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Inflation and Economic Growth in Rwanda

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Abstract

The main objective of the study aimed to investigate the impact of inflation on the economic growth of Rwanda. The specific objectives of this research included analyzing the inflation trends in Rwanda from 1989 to 2021, examining the influence of inflation on Rwanda's economic growth, and assessing the effects of control variables such as imports and exchange rates on the country's economic growth. This study draws upon various economic theories and empirical studies that categorize these variables into dependent and independent variables. In this analysis, we considered inflation as the dependent variable, while imports and exchange rates served as independent variables. The data for this research were sourced from secondary data available on the World Bank's website. We employed econometric techniques, including unit root tests, which revealed that all variables exhibited an I (1) order of integration. This led us to conduct the Johansen cointegration test, which confirmed the existence of a long-term relationship between the dependent and independent variables. The long-term coefficients unveiled a negative association of 0.35 units between inflation and economic growth. Furthermore, a negative correlation was observed between economic growth and both imports and the exchange rate. Additionally, we conducted a block exogeneity Granger causality test, which identified a causal relationship from inflation to economic growth and an impact of inflation on the exchange rate. The post-estimation analysis indicated the absence of econometric issues, affirming the model's stability and reliability.

1. Introduction

Inflation is considered one of the key factors influencing a country's economic growth (Piger, 2004). The focus on controlling inflation should revolve around fostering economic growth to enhance the standard of living for the population. The correlation between inflation and economic development is a prominent subject of debate among economists, particularly in the context of Rwanda. Achieving macroeconomic stability and sustained economic growth in Rwanda necessitates a concerted effort towards price stability, despite the existing controversies. In economic terms, inflation is identified as a significant macroeconomic factor that can potentially lead to economic instability. It is influenced by various factors, including an increase in aggregate demand within the economy. Additionally, external pressures on prices or disruptions in the supply chain can cause inflation. Determining whether persisting inflation in countries under development like Rwanda is essential or avoidable, especially in the long-term, poses a challenge. Furthermore,

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discerning whether this inflation directly impacts household consumers and investors in their day-to-day economic activities, potentially affecting them in the process, is complex.

A study conducted by Mallik et al. (2001) asserts a positive long-term link between inflation and economic development. This research, which used four South Asian countries as case studies, spanned from 1988 to 2015. In contrast, W. Madurapperuma's investigation in 2016 regarding the correlation between inflation and economic development in Sri Lanka, employing the Johansen co-integration test and the error correction mechanism, revealed a significant long-term negative relation between inflation and economic development.

Understanding the link between inflation and economic growth holds particular significance for developing countries like Rwanda, which have witnessed escalating levels of inflation. This study aims to empirically examine whether a noteworthy correlation exists between Rwanda's inflation and economic growth, while also considering the influence of time on this relationship. The study's focus is solely on assessing the influence of inflation on the growth of the economy from 1989 to 2022.

1.1. Objective of the Study

The main objective of the study was to investigate the effects of inflation on economic growth of Rwanda.

This study goes after the following specifics objectives**:**

a) To analyze the trend of inflation in Rwanda.
b) To analyze the relationship between inflation and economic growth of Rwanda
c) To evaluate the effect of Imports and Exchange Rate on economic growth of Rwanda

1.2. Research hypothesis

A hypothesis is a tentative proportion which is subject verification through subsequent investigation. It is proposed of what the research that will reveal: the following hypotheses revealed in this research. Null hypothesis (H_0: $\beta_1+\beta_2+\ldots..\beta_n=0$) inflation have no significant effect on economic growth of Rwanda

Alternative hypothesis (H_1: $\beta_1+\beta_2+\ldots.\beta_n$= different from zero) inflation have significant effect on economic growth of Rwanda.

2. Literature review

The conceptual framework incorporates the dependent variables and independent variable. The dependent variable is economic growth; the independent variable includes inflation, exchange rate, import and gross capital formation. These variables are according to their behavior and effect on economic growth that have similarity with inflation. According to the theories, the empirical model of AbuDalu *et al.* (2014) investigated the relationship between inflation and economic growth among ASEAN founding members, finding a small trade-off in Singapore, South Korea, and Thailand post-Asian financial crisis. Erbaykal and Okuyan (2008) explored Turkey's inflation-economic growth dynamics, detecting a negative short-term relationship. Saaed (2007) found a strong inverse CPI-real GDP link in Kuwait. Mubarik & Riazuddin (2005) determined a threshold inflation rate of 9% detrimental to Pakistan's growth. Ahmed and Mortaza (2005) established a negative long-term inflation-economic growth link in Bangladesh. Sweidan (2004) observed a structural breakpoint effect on Jordan's inflation-economic growth correlation. Mallik and Chowdhury (2001) uncovered a positive but weaker impact of inflation on economic growth in

