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# The Effect of Fiscal and Monetary Policy on Private Investment in Rwanda

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## Abstract

The study investigated the effect of Fiscal and Monetary Policy on Private Investment in Rwanda. The aim of the study was to examine the impact of fiscal policies on private investment in Rwanda, evaluate the influence of monetary policies on private investment dynamics in the Rwandan economy, and assess the combined effects of fiscal and monetary policies on the overall private investment climate in Rwanda. The VAR model was applied to analyze the relationship between fiscal and monetary policy variables on private investment in Rwanda. The results show a discernible legacy effect of past government spending on current expenditures, highlighting the importance of targeted investment and public-private partnerships. Additionally, the inverse relationship between interest rates and private investment underscores the need for transparent monetary policies. Recommendations include implementing open market operations for inflation control, providing taxation incentives for investors, fostering long-term planning, and enhancing global economic awareness to create a conducive environment for private investment in Rwanda.

## Subject Areas

Fiscal and Monetary Policy

## Keywords

Fiscal and Monetary Policy, Vector Autoregressive Model (VAR), Private Investment, Rwanda

## 1. Introduction

This study investigates the role of fiscal and monetary policies in promoting private investment in Rwanda's economy, aiming to determine which policy is more effective. [1] believes fiscal policy impacts economic activity more than monetary policy, while monetarists believe monetary policy has a greater impact. [2] suggested that economic managers prioritize monetary and fiscal policies to accelerate economic growth.

Economists contend that other factors, such as infrastructure, political stability, the regulatory environment, and technological advancements, can affect investment decisions, and that fiscal and monetary policies alone may not be adequate to encourage private investment [3]. Following the 1944 Bretton Woods conference, the world adopted various fiscal and monetary policies, including the introduction of the dollar and Federal Reserve management. The US adopted these policies to maintain its strong global economy, focusing on taxable products and banking transactions, which had grown in other countries [4]. The government's approach to achieving macroeconomic objectives like price stability, decreased unemployment, economic growth, and balanced budgets is known as fiscal policy [5]. To influence public demands, fiscal policy modifies government spending and taxation [6]. One can lower taxes, such as spending or income taxes, in order to adopt an expansionary strategy [7]. The research carried out by [8] showed how variations in interest rates and tax revenue can impact GDP and how this concept can be used by the government to promote economic expansion.

Lower income taxes raise disposable income, which boosts spending Reducing corporate profit taxes, on the other hand, boosts company profits, which can then be reinvested in the company, boosting investment [9]. These elements have an effect on demand as a whole, which raises investment, consumption, and demand overall [10]. Increasing state spending can also increase aggregate demand, leading to a higher aggregate demand. Examples of these expenditures include capital and recent spending [11]. Governments use monetary policy as a tool to accomplish macroeconomic goals like development, low unemployment, price stability, long-term economic growth, and balance-of-payments equilibrium [12]. Changes in interest rates, money supply, or exchange rates can cause it [13]. The central bank may cut interest rates in response to economic growth, which would further weaken the value of the currency [14].

The Bank of England established fiscal and monetary policy in Europe in 1812, emphasizing methods for previous transactions to guarantee that customers received previous obligations and savings [15]. Modern banking has developed from this system, with banks maintaining records as proof of previous transactions. In order to guarantee that banking services maximize the advantages of recognized accounting principles, poverty reduction strategies were also taken into consideration [16]. Muhammad Yunus, an economist, played a pivotal role in shaping Asian fiscal and monetary policy, starting an experimental research project in Bangladesh in the 1970s, which led to the establishment of Grameen Bank [17]. Globally, credit and savings institutions are essential to the expansion of small and medium-sized enterprises (SMEs) because they give the poor access to insurance and credit, which enhances their ability to generate income, control their spending, and generally live better lives [18].

Because of the sophisticated banking services available in trade, agriculture, and mining, West Africa especially Ghana and Nigeria were the first region in Africa to implement fiscal and monetary policy in the early 1970s due to the advanced banking services supporting trade, agriculture, and mining [19]. Empirical studies have shown that monetary policy has been relatively stronger than fiscal policy in influencing economic activity in countries like Ghana, Kenya, and Nigeria [20].

Additionally, research has highlighted the importance of understanding the dynamics of monetary policy in response to external shocks in West African countries, emphasizing the need for diversification of economies to reduce vulnerability to fluctuations in commodity prices [21]. Furthermore, studies have investigated the existence of fiscal dominance regimes in countries like Ghana, Guinea, and Sierra Leone, recommending active fiscal policy reactions to changes in debt levels for credibility and solvency [22].

Financial services for low-income workers in Southern Africa are more closely aligned with the retail finance model found in mainstream banking, as they are governed by fiscal and monetary policies [23]. The study by [24] examines the impact of monetary and fiscal policies on the economies of Southern African Customs Union (SACU) members. It reveals that fiscal policy is crucial in the long run, despite its conflicting impact on short-term economic growth, influenced by government revenue, expenditures, real interest rates, inflation, the official exchange rate, and money supply.

According to [25] the study on Vietnam's fiscal and monetary policy's impact on private investment found a positive long-term relationship between government spending and money supply, with co-integration between policy variables and private investment. Tax revenue coefficients were both positive and negligible, suggesting the need for increased government spending to boost private investment in Vietnam.

For example, research by [26] found that expansionary fiscal policy, characterized by increased government spending and tax incentives, positively influences private investment in Kenya, Uganda, and Tanzania. Similarly, studies by [27] and [28] have highlighted the importance of accommodative monetary policy, characterized by lower interest rates and increased liquidity, in stimulating private investment in the region. However, the effectiveness of these policies may be contingent on factors such as the quality of infrastructure, regulatory environment, and political stability [29].

[30] study examines the impact of Kenya's fiscal policy on private investment and economic growth, revealing that investment, crucial for determining Kenya's economic growth, is significantly influenced by fiscal policy. According to the research carried out by [31] who examined the relationship between monetary policy and investment in Kenya's private sector using quarterly macroeconomic data collected between 1996 and 2009. The methods used are unit root and co-integration testing with the Vector Error Correction Model (VECM). The outcomes show that the variables are stationary at the first difference using

OLS. Because of the COVID-19 pandemic, both developed and developing economies have experienced recessions. This has forced governments and central banks to enact previously unheard-of fiscal and monetary policies, underscoring the unprecedented scope of the global crisis [32].

