrimental. It is further noted that inflation does not return to a short run equilibrium if shocks to money supply are experienced. This implies that the authorities in Uganda must intervene to control money supply and ensure short run equilibrium in inflation (CPI).

From this study, it can be concluded that inflation targeting has led to economic growth in Uganda by neutralizing the negative impact inflation has on economic growth and positive impact that money supply has on inflation rates. It is noticed that in the long run money supply increases GDP by 1.22% while inflation reduces GDP by 0.7% hence having a 0.52% joint impact on economic growth. This is attributed to the fact that Bank of Uganda chose the short-term inter-bank rate (7-day) with a targeted Central Bank Rate (CBR) as the monetary policy anchor instead of money growth which means that money supply has no direct impact in the

Monetary policy framework. This change has helped to keep the inflation rates, inflation volatility and the CBR relatively low.

The CBR has been gradually declining since the implementation of ILT in Uganda, in 2011 Uganda registered a CBR as high as 23% and currently at 9% (the lowest ever) (figure 9; Appendix C). The reduced CBR have resulted into increased Private sector lending (figure: 10, Appendix C). With increased private sector lending Uganda is promised an increase in private sector investment and higher economic growth with continued implementation ITL monetary policy framework. The correlation between CBR and economic growth is drawn from Keynesian theory as discussed in chapter 2 of this paper.

Although the findings in this paper show a positive impact of ITL on economic growth in Uganda, it should be noted that the economic growth rate in Uganda is still relatively low (currently at 1.1%) and very volatile as presented in figure 11 (Appendix c). This implies that macroeconomic stability through stabilized prices was a problem in the early 1990s and 2011 but currently it is not in Uganda. For Uganda to achieve higher economic growth rates a mixed economic policy can be adopted that is a Monetary-fiscal policy framework may be implemented coupled with some structural adjustments in governance and economic planning.

Fiscal policy and monetary policy in Uganda are implemented independently instead of complements to each other as suggested in the mixed policy framework. In Uganda, the Uganda Revenue Authority (URA) is responsible for collecting revenue mainly through taxation and fines for the government. On the other hand, the Ministry of Finance and Economic Planning is responsible for allocating, reallocating and spending of the government resources or revenue. The two bodies implement Uganda's Fiscal policy and yet they are independent of each other; this is possessing a major problem in the economy. The monetary policy is implemented by the central bank (Bank of Uganda) which is also an independent government body. For Uganda to implement a mixed economic policy and promote economic growth, activities of Bank of Uganda, URA and the Ministry of Finance and Economic Planning must be coordinated and complementary to each other rather than substitutes.

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APPENDIX A:

TABLE 5: VECM (3) SYSTEM COEFFICIENTS

VECM Equation 1: $\Delta \mathrm{lnGDP}_{1t}$				
variables	coefficient	Std. Error	t-value	p-value
$\emptyset_1$	-0.158414	0.085643	-1.849688	0.0688*
$\Delta \mathrm{lnGDP}_{1t-1}$	-0.436097	0.133536	-3.265751	0.0017***
$\Delta \mathrm{lnGDP}_{1t-2}$	-0.469531	0.127383	-3.685978	0.0005***
$\Delta \mathrm{lnGDP}_{1t-3}$	-0.374172	0.125356	-2.984876	0.0040***
$\Delta \mathrm{lnCPI}_{1t-1}$	0.801230	0.446911	1.792819	0.0776*
$\Delta \mathrm{lnCPI}_{1t-2}$	-0.404122	0.494323	-0.817527	0.4166
$\Delta \mathrm{lnCPI}_{1t-3}$	0.969255	0.471018	2.057790	0.0436**
$\Delta \mathrm{lnGovt}_{1t-1}$	-0.174011	0.122910	-1.415753	0.1615
$\Delta \mathrm{lnGovt}_{1t-2}$	-0.431534	0.120704	-3.575151	0.0007***
$\Delta \mathrm{lnGovt}_{1t-3}$	-0.147855	0.125303	-1.179978	0.2422
$\Delta \mathrm{lnM2}_{1t-1}$	0.074472	0.253977	0.293223	0.7703
$\Delta \mathrm{lnM2t}_{1t-2}$	0.376003	0.267519	1.405520	0.1646
$\Delta \mathrm{lnM2t}_{1t-3}$	-0.015813	0.263756	-0.059953	0.9524
$\Delta \mathrm{lnEx}_{1t-1}$	-0.329618	0.301497	-1.093270	0.2782
$\Delta \mathrm{lnEx}_{1t-2}$	0.134222	0.296012	0.453436	0.6517
$\Delta \mathrm{lnEx}_{1t-3}$	-0.013571	0.305087	-0.044482	0.9647
μ_{1t}	0.019492	0.020038	0.972750	0.3342
VECM Equation 2: $\Delta \mathrm{lnCPI}_{2t}$				
$\emptyset_2$	-0.058483	0.021540	-2.715116	0.0084***
$\Delta \mathrm{lnGDP}_{2t-1}$	0.075869	0.033585	2.59000	0.0272**
$\Delta \mathrm{lnGDP}_{2t-2}$	0.013906	0.032037	0.434049	0.6657
$\Delta \mathrm{lnGDP}_{2t-3}$	0.116880	0.031528	3.707217	0.0004***
$\Delta \mathrm{lnCPI}_{2t-1}$	0.240766	0.112400	2.142038	0.0359**
$\Delta \mathrm{lnCPI}_{2t-2}$	0.104985	0.124325	0.844442	0.4015
$\Delta \mathrm{lnCPI}_{2t-3}$	-0.212535	0.118463	-1.794103	0.0774*
$\Delta \mathrm{lnGovt}_{2t-1}$	0.027646	0.030913	0.894342	0.3744
$\Delta \mathrm{lnGovt}_{2t-2}$	0.013884	0.030358	0.457348	0.6489
$\Delta \mathrm{lnGovt}_{2t-3}$	0.024491	0.031514	0.777126	0.4399
$\Delta \mathrm{lnM2}_{2t-1}$	-0.130128	0.063877	-2.037175	0.0456**
$\Delta \mathrm{lnM2}_{2t-2}$	-0.103705	0.067282	-1.541333	0.1280
$\Delta \mathrm{lnM2}_{2t-3}$	-0.086922	0.066336	-1.310325	0.1946
$\Delta \mathrm{lnEx}_{2t-1}$	0.032886	0.075828	0.433685	0.6659
$\Delta \mathrm{lnEx}_{2t-2}$	-0.097391	0.074448	-1.308166	0.1954
$\Delta \mathrm{lnEx}_{2t-3}$	0.061008	0.076731	0.795091	0.4294
μ_{2t}	0.016195	0.005040	3.213531	0.0020***
VECM Equation 3: $\Delta \mathrm{lnGovt}_{3t}$				
$\emptyset_3$	0.103479	0.079024	1.309455	0.1949
$\Delta \mathrm{lnGDP}_{3t-1}$	-0.164757	0.123216	-1.337141	0.1858
$\Delta \mathrm{lnGDP}_{3t-2}$	-0.184533	0.117538	-1.569985	0.1212
$\Delta \mathrm{lnGDP}_{3t-3}$	-0.141075	0.115667	-1.219659	0.2269
$\Delta \mathrm{lnCPI}_{3t-1}$	-0.306569	0.412371	-0.743432	0.4599
$\Delta \mathrm{lnCPI}_{3t-2}$	-0.200352	0.456118	-0.439252	0.6619
$\Delta \mathrm{lnCPI}_{3t-3}$	-0.767816	0.434614	-1.766662	0.0819*
$\Delta \mathrm{lnGovt}_{3t-1}$	-0.129634	0.113411	-1.143048	0.2571