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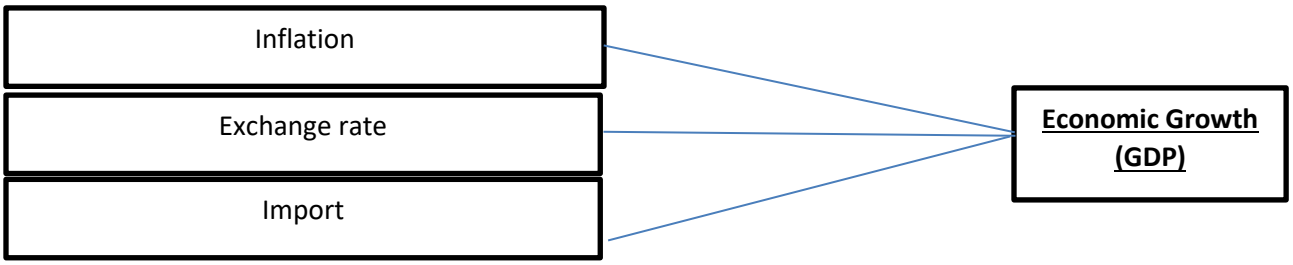
South Asia. These findings highlight the significant relationship between inflation and economic growth across various economies.

The following diagram illustrates conceptual framework of the study.

Independent variables……**Dependent variable**



Gap in literature we found that the majority of these authors used data that did not take into account the inflation effects on economic growth after reviewing several empirical works done on the inflation effects on economic growth in some countries around the world economies, these empirical works were done in Africa and other countries in the world economies.

In order to push the boundaries of knowledge in this particular direction, this study drew on data collected between the years 1989 and 2021 in Rwanda in order to provide an accurate portrait of the situations that currently exist in Rwanda. We adopted the estimation technique such are: Unit root test (ADF test), Cointegration test (Johansen cointegration test), Granger causality test (block exogeneity), Vector Error Correction Model (VECM), Post estimation techniques (Heteroskedasticity, Serial correlation and Normality test). This study will fill this gap by analyzing the effects of inflation on economic growth of Rwanda.

3. Research methodology

The research methodology is the procedure used to collect data for the purpose of making Research-based decisions. In this study it includes two subsections, the first contain the technique and the second addressed the methods of data analysis.

3.1. Research Design

The current study aimed at investigating the effects of inflation on economic growth of Rwanda; the study is oriented to a quantitative research design. This is because it analyses the time series data of 33 years from 1989- 2021. The process involves the econometrics estimation techniques using ordinary least squares. The researcher incorporates variables such as GDP, inflation, the official exchange rate, the imports of goods and services.

3.2 Study Population

The population of this study is a data on the inflation and economic growth rates in Rwanda. This research will cover 33 years from 1989 to 2021.

3.3.Model specification

3.3.1 Hypothesis testing

A hypothesis is a tentative proportion which is subject verification through subsequent investigation. It is proposed of what the research that will reveal: the following hypotheses

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revealed in this research. Null hypothesis (H_0: $\beta_1+\beta_2+\ldots..\beta_n=0$) inflation variables have no significant effect on economic growth in Rwanda.

Alternative hypothesis (H_1: $\beta_1+\beta_2+\ldots. \beta_n$= different from zero) inflation variables have significant effect on economic growth in Rwanda.

3.3.2 Functional relationship between variables

$GDP = (NF, EXCH, IMP,)$ (1)

The functional relationship is then transformed into a linear mathematical model below

$GDPt = \beta 0 + \beta 1INFt + \beta 3IMPt + \beta 2EXCHt + +\varepsilon t$ (2)

The equation (2) describes a linear relationship between the export of goods and services and independent variables. However, the data used may be skewed and not following a normal distribution. This requires a logarithmic transformation where natural logarithm is applied to the variables to normalize the data set. This way the data follows a log distribution and fit or the econometric analysis. Therefore equation (2) becomes

$\mathbf{log}GDPt = Q\mathbf{0} + Q\mathbf{1log}INFt + Q\mathbf{3log}IMPt + Q\mathbf{2log}EXCHt + s\mathbf{t}$ (3)

3.4. Post estimation techniques

This research has been used the post estimation test such as Unit root test (ADF test), Cointegration test (Johansen cointegration test), Granger causality test (block exogeneity), Vector Error Correction Model (VECM), Post estimation techniques (Heteroskedasticity, Serial correlation and Normality test)

3.5. Data source

Source of data includes data that are already collected and data to be collected during the study, which are primary data (the first-hand information collected by an investigator), and secondary data (the second-hand information obtained from already published information). This research adopted secondary data.

