

A Study on Determinants of Inflation in Rwanda from 1970-2013

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Abstract: *Keeping low inflation rate is regarded as a measure of macroeconomic stability, to deal with it; determinants of inflation have to be well managed. This paper investigates the influence of government spending, import of goods and services, population growth, agriculture output and foreign direct investment on inflation. Time series data for the period of 1970-2013 have been used. The ordinary least squares (OLS) method was employed to estimate the regression model. We find that agriculture output and import of goods and services are the main drivers of inflation in Rwanda. Population growth is statistically significant and negative correlated with inflation. Therefore, government spending and foreign direct investment have an insignificant negative and positive impact on inflation respectively. Policy implications of the findings have been discussed.*

Keywords: Inflation, Foreign Direct Investment, Agriculture, Rwanda, OLS

Introduction

Inflation can be defined as an expansion in the quantity of money in circulation (Haberler, 1960) or defined as persistent decreases of the money value (Makinen, 2003). Consequently, inflation lowers the purchasing power of the people as they need more money to purchase one unit of good or service. Hence, people spend huge amount of money for consumption. Saving and investment decline as result: resulting in higher unemployment and lower economic growth.

However, to overcome the hindrance of inflation in economy, most of central banks in developed and developing countries have the core objective to keep inflation at minimum rate for achieving and maintaining high economic growth. In the same way, National Bank of Rwanda (N.B.R) aims to keep price stability towards sustainable economic development. Considering this, to achieve price stability (low inflation rate) N.B.R monetary policy works under flexible monetary targeting with two tools, i.e, reserve money used to increase or decrease liquidity in the banking system and Broad money (M3) used to manage the money supply with targeted inflation and economic growth.

Inflation makes investment doubtful for both domestic and foreign investors. Also, it destroys the terms of trade in the country by increasing the price of domestic goods more than the regional and the world market price. As a result, trade becomes non-competitive to the global market (Ananias and Valence, 2012). Accordingly, the non-competitive of trade leads to the deficit in the current account.

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Statement of the problem

In Rwandan economy, the macroeconomy has been characterized with the problem of inflation since 1973 (Rutayisire, 2013). Inflation has been mainly driven by various factors including supply distresses due to the climate change, collapse in production and distribution system because of the war during the period of 1990 to 1994 and the Genocide of 1994. Demand shocks replicated the impact of monetary and fiscal policies. Also, the external factors have taken place resulting from the shock in international oil prices between 1973 and 1974, as well as 1979 and 1980 (Rutayisire, 2013). However, National Bank of Rwanda has implemented various monetary policies (reserve money and broad money) to maintain price stability (low rate of inflation). The recent study on determinants of inflation in Rwanda (Ananias and Valence, 2012) considered money supply, economic growth, international oil price and exchange rates as main determinants of inflation but they are not the only macroeconomic indicators to determine inflation in the economy. There are other variables which may influence inflation rate in Rwanda. This study focuses on the following factors: population growth, agriculture, government expenditure, foreign direct investment and import of goods and services.

Objectives of the study

1. To study inflation trends in Rwanda;
2. To investigate the main determinants of Inflation in Rwanda;
3. To make policy suggestion on the basis of findings.

Hypotheses

1. Government expenditure has a significant influence on inflation;
2. Population growth has a significant influence on inflation;
3. Import of goods and services has a significant influence on inflation;
4. Foreign direct investment has a significant influence on inflation;
5. Agriculture has a significant influence on inflation.

Overview on inflation determinants

The main reasons for inflation in Rwanda have been found based on the previous studies done by Ananias and Valence (2012) and other researchers. These studies proved that inflation is originated from four major factors comprising of demand side factors, monetary factors, supply side factors and external factors. The demand side factors, as government increases spending for goods and services, price level also will rise. This source of inflation is called demand pull inflation. Population size also has an influence on inflation. If country has enormous populations, demand for goods and services increase beyond production capacity of the country. As result, the inflation rate rises (Shammari and Sabaey, 2012). But they proved that the number of populations determines inflation in developed countries rather than in developing countries.

