EVALUATION OF THE ECONOMIC RELATIONSHIP BETWEEN INFLATION AND ITS DETERMINANTS IN RWANDA

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Abstract:

This study aimed to estimate the inflation determinants in the Rwandan economy from 1980 to 2018 periods, focusing more on the hypothesized drivers such as dollar exchange rate, interest rates, broad money supply and real national income (GDP). The study used quantitative analysis using an econometric model called Ordinary Least Squares (OLS). The findings of this study show that there is a long-run relationship between inflation and its hypothesized drivers mainly growth in GDP (positive), the Exchange rate (negative), Broad money supply growth (positive) and Interest rate (negative).

JEL: E31, D51, P24

Keywords: inflation; exchange rate; interest rate; money supply; Rwanda

1. Introduction

The monetary policy process is when a country's monetary authority controls the money supply, often as a target to ease interest rate or inflation to ensure price stability in currency (Talukder, 2018). Further objectives of monetary policy are generally to contribute to stability and economic growth, to predict exchange rates to other currencies and to contribute to economic growth (ibid). Monetary economics provides insight into how to craft optimal monetary policy. Monetary policy is referred to as being contractionary or expansionary, which means a contractionary policy expands the money supply more slowly than usual. On the other hand, an expansionary policy increases the total supply of money in the economy more rapidly than usual, and contractionary policy intends to slow inflation by avoiding the resulting deterioration and distortion of asset values (Bekhet et al., 2012). Expansionary policy is used traditionally to combat

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unemployment in a recession through lowering interest rates with the aim that cheaper credit will entice businesses expansion (Gravelle et al., 2012; Bekhet et al., 2012).

Monetary policy differs from fiscal policy, which refers to taxation, government spending, and associated borrowing (Bernanke, 2006:32). In economics, inflation is known as a sustained augmentation in the general price level of services and goods in an economy over a while (Bagus et al., 2014). When the general price level increases, every unit of currency buys fewer goods and services. Then, inflation reflects a lowering in the purchasing power per unit of money, a loss of real value in the medium of exchange and unit of account within an economy. Measurement of price inflation is the inflation rate, the annual rate percentage change in a general price index (normally the consumer price index) over time. Deflation is the opposite of inflation. Inflation affects an economy in several ways, which can be positive and negative (Bagus et al. 2014). The part where negative effects of inflation may include an augmentation in the opportunity cost of holding money, discredit over future inflation that may discourage savings and investments, and whether inflation was rapid enough, absence of goods as consumers begin hoarding out concerns of the increase to the price in the future, Bagus, et al. (2014). And the part of positive effects includes the guarantee that central banks can adjust real interest rates and supporting investment in non-monetary capital projects (Ropp, 2010).

Generally, economists note that hyperinflation and high rates of inflation are produced by the excessive growth of the money supply (Talukder, 2018). Yet, Inflation is not necessarily caused by the growth of the money supply. Moderate or low inflation can be assigned to fluctuations in real demand for services and goods, or changes in disposable supplies such as over scarcities (Tobin, 2008). However, money supply growing faster than the rate of economic growth causes a long-sustained period of inflation which is the consensus view (Bernholz, 2003). Today, more economists favor a steady and low rate of inflation, low (as opposed to zero or negative) the severity of economic recessions are reduced by inflation by enabling the labor market to adjust more quickly in a downturn, and reduces the risk that monetary policy is prevented by a liquidity trap from stabilizing the economy (Tobin, 2008). Generally, the central banks that control monetary policy by settings interest rates, settings of banking reserve requirements and by open market operations are monetary authorities (Kin, 2010:11).

Rwanda can create sustained prosperity, by focusing on cross-cutting issues that support all industries and specific high priority sectorial issues. Trade either national or international has been known to be a major contributor to the development and economic growth. Exports are made up of primary agricultural products while imports are composed of food, capital goods, intermediary goods, and energy and lubricants, it's the difference between exports and imports that constitute Rwanda's trade balance. A country's balance of trade is said to be positive (favorable) when the income earned from its exports exceeds its incurred expenditure on imports, and negative (unfavorable) when the reverse is the case (Longatte and Vanhove, 2010:98).