Churchill (1979) has asserted that the secondary data is the information that is available from the written documents consulted in order to obtain complete dependable information. In Data analysis part, the research uses secondary data that are provided by the World Bank.

4. Research findings

This chapter presents and discusses the results of the study. The Analysis the effect of inflation on economic growth of Rwanda, using inflation as the dependent variable and GDP as a measure of economic growth, was assessed in accordance with the research objectives.

4.1 Descriptive Statistics

The summary statistics of all variables used in this study is presented by using E views 7 individualsample descriptive statistic on GDP, inflation, exchange rate, imports, Gross capital formation allvariables were primarily converted into logarithmic (LOG) form.

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Table 1: Descriptive analysis of data

	GDP_CAP	INFLATION	EXCH	IMPORTS	GCF
Mean	6.024528	1.843010	6.028265	3.252075	2.846677
Median	5.857571	2.008174	6.304367	3.251203	2.749454
Maximum	6.726029	2.977424	6.896315	4.171198	3.268952
Minimum	4.843832	0.010226	4.383887	2.644013	2.300834
Std. Dev.	0.521721	0.714076	0.707752	0.281155	0.279274
Skewness	-0.090633	-0.715245	-0.983864	0.754070	0.061589
Kurtosis	1.856239	2.870126	2.907065	4.991638	1.660609
Jarque-Bera	1.843939	2.321068	5.335808	8.581523	2.487568
Probability	0.397735	0.313319	0.069398	0.013694	0.288291
Sum	198.8094	49.76126	198.9327	107.3185	93.94034
Sum Sq. Dev.	8.710166	13.25751	16.02920	2.529543	2.495815
Observations	33	27	33	33	33

Source: researcher's eviews estimation

4.1.1 Descriptions

The mean measures the average value of the series, the median is the middle value (or average of the two-middle value) of the series when they are ordered from the smallest to the largest and maximum and minimum show the maximum and minimum value of the series in the current sample. Standard deviation: this is measure of dispersion or spread in the series. Skewness measures the asymmetry of the distribution of the series around its mean, Kurtosis measures the peaked Ness (that is, tallness or flatness) of the distribution of the series.

Jarque-Bera this is a test statistic for testing whether the series is normally distributed. It shows that the variables are normally distributed since its probability value (0.3977) is greater than 0.05.

4.2 Estimation techniques

4.2.1 Unit root test

The unit roots tests whether the series are stationary or not. It uses the augmented dickey fuller test under the Schwarz information criterion. The null hypothesis states that time series is not stationary or has a unit root and the ADF probability is greater than 5% or 0.05. While, the alternative hypothesis states that time series is stationary and the ADF probability is less than 5% or 0.05.

Table 2: Summary of probabilities under unit root test by using ADF Test

Variables	Level		1st Difference		I ()
	Trend &Intercept		Trend &Intercept		
	t-statistic	p-values	t-statistic	p-values	
GDP	-0.537033	0.8697	-7.501656	0.0000	I (1)
Inflation	-1.680860	0.6	-14.36826	0.0001	I (1)
Exchangerate	-2.196610	0.4753	-6.056432	0.0001	I (1)
Imports	-2.641871	0.2659	-5.5	0.0005	I (1)

Source: Eviews results, researcher's estimation

I: intercept, T&I: trend and intercept

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4.2.1.1 Interpretation

According to ADF results, the null hypothesis (Ho) is rejected that there is a unit root and the alternative hypothesis (H1) accepted that series are stationary and there is no unit root in all variables on different levels. In addition, the following are details of stationarity for each variable; The results indicate that all the variables (Inflation, Exchange rate and Imports) are not stationary at levels as their t-statistics values at level are lower that the critical values, also, their probabilities at level are greater than 0.05 value which implies the presence of unit root or non-stationarity status. However, all the variables are proven to be stationary at first difference as their probabilities are less than 0.05 as a result, we proceed to investigating a long run relationship among the variables.