The supply side inflation occurs through the ineffective supply of certain commodities and an increase of the oil price which raises the prices of certain food items (Ahmed et al, 2013). In an economy, oil (petrol, gasoline and diesel) are used as input in the production process. Therefore, an increase in oil price leads to a persistent rise in cost of production of goods and services. This type of inflation is called cost push inflation (Shammari and Sabaey, 2012). The increase in oil price for the land locked country as in the case of Rwanda leads to a huge increase in the price of the particular items (including foods) due to the high cost of transport. This kind of inflation is known as imported inflation. In addition, the food inflation in Rwanda is caused by

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agriculture harvest, rainfall dependence; this inflation is so-called local inflation (Ananias and Valence, 2012).

On the other hand, inflation emerged from external factors such as exchange rates. Depreciation of domestic currency (Franc for Rwanda) to main currency (US dollar), lead to increase in money spends for buying goods and services from foreign market. Then, the inflation rate is accelerated. This particular sort of inflation is known as import inflation (Ananias and Valence, 2012; Shammari and Sabaey, 2012).

Moreover, the inflation can be sourced from monetary factors via money supply and interest rates. Though, the quantity theory of money stressed the direct relationship between money supply and inflation. Increase in money supply leads to high inflation in economy. On the other side, the interest rates have an inverse relationship with inflation. Therefore, decline in interest rate lower the cost of borrowing. Accordingly, the borrowing increases and high inflation will cause (Shammari and Sabaey, 2012).

Trends in inflation

The period covered by this study, Rwanda has faced a period of high inflation due to the domestic economy system, non economic factors influence and external factors, in that period, GDP also was diminished. The high fluctuation has been observed in the war period 1990-1994. After the genocide of 1994 because of depopulation and destruction of infrastructures, the maximum inflation has been recorded at 48.24 percent in the year of 1995. External factors, due to the first chock of world oil price 1973-1974, inflation was 31 percent , the following year 1975 inflation was 30 percent. The second shock of world oil price during 1979 and 1980, the inflation rate was 15.24 and 7.67 percent respectively. Another huge increase in inflation rate has been recorded in 2008 due to the world economic crisis; in that period inflation reached 15.4 percent.