Rwanda's is to boost up the productive capacity through monetary policy activities friendship climate for inflation control as a key to accelerated productive

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capacity. Considering this, this study aims to show the determinants of inflation in Rwanda.

2. Money Supply

In economics, the total amount of monetary assets disposable in an economy at a specific time is called money supply or money stock (Talukder, 2018). There are various ways to define "money," but standard measures generally include currency in circulation and demand deposits (depositors' easily accessed assets on the books of financial institutions). Generally, the government or the central bank of the country has to record and publish the money supply data. Because of the effects on the price level, inflation, the exchange rate, and the business cycle, private and public sector analysts have long monitored changes in the money supply (Lipsey & Smith, 2010).

The relation between money and prices is historically associated with the quantity theory of money (Talukder, 2018). There is large empirical evidence of a direct relation between long-term price inflation and money-supply growth at least for rapid augmentation in the amount of money in the economy (ibid). For example, a country such as Venezuela which experienced extremely rapid increases in its money supply also experienced extremely rapid increases in prices which is called hyperinflation. This is one reason for the reliance on monetary policy as a means of controlling inflation.

3. Inflation Rate

In economics, a sustained increase in the general price level of goods and services in an economy over some time is inflation. When the general price level increases, each unit of currency buys fewer goods and services. Consequently, a reduction in the purchasing power per unit of money a loss of real value in the medium of exchange and unit of account within the economy is reflected by inflation. The inflation rate is the chief measure of price inflation, the annualized percentage change in a general price index (normally the consumer price index) over time.

Deflation is the opposite of inflation. Inflation affects an economy in different ways, both negative and positive. Negative effects of inflation contain an increase in the opportunity cost of holding money, uncertainty over future inflation which can discourage savings and investment, and if inflation were fast enough, less of goods as consumers begin hoarding out of concern that prices will increase in the future. Positive effects understand ensuring that central banks can adjust real interest rates and encouraging investment in non-monetary capital projects (Kiley, 2008:89).

4. Exchange Rate

In finance, the rate at which one currency will be exchanged for another is called an exchange rate (also known as a foreign-exchange rate or forex rate) (James, 2004). It is

also regarded as the value of one country's currency in terms of another currency. The current exchange rate is referred to as the spot exchange rate. An exchange rate that is quoted and traded today for delivery and payment on a specific future date is referred to as the forward exchange rate. In the retail money exchange market, a different buying and selling rate will be quoted by money dealers. Most trades are to or from the local currency (Steven et al., 2003).

The rate at which money dealers will buy foreign currency is the buying rate and the rate at which they will sell the currency the selling rate. The quoted rates will incorporate an allowance for a dealer's profit in trading, or else the margin may be recovered in the form of a "commission" or in another way.

5. Interest Rate

The rate at which interest is paid by borrowers (debtors) for the use of money that they borrow from lenders (creditors) is called an interest rate. Specific, a percentage of principal paid a certain number of times per period for all periods during the total term of the loan or credit is an interest rate (Pierre, 2014). Interest rates are normally expressed as a percentage of the principal for a period of one year; sometimes they are expressed for different periods like for a monthly or a daily. Different interest rates exist parallelly for the same or comparable periods, depends on the residual term, the default probability of the borrower, the payback currency, and many more determinants of a loan or credit (Willem, 2008:109).

6. Gross Domestic Product (GDP)

The Rwandan GDP has been through more challenges than other countries due to Rwanda's history. Rwanda's economy suffered heavily during the 1994 Genocide, with widespread loss of life, failure to maintain the infrastructure, looting, and neglect of important cash crops. This caused a large drop in GDP and destroyed the country's ability to attract private and external investment. The economy has since strengthened, with per-capita GDP (PPP) estimated at $2,225 in 2018, compared with $416 in 1994. Rwanda is a country of few natural resources, and the economy is based mostly on subsistence agriculture by local farmers using simple tools.