4.2.2 Optimal Lag selection

The study uses the VAR method to select the optimal lag length criteria for the analysis. The rule of thumb suggests that the appropriate criterion is the one that presents the lowest value and should be a go to criterion for the lag selection.

Table 3: Optimal lag selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	24.20802	NA	7.19e-08	-2.259767	-2.014704	-2.235407
1	126.4447	132.3063	9.52e-12	-11.34644	-9.876062	-11.20028
2	191.1608	45.68191*	2.60e-13*	-16.01891*	-13.32322*	-15.75096*

Source: E-Views computation by researcher (2023)

From the E-Views results above, the majority of the criteria all select the use of two lags in the model as indicated by the asterixed indicator on the values on the second lg. this study uses two lags in the model for the estimation.

4.2.3 The cointegration Test (Johansen test)

The cointegration test identifies the presence of a long run relationship among the variables, the study uses the Johansen cointegration test where the null hypothesis (Ho) states that there is no cointegrating equation and occurs when trace and Eigen values are less than its critical values.

While, alternative hypothesis (H1) states that there is cointegrating equation and occurs when traceand Eigen values is greater than its critical values.

Table 4: Trace statistics evaluation for cointegration test

HypothesizedNo. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.988135	125.6324	55.24578	0.0000
At most 1 *	0.855045	50.25204	35.01090	0.0006
At most 2	0.639385	17.41937	18.39771	0.0681
At most 3	0.004713	0.080307	3.841465	0.7769

Source: Author's estimation (2023)

According to Johnsen cointegration results, the null hypothesis (Ho) is rejected and accept the alternative hypothesis that there is cointegration as results shows that that there is three cointegrating equations (none*, and at most 1*) where the trace statistics are greater than 5% critical values. This concludes that, there is a long run relationship between independent variables (inflation, imports, exchange rate) and dependent variable (GDP).

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Table 5: Max eigen values cointegration test

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.988135	75.38039	30.81507	0.0000
At most 1 *	0.855045	32.83267	24.25202	0.0029
At most 2 *	0.639385	17.33906	17.14769	0.0469
At most 3	0.004713	0.080307	3.841465	0.7769

Source: Author's estimation (2023)

The max eigen values test show that there is three co-integrating equations (none, at most 1 and atmost). This is where the max eigen statistics are greater than 5% critical values and their probabilities are less than 0.05. This leads to a rejection of the null hypothesis that suggests that there is no cointegration of the variables

4.2.4 Normalized long run coefficients

Table 6: Long run coefficients

Normalized cointegrating coefficients (standard error in parentheses)

GDP_CAP	INFLATION	IMPORTS	EXCH
1.000000	0.356663	0.006244	1.390309
	(0.01714)	(0.07226)	(0.02323)

Source: *Source: Author's estimation (2023)*

The long run coefficients provided by the cointegration indicate that there is a long run relationship between the dependent and the independent variables. These coefficients are interpreted using a negative sign that they normally possess.

Inflation coefficient is positive and statistically significant. This shows that a one-unit increase of inflation would lead to a reduction of GDP by 0.35 units. Inflation from 1989 to 2021 has been significantly affecting the economy. When inflation rises, consumption of goods and services reduce as people's purchasing power is minimized. Investment also is reduced accordingly as investors fear that their interest and profits will be compromised. Therefore, the production in the economy falls down hence reducing the rateof economic growth.

The long run coefficient of imports is negative but statistically insignificant. This means that imports in the long run have a negative relationship with GDP. However, this relationship is not that strong in the long run. GDP measures the monetary value of all goods and services produced with in the country, imports on the other hand makes the balance of payment weaker and increasesthe consumption of already inflated products. This discourages domestic supply as the producers lose market to competitive imported products hence reducing the GDP. However, this effect is notsignificant implying that it is not that high to damage the economy.

The exchange rate has a negative long run effect on GDP. The long run coefficient is high meaningthat exchange rate influences the reduction in GDP. Exchange rate increment scare away consumers and investors away. An increased exchange rate implies that prices could go up dramatically and shows a weakness of the currency and the economy in general.

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4.2.5 Granger Causality Test (Block exogeneity)

Null hypothesis states that X does not granger cause Y, and probability value is greater than 0.05and means that there is no causality.

While, the alternative hypothesis states that X has granger cause Y, and probability value is less than 0.05, which means that there is causality.