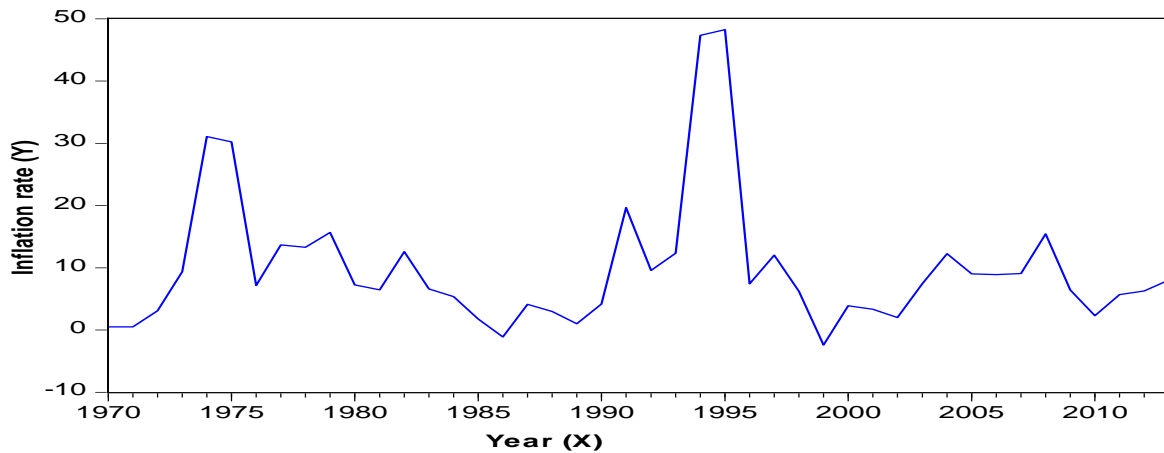
Table1: Time series of inflation rate

Year	CPI	Year	CPI	Year	CPI	Year	CPI
1970	0.514	1981	6.45	1992	9.56	2003	7.449
1971	0.488	1982	12.565	1993	12.354	2004	12.25
1972	3.092	1983	6.593	1994	47.35	2005	9.014
1973	9.373	1984	5.369	1995	48.25	2006	8.882
1974	31.088	1985	1.759	1996	7.411	2007	9.08
1975	30.226	1986	-1.117	1997	12.015	2008	15.444
1976	7.165	1987	4.133	1998	6.21	2009	6.417
1977	13.655	1988	2.978	1999	-2.405	2010	2.309
1978	13.27	1989	1.01	2000	3.899	2011	5.67
1979	15.673	1990	4.185	2001	3.3428	2012	6.27
1980	7.249	1991	19.637	2002	1.992	2013	8.039

Source: World Bank (WDI 2015 report) and IMF database (WEO 2015)

Notes: CPI (Consumer Price Index)

Figure1: Inflation trends from 1970-2013
CPI



The figure 1 shows the fluctuation of inflation under the period of the study as explained above.

Theoretical Reviews

Inflation is a debatable topic among economists. For this reason, many theories related to it were developed. However, the subject remaining controversial because theorists and schools of economics have found different sources and causes of inflation based on the assumptions and observations on macroeconomic indicators. Following theoretical review attempts to revise the different theories in order to explain inflation phenomenon. These theories to be reviewed include: Monetarism theory of inflation, Demand-pull inflation theory and cost-push inflation theory.

Monetarism theory of inflation

According to Friedman (1970), inflation is a monetary phenomenon across countries and time periods. Quantity theory of money says that inflation is generated if the quantity of money supply increases more than growth rate of output. Consequently, as in monetarist view, controlling money supply is the appropriate means of solving inflationary problem. Thus, lower money supply is needed to maintain stable prices. However, controlling inflation also has the effect of increasing unemployment rate in the economy, and this is a dilemma for policymakers (Snowdon and Vane, 2005).

Demand-pull inflation theory

This theory argues that an increase in demand for goods and services beyond production capacity of the economy, inflation will arise. Therefore, output rises and firms increase their prices to raise their profit. This happens because of such factors as currency depreciation and expansion in money supply. For that reason, borrowing from bank will be more for building new firms. Also, inflation is sourced from fiscal policy, reduction in taxes either direct or indirect. Likewise, disposable income increases and consumers will raise demand for goods and services (Tutor2u, 2009).

Cost-push inflation theory

According to this theory, inflation occurs when the cost of factors of production for goods and services increase. These factors of production include price of raw material and wages. The cost-

push inflation is characterized by rising price level, decrease in output. And employment rate is increased more than natural rate (Salvatore and Diulio, 2003).

Empirical review

In this section, there are many empirically research concerned to the determinants of inflation. However, the empirical results differ from the countries depend on selected indicators for the period time of the study. Still, most of the studies are based on the source of inflation such as money supply, exchange rate, government spending, fiscal deficit, population growth, Oil price and interest rate....etc. Therefore, this empirical part will help to select appropriate indicators to assess the sources of inflation in Rwanda.

In Tanzania, Laryea and Sumaila (2001) employed Error Correction Model (ECM) to examine the short run and long run determinants of inflation. The study used quarterly data covering the period 1992:1 to 1998:4. The empirical result shows that in the short run inflation is influenced by money supply and economic growth. In the long run inflation is determined by exchange rate. While inflation in Tanzania is a monetary phenomenon for both short run and long run. The authors have recommended government to use both monetary and fiscal policies to control inflation in Tanzania.