The study by Wu reveals that fiscal and monetary policy significantly influence private investment in Rwanda, with factors such as consumer prices index, owner-occupiers' housing costs, and retail prices index influencing FDI [33]. The study emphasized the relationship between housing costs for owner-occupants and employment generation, as well as the effect of the nominal effective exchange rate on foreign direct investment [34]. The study underscored the significance of trade balance in promoting economic growth, poverty reduction, and maintaining a balanced capital account [35].

The investment theory model is an internal model that has adjustment costs, which are also interpreted as external adjustment costs [36]. The earliest known theory of investing was created in 1934 by John Maynard Keynes and Irving Fisher in 1947. Two researchers agreed that investments are made until the opportunity cost of capital equals the present value of projected future revenue at the margin, essentially, when net present value is zero [37]. An investment is expected to generate a cash flow stream as it represents an outlay at zero, resulting in a negative cash flow [38]. The Rwandan government has advocated for the reopening of banks to secure capital for both business and personal finance [39]. Banks struggle to provide loans due to workers' insufficient savings and high interest rates, making it difficult for individuals to obtain credit facilities [40]. The impact of the private sector on market forces affects the availability of housing, which helps those from lower socioeconomic status. Lower income levels in Rwanda may also result in higher interest rates for borrowers, which could cause projects to default on their credit due to the country's low saving rate and high interest rates [41].

The study aims to explore the influence of monetary and fiscal policies on private investment in Rwanda, thereby filling a research gap [42]. Research on the relationship between monetary and fiscal policy measures and private investment in Rwanda is limited, highlighting the importance of understanding these factors for policymakers. The study offers crucial insights for policymakers to develop effective strategies to boost private sector investment, improve economic stability, and establish a favorable investment environment in Rwanda [43]. This study aims to analyze the impact of fiscal and monetary policies on private investment in Rwanda, enabling policymakers to make informed decisions [44] [45]. Organization of the paper: The section 2 is material and methodology, Section 3 represents Numerical results and interpretation, Section 4 represents conclusion and recommendation.

## 2. Material and Methodology

### 2.1. Data

This research utilized secondary data from 2010Q1-2023Q2, obtained from

World Bank and NISR online publications. The logarithm of private investment was used to eliminate heteroscedasticity. Variables such as inflation, interest rate, money supply, taxation, and government spending were used in percentage terms, ensuring accurate analysis (See Table 1).

**Table 1.** Variables description.

| Variables | Description |
|---|---|
| GOVERNMENT_SPENDING | The variable denotes the entire amount that the government spends on investments and purchases of goods and services in areas such as public administration, infrastructure, healthcare, education, and defense |
| INFLATION | An economy's annual percentage change in the average price of goods and services is measured by the Producer Price Index (PPI) or Consumer Price Index (CPI), which shows the rate of inflation or deflation over a given time period |
| INTEREST_RATE | The variable represents the cost of borrowing or return on investment, indicating the current interest rate at which individuals, companies, or the government can borrow money from banks or the central bank |
| PRIVATE_INVESTMENT | This variable represents private sector investment in the economy, including physical capital, machinery, equipment, and structures, excluding government and public sector investment, made by businesses and individuals |
| MONEY_SUPPLY | The variable represents the total amount of money in circulation within the economy at a given time, including money in circulation, demand and time deposits, and other liquid assets owned by financial institutions, companies, and private citizens |
| TAXATION | The government collects funds from individuals, businesses, or other entities to finance government activities and public services |

**Source:** Author.

## 2.2. Area of Study

Rwanda, a landlocked country in East Africa, is known for its stunning landscapes and vibrant culture. Rwanda is located between latitudes 1.9403˚S and 29.8739˚E longitude in the African Great Lakes region. With a population of over 12 million people, it covers an area of approximately 26,338 square kilometers. The official currency is the Rwandan franc, and the capital city is Kigali. Rwanda's economy is primarily based on agriculture, with coffee and tea being major exports, while tourism and technology sectors are also growing. The people of Rwanda are predominantly engaged in farming, trading, and service industries, contributing to the nation's development and resilience.

## 2.3. Methodology

The study examines how monetary and fiscal policies affect private investment in Rwanda using a Vector Autoregressive (VAR) model [46]. Because VAR models enable the simultaneous modeling of multiple variables over time, they are appropriate for investigating the dynamic interactions between these policies and private investment. Additionally, they prevent predefined decisions about which variables to treat as dependent and independent by enabling endogenous treatment of all variables. In order to capture the temporal lags in the transmission of policy effects on private investment, VAR models also account for lagged values of variables. All things considered, the VAR framework is a helpful tool for examining how fiscal and monetary policies affect private investment in Rwanda and illustrating how policy shocks impact macroeconomic variables.

The AIC and SC rules should be used to determine the best lag order for constructing the VAR model [44].

Assuming the existence of VAR model:

$$X_t = G_0 + G_1 X_{t-1} + G_2 X_{t-2} + \cdots + G_s X_{t-s} + \varepsilon_t \quad (1)$$