$\Delta\ln Govt_{3t-2}$	-0.154153	0.111375	-1.384091	0.1710
$\Delta\ln Govt_{3t-3}$	-0.122442	0.115619	-1.059016	0.2935
$\Delta\ln M2_{3t-1}$	0.514404	0.235348	2.195041	0.0317**
$\Delta\ln M2_{3t-2}$	0.268527	0.246843	1.087844	0.2806
$\Delta\ln M2_{3t-3}$	0.615361	0.243371	2.528491	0.0139**
$\Delta\ln EX_{3t-1}$	0.620347	0.278196	2.229897	0.0292**
$\Delta\ln EX_{3t-2}$	-0.268267	0.273134	-0.982180	0.3296
$\Delta\ln EX_{3t-3}$	0.717322	0.281508	2.548144	0.0132**
μ_{3t}	0.002474	0.018489	0.133825	0.8939
VECM Equation 4: $\Delta\ln M2_{4t}$				
$\emptyset_4$	0.055663	0.064335	0.0865209	0.3901
$\Delta\ln GDP_{4t-1}$	-0.065934	0.100311	-0.657291	0.5133
$\Delta\ln GDP_{4t-2}$	0.003529	0.095689	0.036882	0.9707
$\Delta\ln GDP_{4t-3}$	0.069217	0.094166	0.735048	0.4649
$\Delta\ln CPI_{4t-1}$	-0.090904	0.335716	-0.270776	0.7874
$\Delta\ln CPI_{4t-2}$	0.058087	0.371331	0.156430	0.8762
$\Delta\ln CPI_{4t-3}$	0.173951	0.353824	0.491631	0.6246
$\Delta\ln Govt_{4t-1}$	-0.013252	0.092329	-0.143531	0.8762
$\Delta\ln Govt_{4t-2}$	-0.178984	0.090672	-1.973978	0.0526*
$\Delta\ln Govt_{4t-3}$	0.095616	0.094127	1.015824	0.3134
$\Delta\ln M2_{4t-1}$	0.190606	0.190785	0.999062	0.3214
$\Delta\ln M2_{4t-2}$	0.371226	0.200958	1.847283	0.0692*
$\Delta\ln M2_{4t-3}$	0.105866	0.198131	0.534322	0.5949
$\Delta\ln Ex_{4t-1}$	0.086393	0.226482	0.381458	0.7041
$\Delta\ln Ex_{4t-2}$	0.304059	0.222361	1.367411	0.1761
$\Delta\ln Ex_{4t-3}$	0.201840	0.229179	0.880711	0.3817
μ_{4t}	0.000462	0.015052	0.030663	0.9756
VECM Equation 5: $\Delta\ln Ex_{5t}$				
$\emptyset_5$	-0.081075	0.047343	-1.712526	0.0915*
$\Delta\ln GPD_{5t-1}$	0.120527	0.073817	1.632774	0.1073
$\Delta\ln GDP_{5t-2}$	0.120527	0.070416	-0.639324	0.5248
$\Delta\ln GDP_{5t-3}$	0.034475	0.069295	0.497512	0.6205
$\Delta\ln CPI_{5t-1}$	-0.478605	0.247074	-1.937306	0.0570*
$\Delta\ln CPI_{5t-2}$	0.032291	0.273255	0.118172	0.9063
$\Delta\ln CPI_{5t-3}$	-0.111366	0.260372	-0.427719	0.6702
$\Delta\ln Govt_{5t-1}$	0.029917	0.067943	0.440322	0.6611
$\Delta\ln Govt_{5t-2}$	0.168692	0.066723	2.528231	0.0139**
$\Delta\ln Govt_{5t-3}$	-0.160249	0.069266	-2.313536	0.0238**
$\Delta\ln M2_{5t-1}$	-0.107077	0.140395	-0.762680	0.4484
$\Delta\ln M2_{5t-2}$	-0.298807	0.147881	-2.020594	0.0474**
$\Delta\ln M2_{5t-3}$	0.140194	0.145801	0.961548	0.3398
$\Delta\ln Ex_{5t-1}$	0.221880	0.166664	1.331300	0.1877
$\Delta\ln Ex_{5t-2}$	-0.410917	0.163631	-2.511237	0.0145**
$\Delta\ln Ex_{5t-3}$	0.102316	0.168648	0.612022	0.5426
μ_{5t}	0.022771	0.011077	2.055803	0.0438**

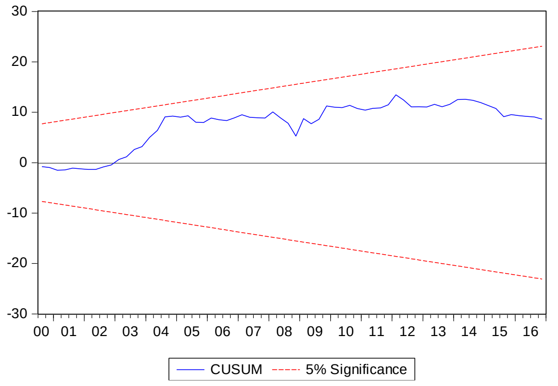
***, **, * represents statistical significance at 1%,5% or 10% respectively, ∅-error correction term, μ-trend

TABLE 6: WALD COEFFICIENT TEST:

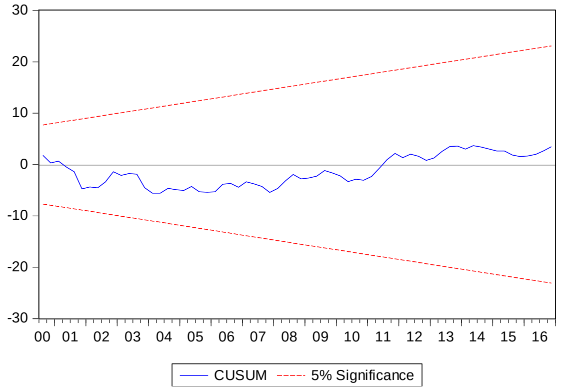
Test statistic	Value	Probability
VECM Equation 1: ΔlnGDP_{1t}		
H_0:$\Delta\text{lnGDP}_{1t-1}$=$\Delta\text{lnGDP}_{1t-2}$=$\Delta\text{lnGDP}_{2t-3}$= 0		
Test statistic	Value	Probability
F-statistic	7.066659	0.0003^{***}
Chi-square	21.19998	0.0001^{***}
H_0:$\Delta\text{lnCPI}_{1t-1}$=$\Delta\text{lnCPI}_{1t-2}$=$\Delta\text{lnCPI}_{1t-3}$=0		
Test statistic	Value	Probability
F-statistic	2.822845	0.0455^{**}
Chi-square	8.468535	0.0373^{**}
H_0:$\Delta\text{lnGovt}_{1t-1}$=$\Delta\text{lnGovt}_{1t-2}$=$\Delta\text{lnGovt}_{1t-3}$=0		
Test statistic	Value	Probability
F-statistic	4.654220	0.0052^{***}
Chi-square	13.96266	0.0030^{***}
H_0:ΔlnM2_{1t-1}=ΔlnM2_{1t-2}=ΔlnM2_{1t-3}=0		
Test statistic	Value	Probability
F-statistic	0.706232	0.5517
Chi-square	2.118696	0.5481
H_0:ΔlnEx_{1t-1}=ΔlnEx_{1t-2}=$\Delta lnEx_{1t-3}$=0		
Test statistic	Value	Probability
F-statistic	0.466553	0.7066
Chi-square	1.399658	0.7056
VECM Equation 2: ΔlnCPI_{2t}		
H_0:$\Delta\text{lnGDP}_{2t-1}$=$\Delta\text{lnGDP}_{2t-2}$= $\Delta\text{lnGDP}_{2t-2}$ =0		
Test statistic	Value	Probability
F-statistic	5.019287	0.0034^{***}
Chi-square	15.05786	0.0018^{***}
H_0:$\Delta\text{lnCPI}_{2t-1}$=$\Delta\text{lnCPI}_{2t-2}$=$\Delta\text{lnCPI}_{2t-3}$=0		
Test statistic	Value	Probability
F-statistic	2.758459	0.0491^{**}
Chi-square	8.275378	0.0407^{**}
H_0:$\Delta\text{lnGovt}_{2t-1}$=$\Delta\text{lnGovt}_{2t-2}$=$\Delta\text{lnGovt}_{2t-3}$=0		
Test statistic	Value	Probability
F-statistic	7.06659	0.0003^{***}
Chi-square	21.1998	0.0001^{***}
H_0:ΔlnM2_{2t-1}=ΔlnM2_{2t-2}=ΔlnM2_{2t-3}=0		
Test statistic	Value	Probability
F-statistic	0.443625	0.7226
Chi-square	1.330876	0.7218
H_0:ΔlnEx_{2t-1}=ΔlnEx_{2t-2}=$\Delta lnEx_{2t-3}$=0		
Test statistic	Value	Probability
F-statistic	2.348949	0.0805^{*}
Chi-square	7.046847	0.0704^{*}

Null hypothesis that estimated coefficient is equal to zero can be rejected at 1% level (*), at 5% level (**) or at 10% level (***).

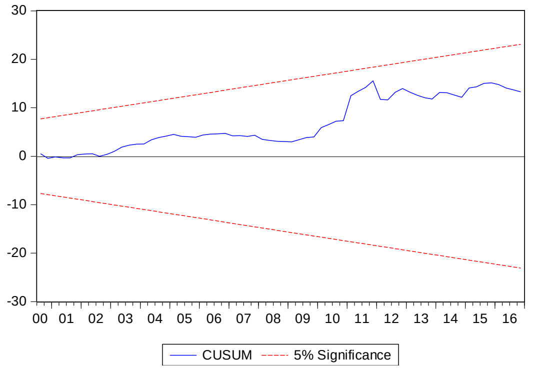
APPENDIX B: STABILITY DIAGONISTICS



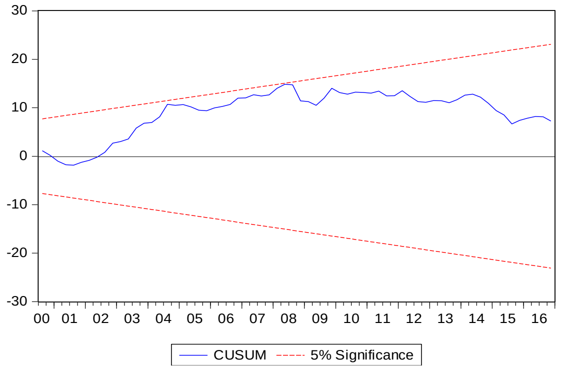
EQUATION 1: D(LNGDP)