Khan et al (2007) applied Ordinary Least Squares (OLS) method on time series data for the period 1972-73 to 2005-06, to identify the major determinants of inflation in Pakistan. They found that the adaptive expectations, private sector credit and rising import prices were the key determinants of inflation. While fiscal policies have less effect to inflation in Pakistan.

DaCosta and Greenidge (2008) empirically investigated the determinants of inflations in Caribbean countries (Jamaica, Guyana, Barbados and Trinidad and Tobago) over the period of 1970-2006 using time series data. Authors have selected the following variables: inflation rate, oil prices, world prices, real national income, interest rates, unemployment rate, money supply and exchange rates. They also, employed dynamic OLS to capture the main drivers of inflations. The results revealed that the inflation in Caribbean is determined by both cost-push and demand-pull.

In order to investigate the determinants of inflation in Sri Lanka, Bandara (2011) used vector autoregressive (VAR) and Granger Causality test for the annual data series for the period of 1993–2008. The result from estimated VAR shows that money supply, exchange rate and the gross domestic (GDP) product also determine the inflation behaviour in Sri Lanka.

Ananias and Valence (2012) studied the determinants of inflation in Rwanda. They used quarterly data covering the period of January 2004 to June 2010. The following variables have been used in this study, inflation, economic growth, exchange rate and international oil price. The authors have employed Cointegration and vector error correction model. They found that in long run economic growth affect inflation negatively. Also, results show that money supply, exchange rate and international oil price were the main determinants of inflation in Rwanda for the period of the study.

Moreover, Aurangzeb and Haq (2012) investigated the determinants of inflation in Pakistan by the use of annual data for the period of 1981-2010. They employed multiple linear regressions. Inflation was dependent variable while exchange rate, unemployment, interest rate, fiscal deficit and gross domestic production were independent variables. They found that the gross domestic product also impacts inflation negatively. However, other variables (i.e., exchange rate, unemployment, interest rate and fiscal deficit) had a positive effect on inflation.

They suggested that government should control spending and reduce borrowings in order to control inflation in Pakistan.

The empirical investigation on the sources of inflation for selected sample of countries in the world has conducted by Shammari and Sabaey (2012). They employed panel regression model with a random effects to estimate the data set for fifty nine countries (59). The yearly data for the period of 1970 to 2007 was used. Their study was based on four foremost factors (demand side factor, supply side factor, monetary factor and external factor) in order to investigate the effects of selected indicators (government spending, money supply growth, nominal effective exchange rate, interest rate, population and world price oil) on inflation. They found that, for developed countries, the major sources of inflation comprise government spending, money supply growth, nominal effective exchange rate, interest rate, population and world price oil. For developing countries, the determinants of inflation are government spending, nominal effective exchange rates and world price oil. They concluded that the inflation is not a monetary phenomenon for developing countries and the effective fiscal policy can control inflation. In contrast, for developed countries the inflation is monetary phenomenon and stronger monetary policy is needed to control domestic inflation.

By applying Johansen co-integration and Error correction Model (ECM) on annual data from 1971 to 2012, Ahmed et al. (2013) examined long run and short run dynamics of inflation in Pakistan. The results illustrated that gross domestic product (GDP), imports; money supply (M2), current government spending, energy crises and output gap contribute positively to inflation in case of Pakistan. Also, the findings show that the export does not have an impact on inflation. The conclusion was both demand side and supply side inflation persisted in Pakistan within the period.

Another study conducted in Ghana by Enu and Havi (2014) examined the determinants of inflation by employing the co-integration analysis. The study investigated whether or not population growth, foreign direct investment (FDI), agricultural and service's output have a potential influence on the inflation for the study period of (1964 – 2008). They found that all selected indicators (population growth, foreign direct investment (FDI), agricultural and service's output) are key determinants of inflation in long run for the Ghanaian economy.