Let $X_t$ represent a vector of variables (Inflation, interest rate, Government expenditure, money supply, Taxation, and private investment) with dimensions 6 × 1, observed at time $t$. $G_0$ denotes the vector of system innovations that are not correlated across time, and s represents the recommended lag length for each variable. Equation (1) represents a system of six equations, which can be expressed as follows:

$$\begin{aligned}
LPI_t &= \beta_1 + \beta_y \sum_{y=1}^{K} PI_{t-y} + \beta_a \sum_{a=1}^{k} IR_{t-a} + \beta_b \sum_{b=1}^{k} INF_{t-b} + \beta_c \sum_{c=1}^{k} MS_{t-c} \\
&\quad + \beta_d \sum_{d}^{k} GEXP_{t-d} + \beta_e \sum_{e=1}^{k} LTAX_{t-e} + \mu_{1t} \\
IR_t &= \beta_2 + \beta_y \sum_{y=1}^{K} PI_{t-y} + \beta_a \sum_{a=1}^{k} IR_{t-a} + \beta_b \sum_{b=1}^{k} INF_{t-b} + \beta_c \sum_{c=1}^{k} MS_{t-c} \\
&\quad + \beta_d \sum_{d}^{k} GEXP_{t-d} + \beta_e \sum_{e=1}^{k} LTAX_{t-e} + \mu_{2t} \\
INF_t &= \beta_3 + \beta_y \sum_{y=1}^{K} PI_{t-y} + \beta_a \sum_{a=1}^{k} IR_{t-a} + \beta_b \sum_{b=1}^{k} INF_{t-b} + \beta_c \sum_{c=1}^{k} MS_{t-c} \\
&\quad + \beta_d \sum_{d}^{k} GEXP_{t-d} + \beta_e \sum_{e=1}^{k} LTAX_{t-e} + \mu_{3t} \\
MS_t &= \beta_4 + \beta_y \sum_{y=1}^{K} PI_{t-y} + \beta_a \sum_{a=1}^{k} IR_{t-a} + \beta_b \sum_{b=1}^{k} INF_{t-b} + \beta_c \sum_{c=1}^{k} MS_{t-c} \\
&\quad + \beta_d \sum_{d}^{k} GEXP_{t-d} + \beta_e \sum_{e=1}^{k} LTAX_{t-e} + \mu_{4t} \\
GEXP_t &= \beta_5 + \beta_y \sum_{y=1}^{K} PI_{t-y} + \beta_a \sum_{a=1}^{k} IR_{t-a} + \beta_b \sum_{b=1}^{k} INF_{t-b} + \beta_c \sum_{c=1}^{k} MS_{t-c} \\
&\quad + \beta_d \sum_{d}^{k} GEXP_{t-d} + \beta_e \sum_{e=1}^{k} LTAX_{t-e} + \mu_{5t} \\
LTAX_t &= \beta_5 + \beta_y \sum_{y=1}^{K} PI_{t-y} + \beta_a \sum_{a=1}^{k} IR_{t-a} + \beta_b \sum_{b=1}^{k} INF_{t-b} + \beta_c \sum_{c=1}^{k} MS_{t-c} \\
&\quad + \beta_d \sum_{d}^{k} GEXP_{t-d} + \beta_e \sum_{e=1}^{k} TAX_{t-e} + \mu_{6t}
\end{aligned}$$

where $INF$ = inflation, $MS$ = money supply, $TAX$ = taxation, $GEXP$ = government expenditure, $PI$ = private investment, $IR$ = interest rate.

The study uses the Ordinary Least Square (OLS) method to compute variables influencing monetary and fiscal policy's impact on private investment. Parameters are computed using E-views 10 software, and the results will test hypotheses and establish significance levels. The Vector Autoregressive model (VAR) is employed to prevent spurious regression and test for causal relationships between variables [47] and [48]. The VAR model offers several advantages, making it ideal for research testing causality effects. Its estimates are flexible, less time-consuming, and allow for easy data integration, making it a more suitable choice.

#### 2.3.1. Testing for Stationarity

The study aims to address the persistent issue of non-stationarity in time series data by conducting a stationarity test using an augmented Dick Fuller test to determine the order of integration and check for stationarity. The unit root test equation for Dickey-Fuller is as follows, and the testable hypothesis is Null hypothesis $H_0$: $\theta = 0$ (*i.e.* $p = 1$), $y_t$ has not a unit root) alternative hypothesis $H_1$: $\theta < 0$ (*i.e.* $p < 1$) $y_t$ has a unit root.

The testable equation (w/ or w/o intercept and/or trend variable) is the basis for three distinct tables. The Augmented DK test (PP) is the more widely used variant of the original DF test.

$$\Delta y_{t=\theta . y_{t-1}} + \sum_{P=1}^{P} w_p \cdot \Delta y_{t-p+1} + u_t, \quad \Delta y_{t=\alpha+\theta . y_{t-1}} + \sum_{P=1}^{P} w_p \cdot \Delta y_{t-p+1} + u_t$$

$$\Delta y_{t=\alpha+\theta . y_{t-1}} + \beta \cdot t + \sum_{P=1}^{P} w_p \cdot \Delta y_{t-p+1} + u_t$$

The variable is considered stationary if the test indicates that the null hypothesis should be rejected.

Stationarity is a crucial characteristic in time series regression and analysis, ensuring that the series lacks long-term trends or irregular patterns, thus facilitating easier modeling and analysis. According to the variables utilized in this analysis, the stationarity demonstrates these results (See **Table 2**).

**Table 2.** Summary of unity roots test.

| Variables | Test statistics | Critical value (1%) | Critical value (5%) | Critical value (10%) | P-value |
|---|---|---|---|---|---|
| INFLATION | −5.406062 | −3.588509 | −2.929734 | −2.603064 | 0.0000 |
| INTEREST_RATE | −5.213892 | −3.574446 | −2.92378 | −2.599925 | 0.0001 |
| LPRIVATE_INVESTMENT | −4.961788 | −3.588509 | −2.929734 | −2.603064 | 0.0002 |
| MONEY_SUPPLY | −4.730636 | −3.584743 | −2.928142 | −2.602225 | 0.0004 |
| GOVERNMENT_SPENDING | −7.184153 | −3.574446 | −2.92378 | −2.599925 | 0.0000 |
| LTAXATION | −7.934928 | −3.574446 | −2.92378 | −2.599925 | 0.0000 |

**Source:** Author.

#### 2.3.2. Co-Integration Test

Co-integration is a statistical concept that examines the long-term relationship between time series variables, commonly used in non-stationary time series analysis, describing data movement over time [48] (Cui & Cui, 2012).

#### 2.3.3. Vector Error Correction Model (VECM)

Vector error correction (VEC) is a statistical technique used in time series analysis that reveals long-term correlations between non-stationary variables. By finding equilibrium links among variables over both long and short-term dynamics, VEC models contribute to the understanding and forecasting of linked time series data by extending the explanation of variable movement over time provided by co-integration. As per Al-[49], there is a long-term correlation between the variables, according to the VECM test results.