7. Literature Review

This section gives us a review of impact studies about economic relationships between inflation and its determinants. These relationships and mechanisms have been explained through different empirical studies (Talukder, 2018). Monetary policy, to a great extent, is the management of expectations. Monetary policy residues on the relationship between the rates of interest in an economy, that is, the price at which money can be borrowed, and the total supply of money. Monetary policy involves a diversity of tools to control

one or both of these, to influence outcomes like economic growth, inflation, exchange rates with other currencies and unemployment. Where money is under a monopoly of issuance, or where there is a controlled system of issuing money by banks that are tied to a central bank, the one which can influence the interest rate (to achieve policy goals) and alter the money supply is the monetary authority. The beginning of monetary policy as such comes from the late 19th century, where it was used to maintain the gold standard (Takaendesa, 2004: 90).

Rwandan's macroeconomy has been characterized by inflation problem 1973 (Rutayisire, 2013). Inflation has been mainly driven by different factors including supply distresses caused by climate change, production collapse and distribution system caused by the Genocide of 1994. Demand shocks replicated the impact of monetary policy. Also, external factors have been made in place resulting from the shock in international oil prices between 1973 and 1974, as well as 1979 and 1980 (Rutayisire, 2013). Yet, the national bank of Rwanda has implemented different monetary policies (broad and reserve money) in maintaining price stability (low rate of inflation). According to Ananias and Valence (2012) in a recent study on determinants of inflation, Rwanda has considered economic growth, money supply, international oil price and exchange rates as the main inflation determinants but these are not the only macroeconomic indicators to determine inflation in the economy.

Rwandan inflation as indicated by existing studies such as Ananias and Valence (2012). originated from four major factors comprising of demand-side factors, supply-side factors, monetary factors, and external factors. The demand-side factors, as the government increases spending on services and goods, the level of the price will rise too. This source of inflation is called demand-pull inflation. The other factor that influences inflation is the population size. When a country has huge populations, the goods and services demand increase beyond the country's production capacity. As a result, the inflation rate rises (Shammari and Sabaey, 2012). But existing studies indicate that the population size determines inflation in developed countries instead of in developing countries. The supply-side inflation comes through the supply's ineffective of certain commodities and an increase of the oil price which raises the prices of certain food items (Ahmed et al, 2013, as cited in Ruzima, Martin and Veerachamy, 2015).

On the other way, inflation emerged from external factors such as exchange rates. Domestic currency's (which is the Rwandan franc) depreciation to the main currency (US dollar), push to the increase in money spent on buying goods and services through the foreign market. Then, the acceleration of the inflation rate happens. This particular sort of inflation is known as import inflation (Ananias and Valence, 2012; Shammari and Sabaey, 2012), furthermore, the inflation is triggered by monetary factors via money supply and interest rates. Though, the direct relationship between inflation and money supply can be stressed by the quantity theory of money. High inflation in the economy may be caused by an increase in the money supply. On the other way, the interest rates have an inverse relationship with inflation. Therefore, the cost of borrowing is lowed by the decline in the interest rate.

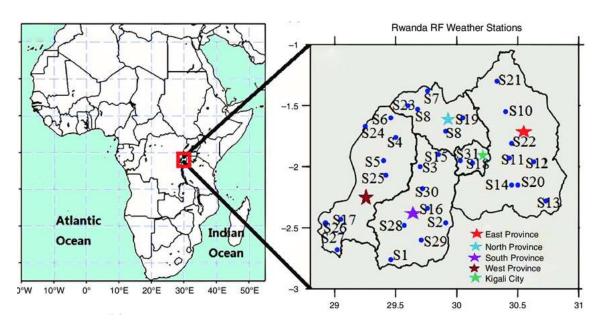## 8. Methodology

8.1 Study Area

Figure 3.1: Location of Rwanda
(Source:)

Rwanda is bordered by Uganda, Tanzania, Burundi, and the Democratic Republic of the Congo. It is in the African Great Lakes region and is highly elevated; its geography is dominated by mountains in the west and savanna to the east, with numerous lakes throughout the country. The climate is temperate to subtropical, with two rainy seasons and two dry seasons each year. Rwanda has a population of over 12.6 million (UN, 2019) living on 26,338 sq. km of land, and therefore it is the most densely populated mainland African country.