In the Ghanaian economy, empirical study carried out by Oppong et al (2015) investigated the key determinants of inflation. The study used monthly data from 2000:1 to 2014:12. OLS model was used to test if the selected indicators (Crude Oil Price, Exchange Rate and Electioneering Spillover Quaternary Effects (ESQE)) affect inflation rate. They found that all the variables have a positive relationship with inflation and statistically significant at 1% level. The findings also indicated that the Crude Oil Price, Exchange Rate and Electioneering Spillover Quaternary Effects (ESQE) explain more than 95% variation of inflation in Ghana. They concluded that all 3 indicators are main determinants of inflation in Ghana.

The empirical studies reviewed above have presented different results. The difference in findings depend on country's economy, period of the study, methods employed, factors considered and indicators used in the study. In this particular study for determinants of inflation in Rwanda, different factors include demand factors, monetary factors, supply side factors and external factors have considered. In addition, the study investigates the influence of population growth, agriculture, government expenditure, foreign direct investment and import of goods and services in determining inflation in Rwanda.

Methodology

Model Specification

The study focuses on demand side factors, supply factors and external factors to determine the key determinants of inflation for Rwandan economy. Many indicators have been considered in the existing study by Ananias and Valence (2012) like money supply, economic growth, international oil price and exchange rates. Though, this particular study attempts to determine if government spending, import of goods and services, population growth, agriculture and foreign direct investment cause inflation in Rwanda.

For achieving the objectives of the study, the following function model is used:
 $\pi = f(AGC, IGS, POP, FDI, GS) \dots \dots \dots (1)$

However, the above model can be written as:
 $\pi_t = \alpha + \beta_1IGS_t + \beta_2GS_t + \beta_3AGC_t + \beta_4FDI_t + \beta_5POP_t + \varepsilon_t \dots \dots \dots (2)$

Finally the model can be expressed as:
 $\pi_t = \alpha + \beta_1LnIGS_t + \beta_2LnGS_t + \beta_3LnAGC_t + \beta_4LnFDI_t + \beta_5POP_t + \varepsilon_t \dots \dots \dots (3)$

Where π represents inflations, AGC is agriculture productions as % of GDP, IGSP is an import of goods and services as share GDP in %, POP is the population growth rates, FDI is the foreign direct investment as percentage of GDP, GS stands for government expenditure, α is an intercept, $\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 are the slope coefficients, t denotes time period and ε_t is an error term.

The variables are logged to help capture the elasticities. Thus, logging the variables makes it easy to interpret the results. However, not all the variable can be logged. For instance, when a variable has a negative value (-) like inflation and population growth rate in the above model, it is not proper to take the logarithm of such variables.

Table2: Expected sign of variables

Indicators	Expected signs
Government spending	+
Import of goods and services	-
Agriculture	-
Foreign direct investment	-/+
Population growth rates	+

Methods of estimations

The OLS methods (Ordinary Least Squares) is used to determine the influence of population growth, government expenditure, import of goods and services, agriculture and foreign direct investment on inflation in Rwanda. This particular method OLS is chosen among others because the estimator is BLUE (Best Linear Unbiased Estimator) (Gujarati, 2004). Eviews version seven Econometrics software is used to carry out statistical calculation in this study.

Sources of Data

To find out the most determinants of inflation in Rwanda, time series data for the period of 1970-2013 are used. This particular study is based on secondary data which are sourced from World Development Indicators (WDI) 2015 database reported by World Bank. Inflation data for 1994

and 1995 was taken from WEO (World Economic Outlook) 2015 database published by International Monetary Fund (IMF). This is because WDI did not have data.

Empirical analysis

Unit root tests

The time series data are stationary if their mean, variance and auto covariance are constant over period of time. Most of macroeconomic variables are not stationary. Regression analysis based on non stationary data leads to spurious results. Thus, in order to check the stationary, the unit root test is conducted (Gujarati, 2004).