Equation (2): The vector error correction model equation

$$\Delta LPI_t = \beta_1 + \beta_y \sum_{y=1}^{K-1} \Delta PI_{t-y} + \beta_a \sum_{a=1}^{k-1} \Delta IR_{t-a} + \sum_{b=1}^{k-1} \Delta INF_{t-b} + \beta_c \sum_{c=1}^{k-1} \Delta MS_{t-c} + \beta_d \sum_{d}^{k-1} \Delta GEXP_{t-d} + \beta_e \sum_{e=1}^{k-1} \Delta LTAX_{t-e} + \tau_1 ECT_{t-1} + \mu_{1t}$$

$$\Delta IR_t = \beta_2 + \beta_y \sum_{y=1}^{K-1} \Delta LPI_{t-y} + \beta_a \sum_{a=1}^{k-1} \Delta IR_{t-a} + \beta_b \sum_{b=1}^{k-1} \Delta INF_{t-b} + \beta_c \sum_{c=1}^{k-1} \Delta MS_{t-c} + \beta_d \sum_{d}^{k-1} \Delta GEXP_{t-d} + \beta_e \sum_{e=1}^{k-1} \Delta LTAX_{t-e} + \tau_2 ECT_{t-1} + \mu_{2t}$$

$$\Delta INF_t = \beta_2 + \beta_y \sum_{y=1}^{K-1} \Delta LPI_{t-y} + \beta_a \sum_{a=1}^{k-1} \Delta IR_{t-a} + \beta_b \sum_{b=1}^{k-1} \Delta INF_{t-b} + \beta_c \sum_{c=1}^{k-1} \Delta MS_{t-c} + \beta_d \sum_{d}^{k-1} \Delta GEXP_{t-d} + \beta_e \sum_{e=1}^{k-1} \Delta LTAX_{t-e} + \tau_3 ECT_{t-1} + \mu_{3t}$$

$$\Delta MS_t = \beta_4 + \beta_y \sum_{y=1}^{K-1} \Delta LPI_{t-y} + \beta_a \sum_{a=1}^{k-1} \Delta IR_{t-a} + \beta_b \sum_{b=1}^{k-1} \Delta INF_{t-b} + \beta_c \sum_{c=1}^{k-1} \Delta MS_{t-c} + \beta_d \sum_{d}^{k-1} \Delta GEXP_{t-d} + \beta_e \sum_{e=1}^{k-1} \Delta LTAX_{t-e} + \tau_4 ECT_{t-1} + \mu_{4t}$$

$$\Delta GEXP_t = \beta_5 + \beta_y \sum_{y=1}^{K-1} \Delta LPI_{t-y} + \beta_a \sum_{a=1}^{k-1} \Delta IR_{t-a} + \beta_b \sum_{b=1}^{k-1} \Delta INF_{t-b} + \beta_c \sum_{c=1}^{k-1} \Delta MS_{t-c} + \beta_d \sum_{d}^{k-1} \Delta GEXP_{t-d} + \beta_e \sum_{e=1}^{k-1} \Delta LTAX_{t-e} + \tau_5 ECT_{t-1} + \mu_{5t}$$

$$\Delta LTAX_t = \beta_5 + \beta_y \sum_{y=1}^{K-1} \Delta LPI_{t-y} + \beta_a \sum_{a=1}^{k-1} \Delta IR_{t-a} + \beta_b \sum_{b=1}^{k-1} \Delta INF_{t-b} + \beta_c \sum_{c=1}^{k-1} \Delta MS_{t-c} + \beta_d \sum_{d}^{k-1} \Delta GEXP_{t-d} + \beta_e \sum_{e=1}^{k-1} \Delta LTAX_{t-e} + \tau_6 ECT_{t-1} + \mu_{6t}$$

where $IR$ = interest rate, $INF$ = inflation, $TAX$ = taxation, $MS$ = money supply, $GEXP$ = government expenditure, $PI$ = private Investment.

NOTE: $K-1$ = the lag length is reduced by 1.

$\beta_y, \beta_\alpha, \beta_b, \beta_c, \beta_d, \beta_e$ = Short run dynamic coefficients of the model's adjustment long run equilibrium.

$\tau_n$ = Speed of adjustment parameter with a negative sign.

$ECT_{t-1}$ = The lagged value of the residuals from the co-integrating regression of the dependent variables on the regressors is the error correction term. Include long-term data obtained from the long-term co-integrating relationship.

$\mu_{it}$ = Residuals (stochastic error term is often called impulses, or innovations or shocks).

#### 2.3.4. Serial Autocorrelation

When the residuals or errors of a time series model exhibit a systematic relationship with their historical values, it is statistically known as serial correlation, or autocorrelation.

### 2.4. Normality Test

To ascertain whether a given dataset has a normal distribution, statisticians use the normality test, or more specifically the Jarque-Bera test. The Jarque-Bera test evaluates the data's kurtosis and skewness in order to determine how far the data deviate from normal.

## 3. Results and Interpretation

### 3.1. Descriptive Statistics

Descriptive statistics analyze six main variables spanning from 2010Q1 to

2023Q2, detailing their central tendencies, variations, skewness, kurtosis, and normality assessments (See **Table 3**). Mean values depict average levels, with "GOVERNMENT_SPENDING" averaging at 14.44 and "INFLATION" hovering around 5.577335. Medians offer middle values, while maximum and minimum values showcase the range of variation. Metrics like standard deviation, skewness, and kurtosis unveil the data's dispersion, asymmetry, and tail characteristics. For instance, "MONEY_SUPPLY" exhibits a moderate standard deviation, indicating a stable pattern. "INFLATION" displays positive skewness, indicating a right-skewed distribution, and "INTEREST_RATE" manifests slightly above 3 kurtoses, implying heavier tails. Jarque-Bera tests offer insights into normality, with certain variables demonstrating closer adherence to a normal distribution.