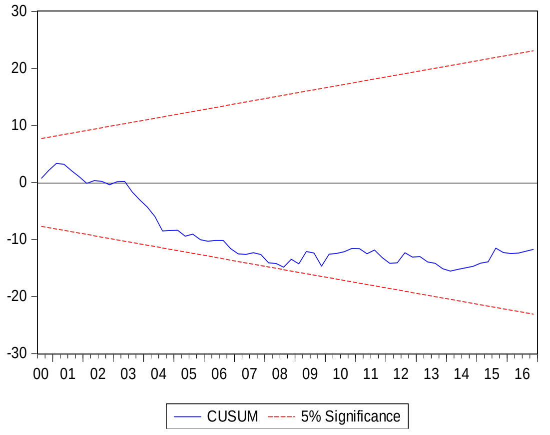
EQUATION 2: D(LNCPI)



EQUATION 3: D(LNGOVT)



EQUATION 4: D(LNM2)



EQUATION 5: D(LNEX)

Figure 6: CUSUM test

TABLE 8: GRANGER CAUSALITY TEST

Equation	Excluded	Chi-square	df	Prob
D(LNGDP)	D(LNCPI)	8.468535	3	0.0373**
	D(LNGOVT)	13.96266	3	0.0030***
	D(LNM2)	2.118696	3	0.5481
	D(LNEX)	1.399658	3	0.7056
	ALL	36.19389	12	0.0003***
D(LNCPI)	D(LNGDP)	15.05786	3	0.0018
	D(LNGOVT)	1.330876	3	0.7218
	D(LNM2)	7.046847	3	0.0704*
	D(LNEX)	2.162149	3	0.5394
	ALL	24.17820	12	0.0192**
D(LNGOVT)	D(LNGDP)	3.692933	3	0.2966
	D(LNCPI)	5.810720	3	0.1212
	D(LNM2)	10.50767	3	0.0147**
	D(LNEX)	9.342845	3	0.0251**
	ALL	28.82072	12	0.0042***
D(LNM2)	D(LNGDP)	1.560038	3	0.6685
	D(LNCPI)	0.350863	3	0.9502
	D(LNGOVT)	5.715668	3	0.1263
	D(LNEX)	3.001126	3	0.3915
	ALL	10.44330	12	0.5771
D(LNEX)	D(LNGDP)	4.003283	3	0.2611
	D(LNCPI)	4.642763	3	0.1999
	D(LNGOVT)	14.08398	3	0.0028***
	D(LNM2)	6.382579	3	0.0944*
	ALL	29.58203	12	0.0032***