Table 7: Block exogeneity granger causality test

Dependent variable: D(GDP_CAP)

Excluded	Chi-sq	df	Prob.
D(INFLATION)	6.112266	1	0.0134
D(IMPORTS)	0.261942	1	0.6088
D(EXCH)	0.579641	1	0.4465
All	6.481961	3	0.0904

Source: researcher's estimation

The Block exogeneity granger causality test shows a unidirectional causality where inflation doesgranger cause GDP as the probability is less than 5%. This relationship is also reflected in the longrun coefficients as seen earlier. Other variables like imports and exchange rate seem to have no granger causality cause on GDP.

Dependent variable: D(EXCH)

Excluded	Chi-sq	df
D(GDP_CAP)	2.2723	
D(INFLATION)	2	
D(IMPORTS)		

***Source**: researcher's estimation*

The block exogeneity granger causality results also show that there is a causality of inflation on exchange rate of Rwanda. This implies that the increase in exchange rate is caused by the increasein inflation especially on the global scale. An example is in the Covid 19 period where supply shockincreased global inflation. In this time, as the country imported goods, the exchange rate increasedas a result of inflation caused by importation of already inflated commodities.

4.2.6 Vector Error Correction Model (VECM)

The presence of a long run relationship requires a vector error correction model to correct the shortrun deviation. This study adopts an error correction term using vector error correction.

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Table 3: Error correction model estimates

Cointegrating Eq:	CointEq1
GDP_CAP(-1)	1.000000
INFLATION(-1)	-1.505584
	(0.13542)
	[-11.1175]
IMPORTS(-1)	-1.706196
	(0.48119)
	[-3.54581]
EXCH(-1)	-0.843653
	(0.14399)
	[-5.85897]
C	7.397483
Error Correction:	D(GDP_CAP)
CointEq1	-0.085010
	(0.02585)
	[-3.28892]

Source: E-Views results, researcher estimation

The vector error correction is estimated in order to find the error correction term that eliminated the shock in the long run- short run dynamics. The error correction term; in order to eliminate theshock, must be negative and statistically significant. The error correction term under VECM is seen on the dependent variable, the term is -0.085 with the t-statistic of 3.28 which shows that thespeed of adjustment of the long run dynamics is 8.5%. This show that each year, 8% of the shock gets eliminated.

The short run coefficients also show a negative relationship between these major variables in the short run. Inflation in the short-run has a negative effect on GDP which is also the case for importsand exchange rate of Rwanda.

4.3 Post estimation technique

4.3.1 The serial correlation (LM) test

The auto correlation is detected using the auto correlation LM test, the null hypothesis (Ho) states that there is serial correlation if the chi-square probability values are less than 0.05 critical value while, the alternative hypothesis (H1) states that there is no serial correlation and the probability values are greater than 0.05 or 5%.

Table 8: LM auto correlation test results

F-statistic	1.358276	Prob. F (2,5)	0.3380
Obs*R-squared	5.984718	Prob. Chi-Square (2)	0.0502

Source: Author's estimation

As it is shown in the table above, the probability values at different lags are all greater than 0.05 which implies the rejection of the null hypothesis and conclusion that there is no presence of serialcorrelation in the residuals.

4.3.2 Test for Normality

The normality test investigates the normal distribution of the variables. The null hypothesis (Ho) states that residuals are not normally distributed and probability of Jarque-Bera is below 5 % or 0.05.