**Table 3.** Descriptive statistics.

| | GOVERNMENT_SPENDING | INFLATION | INTEREST_RATE | MONEY_SUPPLY | PRIVATE_INVESTMENT | TAXATION |
|---|---|---|---|---|---|---|
| Mean | 14.44225 | 5.577335 | 16.91381 | 20.17504 | 1.82E+12 | 1648.241 |
| Median | 14.34125 | 5.002666 | 17.00656 | 20.17560 | 1.79E+12 | 1660.002 |
| Maximum | 16.95559 | 17.68921 | 17.33333 | 26.20377 | 2.91E+12 | 2355.392 |
| Minimum | 12.02497 | −0.391347 | 16.17583 | 15.56249 | 7.10E+11 | 810.2947 |
| Std. Dev. | 1.303583 | 3.830099 | 0.346811 | 2.539688 | 6.82E+11 | 487.7485 |
| Skewness | 0.020736 | 0.799147 | −0.535376 | 0.218636 | 0.002926 | −0.134961 |
| Kurtosis | 2.171796 | 3.778705 | 2.108339 | 2.290547 | 1.629101 | 1.738118 |
| Jarque-Bera | 1.547193 | 7.112077 | 4.368534 | 1.562693 | 4.228649 | 3.746709 |
| Probability | 0.461351 | 0.028552 | 0.112560 | 0.457789 | 0.120715 | 0.153607 |
| Sum | 779.8815 | 301.1761 | 913.3455 | 1089.452 | 9.82E+13 | 89004.99 |
| Sum Sq. Dev. | 90.06449 | 777.4921 | 6.374710 | 341.8508 | 2.47E+25 | 12608625 |
| Observations | 54 | 54 | 54 | 54 | 54 | 54 |

**Source:** Author.

## 3.2. Lag Order Selection

Choosing how many historical observations (lags) to include in the model is a common step in the process of specifying lags in a time series or econometric model. A crucial component of time series analysis is the lag specification, particularly when working with autoregressive (AR) or moving average (MA) components.

The results make it evident that selecting the optimal lag order is a challenging process. The selection criteria provide different recommendations: AIC suggests two, SC suggests two, and HQ recommends two as the lag order. But a lag order of two is also supported by the final prediction error (FPE), and the sequential modified likelihood ratio (LR) test statistic strongly points to a lag order of two as the best choice. It's interesting to note that the lag order of 2, which was selected for this VAR model, is consistent with these criteria, indicating that this choice was appropriate (See **Table 4**).

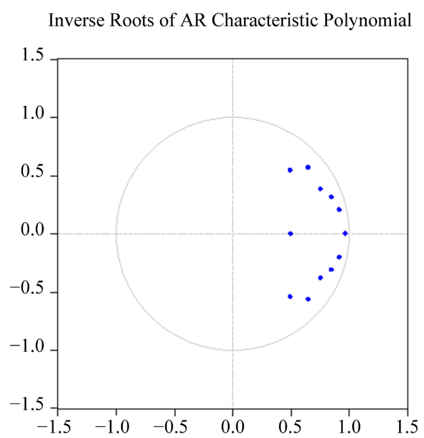
**Table 4.** Lag selection criteria.

| VAR Lag Order Selection Criteria | | | | | | |
|---|---|---|---|---|---|---|
| Endogenous variables: INFLATION INTEREST_RATE LPRIVATE_INVESTMENT LTAXATION MONEY_SUPPLY GOVERNMENT_SPENDING | | | | | | |
| Exogenous variables: C | | | | | | |
| Date: 07/07/24 Time: 16:21 | | | | | | |
| Sample: 2010Q1 2023Q2 | | | | | | |
| Included observations: 50 | | | | | | |
| Lag | LogL | LR | FPE | AIC | SC | HQ |
| 0 | −208.1367 | NA | 0.000211 | 8.565470 | 8.794913 | 8.652843 |
| 1 | 300.1069 | 874.1792 | 1.34e−12 | −10.32428 | −8.718178 | −9.712666 |
| 2 | 410.2132 | 162.9573* | 7.34e−14* | −13.28853* | −10.30577* | −12.15268* |
| 3 | 431.4407 | 26.32208 | 1.57e−13 | −12.69763 | −8.338216 | −11.03754 |
| 4 | 459.4497 | 28.00897 | 3.06e−13 | −12.37799 | −6.641918 | −10.19366 |
| *indicates lag order selected by the criterion | | | | | | |
| LR: sequential modified LR test statistic (each test at 5% level) | | | | | | |
| FPE: Final prediction error | | | | | | |
| AIC: Akaike information criterion | | | | | | |
| SC: Schwarz information criterion | | | | | | |
| HQ: Hannan-Quinn information criterion | | | | | | |

**Source:** Author.

## 3.3. Stability Test

For time series analysis, stability in a Vector Autoregressive (VAR) model is essential, particularly when dealing with interconnected variables. Eigenvalues, unit root tests, cointegration, and impulse response analysis are needed. It is crucial to choose the right order, take variables into account, and specify the model correctly. For accurate analysis and implications for policy, diagnostic tests keep an eye on and update models (See **Figure 1**).




**Source**: Author

**Figure 1.** Inverse roots of ar characteristic polynomial.

The most important factor to consider when evaluating a VAR model's stability is if any of the characteristic polynomial's roots are outside the unit circle. Here, the unit circle indicates the point at which the behavior of the model becomes potentially explosive and unpredictable. Our analysis shows that all the typical roots of polynomials have a modulus of one. Since every modulus value is smaller than 1, every root needs to be found inside the unit circle. This important discovery indicates that the VAR model satisfies the stability requirement.

### 3.4. Estimation of Results and Discussion

The results of the variance decomposition and recursive impulse response are presented and discussed in this section (See **Appendix**).

#### 3.4.1. Impulse Response Functions

In this analysis, we look at a Vector Auto-regression (VAR) model's output and pay particular attention to how different economic variables respond. The endogenous variables GOVERNMENT_SPENDING, INFLATION, INTEREST_RATE, LPRIVATE_IMVESTMENT, TAXATION, and MONEY_SUPPLY are taken into account by the model (See Table 5 and Figure 2).