***, **, * represents statistical significance at 1%,5% or 10% respectively

IMPULSE RESPONSE

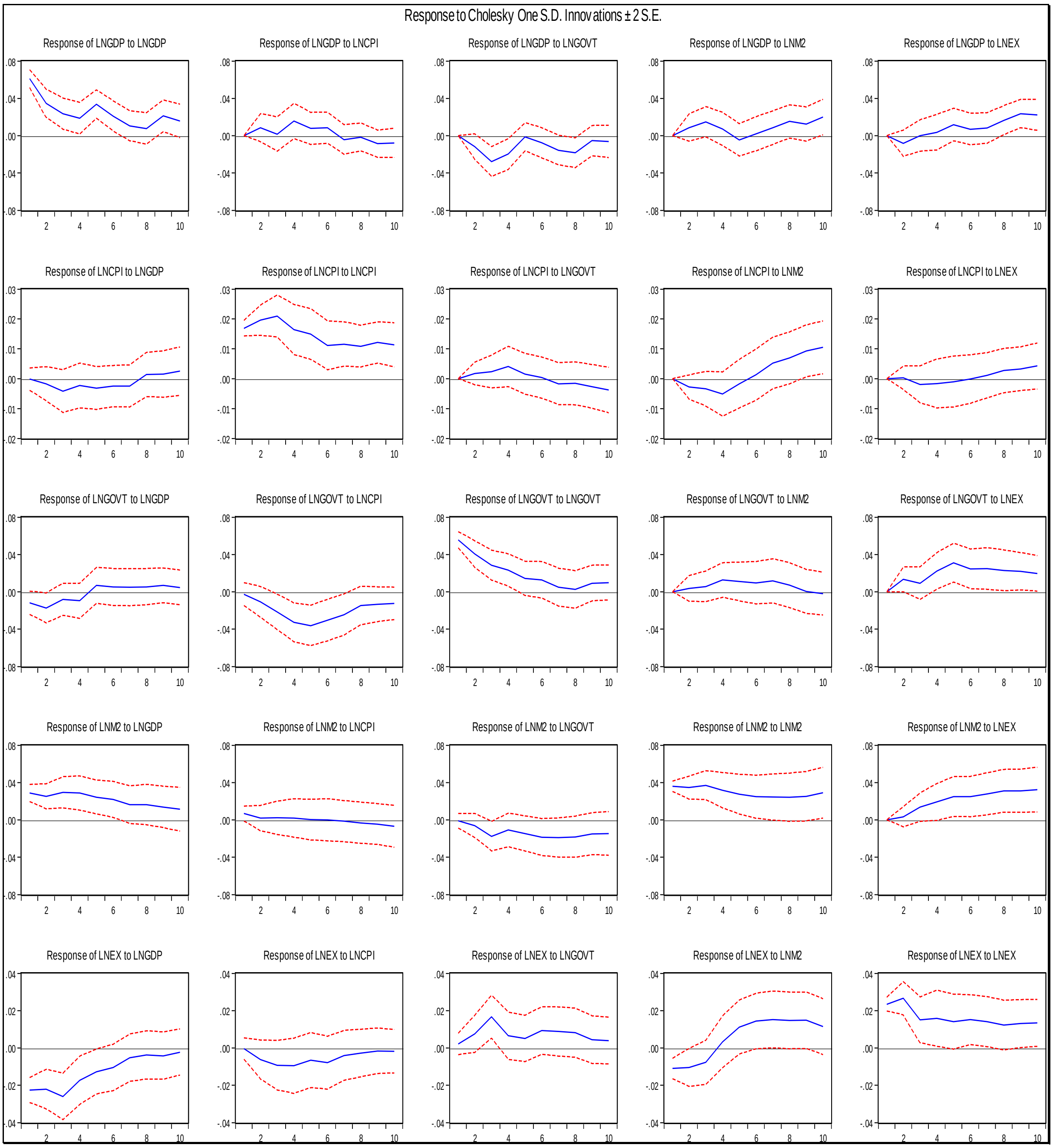


Figure 7: Impulse Response.

APPENDIX C:

Figure 8: Uganda's Core inflation rate Source: Tradingeconomics.com/ Uganda bureau of Statistics

Figure 9: Trend of Uganda's CBR Source: Trading Economics.com /Bank of Uganda (BOU)

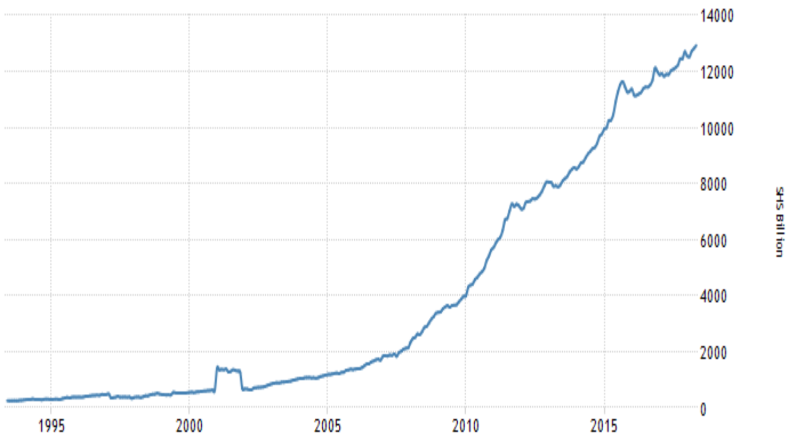


Figure 10: Loans to Private Sector Source: Tradingeconomics.com/ Bank of Uganda.

Figure 11: Uganda's GDP growth rate Source: Tradingeconomics.com/ Uganda bureau of Statistics

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August 19, 2018

Olivia Nabbosa