8.2 Conceptual Framework

A conceptual framework is an analytical tool with several variations and contexts. It is used to make conceptual distinctions and organize ideas. This part of the conceptual framework shows and presents the aim and literature of variables which can be two or more than two variables. According to our study research, we present two main variables which are Money Supply (M_3) and Inflation.

Table 3.1: Conceptual Framework

Dependent Variable	Independent Variable (Moderator Variables)
Inflation	Exchange Rate
	Real Income
	Interest Rate

8.3 Empirical Methodology

The study used quantitative analysis using an econometric model called Ordinary Least Squares (OLS) on time series data during the period 1980-2018. This method allows us to analyze econometrical variables such as Inflation rate (dependent variable), and independent variables such as Money Supply (M3), Exchange rate and Interest rate. These variables are measurable and allow us to present data in figure forms (descriptive analysis). The application of mathematical and statistical theories to economics is for testing hypotheses and forecasting future trends. Econometrics takes economic models and tests them through statistical trials, the results are then shown and interpreted or explained. The study employed annual data over the period 1980-2018. This particular study is based on secondary data which are obtained from the electronic database of Index Mundi, World Development Indicators (WDI) and the national bank of Rwanda statistics as well.

8.4 Model Specification

Initially, the supply function is modeled in the following form:

$$LINFL_t = \beta_0 + \beta_1 * LMS_t + \beta_2 * LINTR_t + \beta_3 * LEXCH_t + \beta_4 * LGDP_t + \mu_t$$

Where,
LINFL: Logarithm of Inflation Rates;
LMS: Logarithm of Money Supply;
LINTR: Logarithm of Interest Rates;
LEXCH: Logarithm of Exchange Rates;
LGDP: Logarithm of Gross domestic product;
B$_1$, β_2, β_3, and β_4 are parameters of the model;
B$_0$ is constant or intercept;
μ_t is standing for the error term.

Based on the theories, the expected sign of variables in the model are the following:

Table 1: Variables and expected sign

Variables: I	Description	Expected sign
NFL;	Gross domestic product	Positive
M3;	Money supply	Negative or Positive
Inter;	Interest rates	Negative
EXCH;	Nominal exchange rate	Negative
GDP.	Gross domestic product	Positive

Log RGDP, is expected to be negative, Log Exch, is expected to be positive or negative accordingly, Log M3 is expected to be positive, Log Inter is expected to be positive.

The data which will be used to estimate the inflation function in Rwanda are annual observations over the period of 1980 to 2018, on money supply M3, real GDP,

exchange rate, and Interest rates. These four series were obtained from the National bank of Rwanda (NBR) data.

9. Results and Discussion

9.1 Test of Data
To measure all economic relationships between variables, we used time-series data which requires the econometric tests. After demonstrating our expected signs, the following econometric results will allow us to make decisions.

9.2 Expected Signs
$\text{ß}_1 > 0$: this means that the explanatory variable LMS_t is positively related to RINFL.

$\text{ß}_2 > 0$: this means that the explanatory variable $LINTR_t$ is positively related to RINFL.

$\text{ß}_3 > 0$: this means that the explanatory variable $LEXCH_t$ is positively related to real Inflation Rates (total supply).

$\text{ß}_4 > 0$: this means that the explanatory variable $LGDP_t$ is positively related to RINFL.

9.3 Stationary Test
The stationary test is done to indicate whether the data is stationary series and non-stationary series. When the series is stationary, we use Ordinary Least Square (OLS) as a methodology.