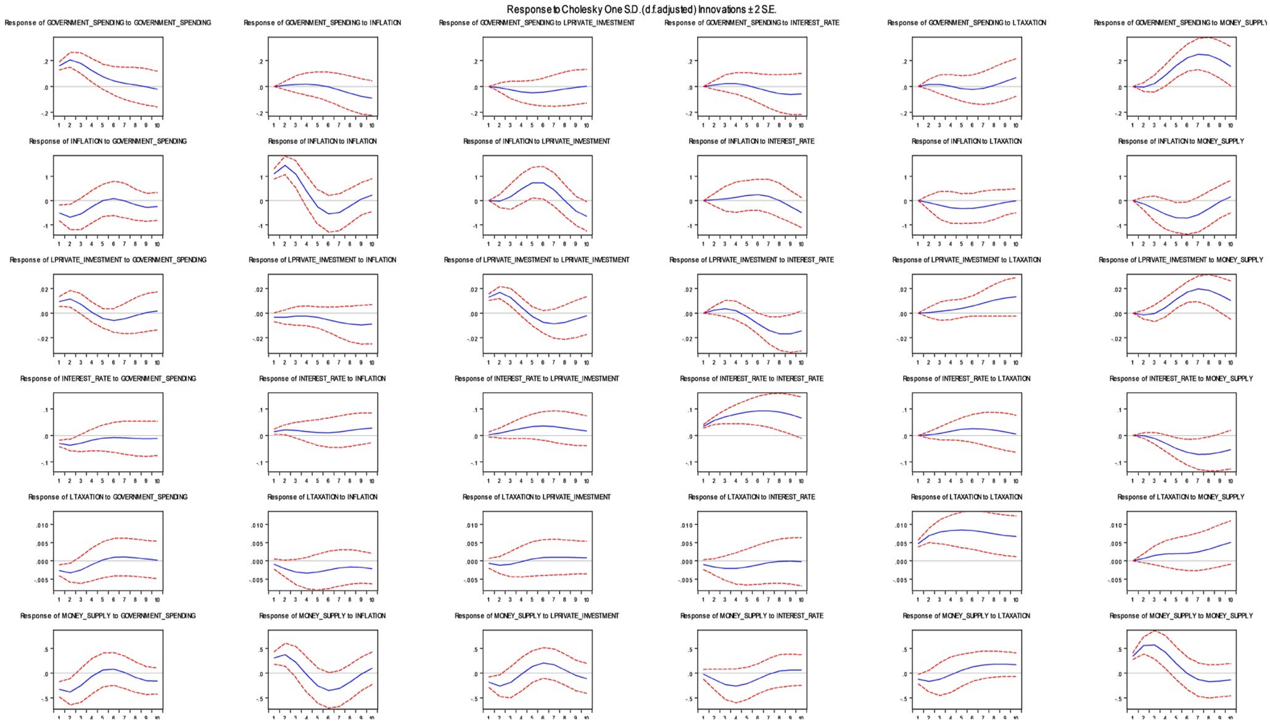
Table 5. Impulse response functions.

| Impulse response of variables | Interpretations |
|---|---|
| GOVERNMENT_ SPENDING | In the first stage, higher government spending produces positive outcomes, indicating that higher government spending stimulates the economy. Increased government spending has a gradual but beneficial effect over time. The fact that the error bands, or standard errors, are so small indicates the statistical significance of these effects. Data for this indicator is usually collected from government budget reports, financial statements, and public expenditure reviews. It reflects the government's fiscal policy and its role in economic activities. |
| PRIVATE_ INVESTMENT | Higher levels of government spending appear to encourage private investment, as evidenced by the first period's increase in government spending and its positive impact on private investment. Spending by the government has a positive but progressively declining effect on private investment. The statistical significance of these findings is demonstrated by the relatively narrow error bands.<br>Data for private investment is collected from business investment reports, capital expenditure surveys, and financial statements of companies. It reflects business confidence and economic growth potential. |
| INTEREST_ RATE | An increase in government spending initially causes interest rates to rise favorably, suggesting a crowding-out effect whereby higher government spending raises interest rates. Over time, interest rates fall but remain positive, indicating a long-term impact.<br>Interest rates are set by central banks based on monetary policy objectives and economic conditions. Data is published by central banks and financial regulatory authorities. This variable affects investment decisions and consumer spending. |
| TAXATION | In the first period, taxation responded favorably to increased government spending, suggesting a relationship between higher government spending and higher taxation. While still beneficial, this effect gets smaller with time. This implies that adjustments to tax laws have an ongoing effect on tax rates. The financial resources available for private investment can be impacted by tax policies.<br>Taxation data is derived from government tax collection agencies, tax returns filed by entities, and financial audits. This variable indicates the fiscal capacity of the government and impacts disposable income and investment. |

**Continued**

| | |
|---|---|
| MONEY_ SUPPLY | Because of higher government spending, the first period exhibits a contractionary monetary effect. However, over time, this effect turns positive, indicating an expansionary monetary effect. Due to their effects on the economy's liquidity and financing options, these fluctuations may have an effect on private investment. Central banks compile money supply data from financial institutions' reports, banking system transactions, and monetary aggregates. This indicator is crucial for understanding liquidity conditions and monetary policy effectiveness. |

**Source:** Author.




Source: Author.

**Figure 2.** Impulse response function.

### 3.4.2. Variance Decomposition (See Table 6)

**Table 6.** Variance decomposition.

| Variance decomposition of variables | Interpretations |
|---|---|
| GOVERNMENT _SPENDING | The variance analysis of GOVERNMENT_SPENDING shows that 100% of the variance in the spending is accounted for by previous values. But as time goes on, other elements that can be used to explain variations in government spending include inflation, private investment, interest rates, taxes, and the money supply. This shows that in response to these economic factors, government spending changes over time. |
| INFLATION | The first variables, government spending, private investment, interest rates, taxation, and money supply account for 82.63% of the variance in inflation rates, according to the variance decomposition of inflation rates. But over time, other elements like taxation, interest rates, private investment, government spending, and money supply all gain significance. These variables only account for 46.13% of the variance by the tenth period, suggesting that over time, external economic factors also affect inflation rates. |