The unit root test is conducted by using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test. Moreover, the ADF deals with serial correlation in the error terms by including the lagged difference of the dependent variable. While, Phillips-Perron uses the non-parametric statistical method to deal with the problem of serial correlation in the error terms (Gujarati, 2004). The unit root test in table 3 Shows that most of the variables were stationary at level except Agriculture (Ag) for ADF and PP test. Also foreign direct investment was not stationary with ADF test. Though, all variables become stationary after first difference test.

Table 3: Unit root test results

Variables	ADF Test	PP Test	ADF Test	PP Test
	Level		First Difference	
Ln INF	-3.738***	-3.738***	-	-
Ln POP	-3.237**	-2.607*	-	-
Ln AG	-2.274	-2.274	-7.543***	-7.565***
Ln IGS	-3.701***	-3.679***	-	-
Ln FDI	-2.425	-5.045***	-12.192***	-
Ln GEX	-4.041***	3.958**	-	-

Note: “***”, “**” and “*” designate 1, 5 and 10 percent level of significance and rejection of null hypothesis of unit root respectively.

Descriptive statistics

The table 4 presents the outlook of the data used in the study. The data are characterized by mean, minimum, maximum and standard deviation. All calculations are done by using Eviews7 statistical package.

Table 4: Descriptive statistics for variables used in the model

	CPI	AG	FDI	GEX	IGS	POP
Mean	9.912	3.715	-0.814	2.567	3.111	2.668
Minimum	-2.405	3.469	-8.927	2.166	2.598	-7.597
Maximum	48.249	4.120	0.804	2.997	4.171	10.258
Std. Dev.	10.813	0.190	1.584	0.191	0.265	3.401
Observations	44	44	44	44	44	44

Author's calculations (data from World Bank (WDI 2015 report) and IMF database (WEO, 2015))

Model Estimation

In order to find out the determinants of inflation in Rwanda, inflation and independent variables stated in equation 3 was estimated. The results are presented in table 5 below:

Table 5: OLS results

Variable	Coefficient	Standard Error	t-Statistic	Probabilities
lnAG	25.7914	10.1783	2.5339	0.0155***
lnFDI	0.2557	0.7634	0.3350	0.7395
lnGEX	-0.5567	10.5380	-0.0528	0.9581
lnIGS	19.8842	5.4255	3.6649	0.0008***
POP	-1.6161	0.2907	-5.5578	0.0000***
C	-141.8208	45.2414	-3.1347	0.0033
Regression model and Summary statistics				
R ²	0.5022	Adjusted R ²	0.4367	
F-statistic	7.6672	Prob(F-statistic)	0.000046	
Durbin-Watson stat	1.614040			
Fitted model: CPI = 25.79*lnAG + 0.25*lnFDI - 0.55*lnGEX + 19.88*lnIGS - 1.61*POP - 141.82				

Note: “***” designate 1 percent level of significance and rejection of null hypothesis respectively. Results are processed with the help of Eviews 7 package.

From the results presented in table 5, it is seen that the coefficient of the variables have signs which are differ from the expected one except the population growth. The results indicated that agriculture output, population growth and import of goods and services are statistically significant at 1% level and have an influence on inflation. Government expenditure and foreign direct investment are not statistically significant and their influences are few.

The summary statistics in table 5 shows that the coefficient of determinations, R² is greater than adjusted R², (R²=0.50>Adj.R²=0.43). Thus, it confirms the fitness of the model. Again, the value of Durbin-Watson statistical, d, test proves that the error terms are uncorrelated and is lesser than R², (R²=0.50<d=1.6140). This explains that the regression result is not spurious one. The F-Statistic test is used to verify the overall significance of the regression model. Its value is 7.6672 with the probability of 0.0000; this justifies the significance and consistence of our regression model. In addition, the results of OLS model show that 50% of the change in inflation rates is verified by the variables used in the model.