Table 4.1 Table OLS Results

Variable	Coefficient (ß$_x$)	Std. Error	t-Statistic	Prob.
LMS	0.263138	0.337341	0.780037	0.0445
LINTR	-0.655737	0.670023	-0.978678	0.0394
LEXCH	-0.681535	0.209188	3.258006	0.0399
LGDP	0.588419	0.529866	-1.110506	0.0210
R-squared	0.920417	Mean dependent var		1.940294
Adjusted R-squared	0.884723	S.D. dependent var		0.596976
S.E. of regression	0.571127	Akaike info criterion		1.868603
Sum squared resid	6.523731	Schwarz criterion		2.064945
Log-likelihood	18.42324	Hannan-Quinn criter.		1.920693
Durbin-Watson stat	1.622785			

The results show that in long run, the variables are explained by the probability of 0.0445 for Money Supply & probability of 0.0394 for Interest Rates, probability of 0.0399 for Exchange Rates and probability of 0.021 for Gross domestic product respectively. When Money Supply changes by 1%, Real INFL increases by 0.263% other things being constant (Ceteris Paribus). Reasoning about the probabilities, Real INFL is significantly explained by the Money Supply, because it is statistically significant at 1% level of confidence.

ß2= -0.655737. This means that in the long run Interest Rates are negatively related to the Rwandan Inflation indicator as expected. When Interest Rates increase by 1%, Real

INFL decreases by 0.655% other things being constant (Ceteris Paribus). Reasoning about the probabilities, in the long run, Interest Rates significantly explains Real INFL, because it is statistically significant at 5% level of confidence.

ß3= -0.681535: This means that in the long run Exchange Rates is negatively related to the Rwandan growth indicator as expected. When Exchange Rates change by 1%, Real INFL decreases by 0.6815% other things being constant (Ceteris Paribus). Reasoning about the probabilities, in the long run, Exchange Rates significantly explains Real INFL, because it is statistically significant at 5% level of confidence.

ß4= 0.588419: This means that in the long-run gross domestic product is positively related to the Rwandan Inflation indicator as it is explained by expectation. When gross domestic product changes by 1% in increase, Real INFL increases by 0.588% other things being constant (Ceteris Paribus). Reasoning about the probabilities, Real INFL is significantly explained by the gross domestic product, because it is statistically significant at 5% level of confidence. According to findings, the appreciation of domestic currency by 1% is associated with a 0.68% reduction in inflation. This explains how the depreciation of the currency does not highly affect inflation pressures, this small long-run impact while attracting foreign direct investment may encourage the central bank to continue liberalizing the exchange money market since it does not significantly cause big inflation, however, the Gross domestic product has expansionary impacts on inflation.

R^2 = 0.920417 and Adjusted R^2 = 0.884723, show us the goodness of fit of the estimated model. Up to 92.04% of long-run fluctuations in Real inflation rates are influenced by changes in Interest Rates, Exchange Rates, gross domestic product, and Money Supply.

10. Conclusions

The aim of this study aimed to estimate the inflation determinants in the Rwandan economy during the period 1980 to 2018 period, focusing more on its hypothesized drivers such as dollar exchange rate, interest rates, broad money supply and real national income (GDP). The empirical findings of the present study show that there is a long-run relationship between inflation and its hypothesized drivers mainly growth in GDP (positive), an Exchange rate (negative), Broad money supply growth (positive) and Interest rate (negative). The study results help to check the stability of inflation functions that could serve as a guide to policymakers in stabilizing the Rwandan economy. As a recommendation, the study points out that policymakers should push for calculated investment in the agricultural sector, especially in rural areas not so much as to increase inflation. Growth in GDP causes inflation, and inflation begets hyperinflation. Furthermore, the independent monetary policy authority is crucial, where the results point to the long-run effects of monetary aggregate on inflation. Hence, sound monetary and fiscal policies should strive for macroeconomic stability. Finally, policymakers have to be more firm in managing interest rates and exchange rates since they are the only inflation reducing variables.

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