**Continued**

| | |
|---|---|
| LPRIVATE_INVESTMENT | The examination of private investment levels reveals that historical values explain 63.12% of the variation, but over time, other factors like money supply and taxation become more significant. By the tenth period, the money supply and tax laws have a substantial impact on private investment decisions, causing investment levels to fluctuate over time. |
| INTEREST_RATE | 50.58% of the variance in interest rates can be attributed to their historical values, according to the INTEREST_RATE variance analysis. But over time, other factors like LTAXATION and LTAXATION become more significant, and by the tenth period, the historical values of interest rates themselves explain about 58.99% of their variance. |
| LTAXATION | The variance decomposition for LTAXATION shows that taxation levels are primarily determined by past values, accounting for 70.60% of variance. However, interest rates and money supply become more significant as time progresses. By the 10th period, past values only account for 75.15% of variance, indicating that taxation levels are also significantly influenced by external economic factors. |
| MONEY_SUPPLY | The money supply is initially impacted by past values and inflation, with its own past values making up the largest contributions, according to the variance decomposition analysis for MONEY_SUPPLY. Other factors like LTAXATION and INTEREST_RATE gain significance over time. By the tenth period, historical behavior, inflation, and outside economic factors are reflected in past values, which account for 39.23% of the variance. |

**Source:** Author.

## 4. Conclusion and Recommendation

To sum up, this research provides a thorough understanding of Rwanda's economic dynamics by highlighting the crucial relationships between monetary and fiscal policy, as well as private investment. There is a noticeable legacy effect of previous government spending on current spending, and the inverse relationship with interest rates highlights policymakers' options. Co-integration tests contribute to a comprehensive understanding of the economic environment by demonstrating persistent relationships between economic variables. The analyses of impulse response and VECM provide important information about the short- and long-term adjustments brought about by economic shocks, and the variance decomposition shows how the interdependencies between the variables are changing. Significantly, the VAR model's stability is evidence of its dependability for policy formulation and economic forecasting.

The development of Rwanda's economy depends on wise policy decisions that encourage private investment by addressing business environment, financial sector, human capital, incentives, innovation, governance, regional integration. A study that makes use of a Vector Auto-regression model recommends a balanced budgetary strategy that prioritizes important industries like technology, education, and infrastructure. The financial burden on the government can be decreased by promoting public-private partnerships by leveraging private sector resources and expertise to fund and manage infrastructure projects, leading to cost savings and improved service delivery for the public. Open Market Operations is essential for controlling the money supply and interest rates. Price stability requires both market competition and inflation targeting. Tax laws ought to prioritize employment growth, export-oriented businesses, and research. Additionally, crucial are ongoing observation and awareness of the world economy.

## Conflicts of Interest

The authors declare no conflicts of interest.

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## Appendix

Variance Decomposition of LPRIVATE_INVESTMENT:

| Period | S.E. | LPRIVATE_INVESTMENT | LTAXATION | MONEY_SUPPLY | INRT | INFL | GV_SP |
|---|---|---|---|---|---|---|---|
| 1 | 0.016408 | 100 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0.026538 | 98.71574 | 0.001097 | 0.094104 | 0.982341 | 0.122991 | 0.083724 |
| 3 | 0.030678 | 97.14699 | 0.078625 | 0.077751 | 2.375125 | 0.093132 | 0.228379 |
| 4 | 0.031648 | 93.54517 | 0.899636 | 1.375592 | 2.464055 | 1.311983 | 0.403569 |
| 5 | 0.034513 | 79.93141 | 3.468002 | 6.210444 | 3.67856 | 6.194964 | 0.516623 |
| 6 | 0.041398 | 59.48591 | 7.009146 | 11.06111 | 10.45468 | 11.46929 | 0.519858 |
| 7 | 0.050171 | 43.09339 | 10.467 | 12.6916 | 19.45872 | 13.78837 | 0.500913 |
| 8 | 0.05832 | 32.68154 | 13.88093 | 12.18223 | 26.7728 | 13.986 | 0.496491 |
| 9 | 0.064661 | 26.64766 | 17.31372 | 11.00589 | 31.19577 | 13.33616 | 0.500805 |
| 10 | 0.069032 | 23.40772 | 20.59944 | 9.949439 | 32.98788 | 12.54491 | 0.510611 |

Variance Decomposition of LTAXATION:

| Period | S.E. | LPRIVATE_INVESTMENT | LTAXATION | MONEY_SUPPLY | INTRT | INFL | GOV_SP |
|---|---|---|---|---|---|---|---|
| 1 | 0.00568 | 10.7491 | 89.2509 | 0 | 0 | 0 | 0 |
| 2 | 0.010071 | 9.104449 | 89.62262 | 0.000122 | 0.407916 | 0.767839 | 0.097058 |
| 3 | 0.013698 | 6.167696 | 90.13764 | 6.88E05 | 1.359858 | 1.812176 | 0.522563 |
| 4 | 0.016669 | 4.166073 | 89.73987 | 0.001168 | 2.273701 | 2.348328 | 1.470864 |
| 5 | 0.019128 | 3.541619 | 88.42936 | 0.001306 | 2.708357 | 2.372351 | 2.947009 |
| 6 | 0.021164 | 3.595138 | 86.72018 | 0.009562 | 2.706006 | 2.22042 | 4.748694 |
| 7 | 0.022863 | 3.707003 | 84.95044 | 0.104437 | 2.522418 | 2.126626 | 6.589079 |
| 8 | 0.024341 | 3.691818 | 83.10209 | 0.438289 | 2.330269 | 2.231204 | 8.206328 |
| 9 | 0.025733 | 3.578817 | 81.00815 | 1.122776 | 2.195388 | 2.678708 | 9.416163 |
| 10 | 0.02715 | 3.419788 | 78.63451 | 2.101974 | 2.160138 | 3.545451 | 10.13814 |