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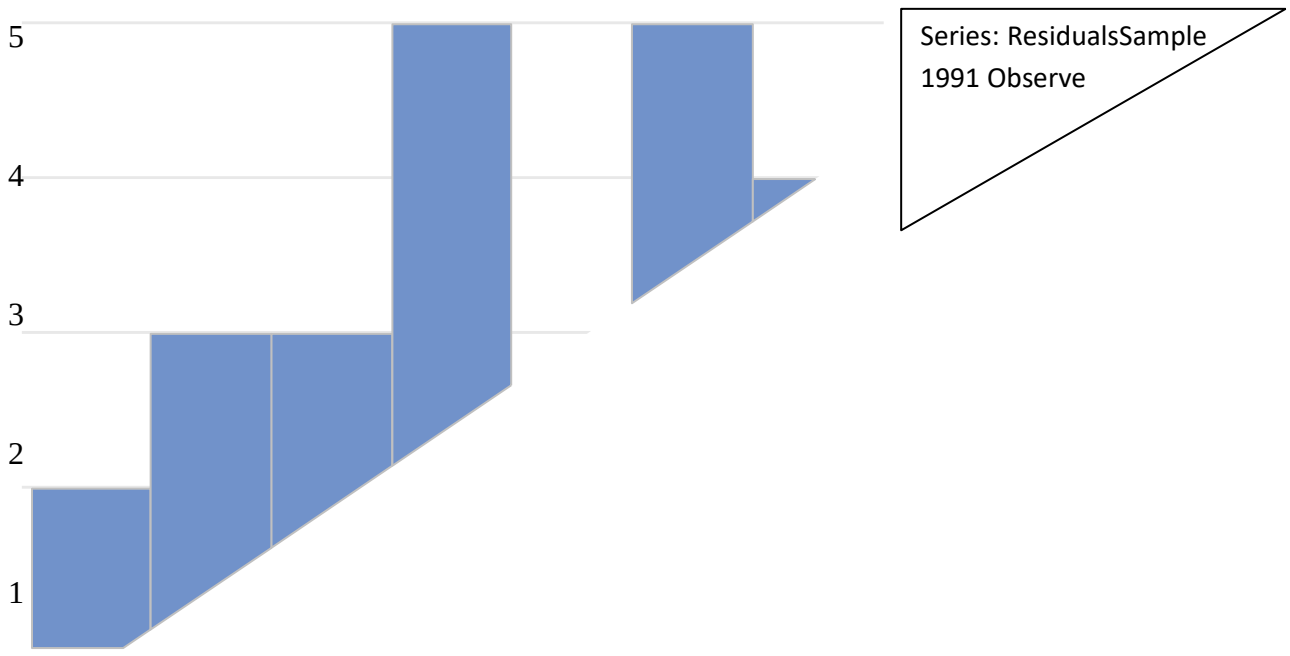
While the alternative hypothesis (H1) states that residuals are normally distributed and the probity of Jarque-Bera is greater than 0.05 or 5%

Figure 1 Jarque-bera Normality test results



The results show that the individual components representing the variables, their probabilities aregreater than 0.05 and the combination or the joint probability is greater than 0.05, this implies thatthe variables are normally distributed.

4.3.3 Test for Heteroskedasticity

Null hypothesis (Ho) suggests that there is heteroscedasticity and chi- square probability is below0.05 or 5%.

While, Alternative hypothesis (H1) states that there is no heteroscedasticity and chi-square probability is greater than 0.05 or 5%.

Table 9: Heteroscedasticity test results

F-statistic	2.628693	Prob. F (9,7)	0.1080
Obs*R-squared	13.11850	Prob. Chi-Square (9)	0.1573
Scaled explained SS	0.892952	Prob. Chi-Square (9)	0.9996

The results show that the probability of chi square is greater than 0.05. This implies that the nullhypothesis is rejected and there is no presence of heteroscedasticity.

4.3.4 Stability test (Ramsey reset test)

The study incorporates the Ramsey reset test to evaluate whether there are no specification errors. The model is stable when there is absence of specification errors and it is observed when the t-statistic, F-statistic and likelihood ratio are greater than 0.05 and the opposite is true.

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Table10: **Ramsey reset stability test**

Specification: GDP_CAP GDP_CAP(-1) GDP_CAP(-2) INFLATION INFLATION(-1) INFLATION(-2) IMPORTS IMPORTS(-1) EXCH EXCH(-1) C

	Value	df	Probability
t-statistic	0.303852	6	0.7715
F-statistic	0.092326	(1, 6)	0.7715
Likelihood ratio	0.259598	1	0.6104

The Ramsey reset test results show that the statistical tests and the likelihood ratio's probabilities are greater than 0.05 which implies that there are no specification errors and therefore the model is stable.

5. Conclusion

The study successfully achieved its objective, which was to assess the impact of inflation on the economic growth of Rwanda. The research revealed the existence of a long-term relationship between inflation and Rwanda's economic growth, as determined by the Johansen cointegration test. The study also incorporated the block exogeneity granger causality test and found that inflation granger causes economic growth. It also found that inflation granger cause exchange rate volatility and variations. The ultimate objective of the study was answered by concluding that inflation affect economic growth negatively.

6. Recommendations

The study recommends that monetary authorities make a more pragmatic effort to target inflation aggressively in order to prevent its negative effects by ensuring a tolerable rate that stimulates economic growth. This study also suggests that the monetary policies aimed at exchange rates be strengthened by the monetary authorities' effective supervision and regulatory framework of the financial system. Hence, continuous monetary policy that will active the desire macroeconomic stability increases private sector credits and investments to boost economic growth of Rwanda.
Finally, there is need for further management of money supply in Rwanda, because the more money supply management, the more the level of economic growth in Rwanda.

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