Discussion of result

The finding from OLS (table 5) shows that, the agriculture output coefficient is positive with 25.79 and statistically significant at 1% level of significance. It means that one percent increase in agriculture output will cause inflation to increase by 25.79. Though, the contribution of agriculture output to inflation in Rwanda is caused by the high cost of inputs production like (labour cost, oil price, seeds, and fertilizers). This finding on positive relationship between agriculture output and inflation differs from that found by Enu and Havi (2014). In addressing this problem, government can provide some form of subsidies to farmers in order to reduce cost of production and ultimately reduce the price of agricultural produce.

The import of goods and services affect inflation level positively. The coefficient of import of goods and services is 19.88 statistical significant at 1% level; this implies that 1 percent increase in import of goods and services lead to rise in inflation rate by 19.88 percent. Thus, this positive relationship shows that most of the import of goods and services in Rwanda

are consumer goods and luxury goods. As a consequence, income level and saving decline. Accordingly, domestic investment is turned down and the production level of goods and services also is reduced. The inflation is a supply side. This finding agrees to those found by (Lim and Papi, 1997; Olatunji et al., 2010; Bashir et al., 2011; Enu and Havi, 2014). Therefore, in order to control this kind of inflation government should increase production of necessary consumer goods such as food, sugar, clothing, vegetable oil, etc. to reduce imports. This can be achieved by providing incentives to manufacture industries.

Unexpectedly, the results revealed that the population growth affects inflation negatively. Its coefficient is -1.61 and is statistically significant at 1 percent level of confidence. Thus, one percent increase in population growth reduces inflation by 1.6 percent. It means that population growth in Rwanda has not contributed to inflation. The possible reasons are: Increase in population is not accompanied by increased income which could also reduce demand. Increase in population leads to increase in labour force which increases also supply side. In this case, supply side matches the demand side and it is possible to have a negative relationship. And another reason is that if there is high inequality, population growth may not cause inflation. Similar to the findings of Mosayed and Mohammad (2009), population growth is not a major determinant of inflation in developing countries. This result also deviates from Enu and Havi's(2014) findings.

Government expenditure is found not to be statistically significant in determining of inflation. However, it has important information and policy implications. Its coefficient shows that one percent increase in government expenditure decreases inflation rate by -0.55. It is not main determinant of inflation in Rwandan economy. Thus, the government spending flows into capital goods and infrastructure. As a result, production capacity increases and inflation may not occur. As the government spends in productive areas in the economy, inflation declines. Our findings deviate from (Mosayed and Mohammad, 2009; Ahmed et al., 2013; Olatunji et al., 2010; Nawaz et al., 2011) studies.

In this study, we find that foreign direct investment (FDI) has a positive effect on inflation but statistically insignificant. The reason is that, FDI brings more foreign currency to be converted into local currency. Accordingly, money supply rises to meet the exchange rate. As result, inflation will rise. Appropriate policy measures to channel FDI to productive sectors, such as manufacturing sector, of the economy will help address inflation problem.

Conclusion and policy suggestions

This study aims to examine the major macroeconomic determinants of inflation in Rwanda. Multiple linear regressions model was applied on time series data for the period of 1970-2013. The results from the study illustrates that the agriculture output and import of goods and services are strong drivers of inflation in Rwanda. Whereas population growth rate significantly has negative effects on inflation. Therefore, findings also proved that foreign direct investment impacts on inflation is insignificant but positive; and government spending insignificantly affects inflation negatively.

Along with the findings of estimated regression, the outcomes of this study could be used by policy makers in Rwanda to frame a suitable economy policy. Moreover, the study found that inflation is mainly accelerated by the supply side (high cost of inputs productions) and external factors (import of goods and services). In this regard, the results show that inflation in Rwanda is not a monetary phenomenon. Therefore, in Rwanda, inflation can be efficiently controlled by fiscal policy through government spending, improvement in term of trades (not to depend on imports) and lessening the production cost of agriculture sector.

Authors' Note

This manuscript is the authors' original work, has not been published and is not under consideration for publication elsewhere.

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