Variance Decomposition of MONEY_SUPPLY:

| Period | S.E. | LPRIVATE_INVESTMENT | LTAXATION | MONEY_SUPPLY | INTR | INFL | GOV_SP |
|---|---|---|---|---|---|---|---|
| 1 | 0.606989 | 42.96462 | 3.437991 | 53.59739 | 0 | 0 | 0 |
| 2 | 1.037052 | 38.0246 | 3.023839 | 57.0072 | 1.689606 | 0.223562 | 0.031187 |
| 3 | 1.271993 | 32.2687 | 2.353497 | 58.84704 | 5.474604 | 1.030464 | 0.0257 |
| 4 | 1.367422 | 28.0555 | 2.132228 | 57.47232 | 9.621148 | 2.636662 | 0.082136 |
| 5 | 1.428697 | 27.4967 | 3.135134 | 52.97802 | 11.44672 | 4.506977 | 0.436448 |
| 6 | 1.497745 | 28.53102 | 5.172573 | 48.7871 | 10.8538 | 5.627417 | 1.028096 |
| 7 | 1.554219 | 28.25911 | 7.405901 | 46.8725 | 10.12146 | 5.830105 | 1.510926 |
| 8 | 1.588474 | 27.11105 | 9.240393 | 46.11842 | 10.2135 | 5.62286 | 1.693781 |
| 9 | 1.616224 | 26.77493 | 10.33771 | 45.06116 | 10.61039 | 5.555741 | 1.660079 |
| 10 | 1.646146 | 27.30401 | 10.71572 | 43.58554 | 10.81458 | 5.956129 | 1.624024 |

**Continued**

| Variance Decomposition of INTEREST_RATE: | | | | | | | |
|---|---|---|---|---|---|---|---|
| Period | S.E. | LPRIVATE_INVESTMENT | LTAXATION | MONEY_SUPPLY | INTR | INFL | GOV_SP |
| 1 | 0.048518 | 13.50104 | 0.040871 | 7.334428 | 79.12366 | 0 | 0 |
| 2 | 0.086034 | 8.836563 | 0.1152 | 5.824495 | 84.81473 | 0.00071 | 0.408298 |
| 3 | 0.118432 | 4.989189 | 0.065529 | 3.360102 | 90.29083 | 0.063373 | 1.230977 |
| 4 | 0.150892 | 3.35159 | 0.104859 | 2.64725 | 91.57002 | 0.409603 | 1.916683 |
| 5 | 0.186208 | 3.188405 | 0.262847 | 4.297649 | 89.04652 | 1.055142 | 2.149435 |
| 6 | 0.222259 | 3.185536 | 0.379752 | 6.656747 | 85.86011 | 1.842361 | 2.075494 |
| 7 | 0.255114 | 2.922748 | 0.383197 | 8.404754 | 83.6996 | 2.670163 | 1.919534 |
| 8 | 0.282022 | 2.550152 | 0.325208 | 9.277974 | 82.55494 | 3.506163 | 1.78556 |
| 9 | 0.302125 | 2.245827 | 0.293948 | 9.536979 | 81.91342 | 4.318648 | 1.69118 |
| 10 | 0.315902 | 2.055097 | 0.351281 | 9.512499 | 81.40787 | 5.050284 | 1.62297 |
| Variance Decomposition of INFLATION: | | | | | | | |
| Period | S.E. | LPRIVATE_INVESTMENT | LTAXATION | MONEY_SUPPLY | INTR | INFL | GOV_SP |
| 1 | 1.212927 | 17.97243 | 1.140637 | 27.51628 | 7.141791 | 46.22886 | 0 |
| 2 | 2.015916 | 18.67213 | 2.034777 | 23.23225 | 8.275467 | 47.67753 | 0.107843 |
| 3 | 2.390538 | 16.20246 | 2.824479 | 19.79763 | 10.60786 | 49.45181 | 1.115762 |
| 4 | 2.560696 | 14.51543 | 3.288689 | 17.2674 | 13.38404 | 47.42354 | 4.1209 |
| 5 | 2.794655 | 17.36517 | 3.120467 | 16.74068 | 14.68379 | 40.08572 | 8.004175 |
| 6 | 3.054414 | 20.42942 | 2.752739 | 17.72496 | 14.78554 | 33.61933 | 10.68801 |
| 7 | 3.192921 | 20.63597 | 2.576844 | 18.85063 | 14.76607 | 30.90213 | 12.26835 |
| 8 | 3.226319 | 20.25072 | 2.543848 | 19.27537 | 14.58123 | 30.28842 | 13.06042 |
| 9 | 3.277819 | 22.0657 | 2.467082 | 18.68788 | 14.53929 | 29.36583 | 12.87421 |
| 10 | 3.396548 | 24.77885 | 2.297913 | 17.55379 | 15.90677 | 27.46706 | 11.99561 |
| Variance Decomposition of GOVERNMENT_SPENDING: | | | | | | | |
| Period | S.E. | LPRIVATE_INVESTMENT | LTAXATION | MONEY_SUPPLY | INTR | INFL | GOV_SP |
| 1 | 0.158793 | 32.70486 | 8.59152 | 9.146935 | 15.02069 | 0.693294 | 33.8427 |
| 2 | 0.260693 | 29.49049 | 7.115704 | 10.20353 | 12.90437 | 1.127794 | 39.15811 |
| 3 | 0.31899 | 25.50526 | 7.220774 | 8.556752 | 12.32091 | 0.821416 | 45.5749 |
| 4 | 0.356099 | 21.29119 | 7.805595 | 7.16251 | 12.71551 | 1.430542 | 49.59465 |
| 5 | 0.401274 | 16.76734 | 7.577325 | 10.67425 | 13.36759 | 4.923408 | 46.69008 |
| 6 | 0.463251 | 12.63565 | 6.266013 | 17.68133 | 14.25315 | 10.12514 | 39.03873 |
| 7 | 0.530202 | 9.663576 | 4.814828 | 23.45857 | 15.44334 | 14.86142 | 31.75827 |
| 8 | 0.588727 | 7.838883 | 4.112438 | 26.35626 | 16.59099 | 18.49313 | 26.60829 |
| 9 | 0.633233 | 6.790959 | 4.65195 | 26.94174 | 17.27534 | 21.0565 | 23.28351 |
| 10 | 0.664592 | 6.175768 | 6.549412 | 26.22771 | 17.30084 | 22.55798 | 21.18829 |

**Source:** Author.