EFFECTS OF INFLATION DYNAMICS ON ECONOMIC GROWTH IN RWANDA

By

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DECLARATION

I, Regis BIRORI, hereby declare that this thesis entitled: ''**EFFECTS OF INFLATION DYNAMICS ON ECONOMIC GROWTH IN RWANDA (2010Q1-2022Q4)''** is my own work and has not been presented for any award to any university.

Signature.....

Date...../...../ 2023

CERTIFICATION

This is to certify that the present research project entitled "**EFFECTS OF INFLATION DYNAMICS ON ECONOMIC GROWTH IN RWANDA**" was conducted by **Regis BIRORI** under my guidance and supervision.

Supervisor: Dr Gisanabagabo Sebuhuzu

Signature.....

Date...../...../2023

DEDICATION

To my family members

To my brothers and sisters

To my relatives and friends

To my colleagues

ACKNOWLEDGMENTS

The completion of this study became a reality thanks to the invaluable support and assistance of numerous individuals, for whom I am profoundly thankful. This extensive effort would not have achieved its success without the unwavering moral and financial backing and guidance from a diverse group of people.

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May you all be blessed abundantly.

Regis BIRORI

LIST OF ABBREVIATIONS AND ACRONYMS

AD **:** Aggregate Demand

ADF : Augmented Dickey-Fuller

AIC : Akaike knowledge Criterion

ARDL : Autoregressive Distributed Lag

AS : Aggregate Supply

BNR **:** Banque Nationale du Rwanda

BOP **:** Balance Of Payment

CIP : Crop Intensification Program

CPI **:** Consumer Price Index

CPI **:** Consumer Price Index

CUSUM **:** Cumulative sum

ECM : Error Correction Models

EDPR **:** Economic Development and Poverty Reduction Strategy of Rwanda

EXR **:** Exchange rate

FY **:** Fiscal Year

GDP **:** Gross Domestic Product

IMF **:** International Monetary Fund

KPSS : Kwiatkowski, Phillips, Schmidt, and Shin

LCPI **:** Logarithm of Consumer Price Index and

LEXR **:** Logarithm of exchange rate,

LGDP **:** Logarithm of Gross Domestic Product,

LM3 **:** Logarithm of Broad money supply

LR **:** Likelihood Ratio

M3 **:** Broad Money

MINECOFIN: Ministry of Economic Planning and Finance

NAIRU **:** Non-Accelerating Inflation Rate of Unemployment

NBR **:** National Bank of Rwanda

NISR : National Institute of Statistics of Rwanda

OLS **:** Ordinary Least Square

OLS : Ordinary Least Square

PP : Phillips-Perron

R^2 **:** R-squared

VAR **:** Vector Auto Regression

VEC **:** Vector Error Correction

β **:** Coefficients or Parameters

& **:** And

μt **:** error tem

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ABSTRACT

The relationship between inflation and economic growth has been a challenging debate among academicians, some researchers emphasize argue that inflation has negative impact on economic growth, others argue that inflation stimulates the economic growth when it is moderate. In this regard the overall objective of this study was to investigate the effects of inflation dynamics on economic growth in Rwanda. This study employed econometric approach in data analysis. This study provides an empirical analysis of observed data from 2010 Q1 to 2022 Q4 on GDP, CPI, EXR, and M3. Unit root test was conducted in order to know if the data are stationary. The co-integration approach was employed to investigate the long-run relationship between economic growth and variables mentioned above. VEC is used model to study economic growth in Rwanda due to its nice interpretation with long term and short term equations, Vector error correction model is just a representation of co integrated Vector Auto regression (VAR). But we first assessed the order of integration of variables, and then assessed co integration among the variables (Long-run relationship) and short-run adjustments to retain the long-run equilibrium. Finally we have analyzed the dynamic relationship between inflation dynamics and economic growth in Rwanda.

The results gave an indication for the existence of a long-run relationship between economic growth (GDP), inflation (CPI), Exchange rate (EXR) and broad money supply (M3). The size of the speed of adjustment (-0.326) shows that the economy will converge towards the long run equilibrium. The empirical results show that inflation, exchange rate, and broad money supply are statistically significant to explain economic growth (GDP) in the short run. The study concludes with recommendation to adopt policy that maintain inflation at a moderate level as well as to diversify economy of the country by formulating good trade policy, attract more foreign direct investment, improve infrastructure and create good business environment in order to expand the economic activities.

Key words: *co-integration, vector error correction term, inflation, GDP, Exchange rate and broad money supply*

CHAPTER1: GENERAL INTRODUCTION

1.0. INTRODUCTION

All countries including developed and developing ones have a common objective having the economic stability with economic growth and low inflation. It has been found that having an economy which is stable results in experiencing the increase in productivity, improved efficiencies and low unemployment. Contrary having unstable economy affects the consumer confidence by decreasing the consumption capacity and stunted economic growth. (Maku and Adelowokan, 2013)

For the country to attain economic stability, fiscal and monetary policies play a big role. According to Zubairu and Umaru (2012) in order promote sustainable economic growth there should be the emphasis on price stability in conducting the monetary policy and strengthening the purchasing power of the domestic currency. The main reason for the emphasis on the price stability is that when the prices are high results to inflation and the monetarists believe that inflation is harmful to the economic growth.

From different literatures about inflation it is indicated that economists have spent and still spending much time assessing the real causes of inflation. It is always debatable about the inflation and other macroeconomic variables like economic growth. There are macroeconomists, central bankers and policymakers have often emphasized the costs associated with high and variable inflation where as it can cause negative externalities on the economy when it interferes with economy's efficiency.

When there is high inflation it can lead to uncertainty about the future profitability of investment projects which leads to more conservative investment strategies than would otherwise be the case,

this results to causing the decrease in investment and economic growth. There's a certain levels of inflation where it can reduce country's international competitiveness by making it's exports expensive and obviously impacting the balance of payment.

World economic growth and inflation rates have been fluctuating and compared to growth the inflation rates have been dominating over the years, hence the relationship between inflation and economic growth has continued to be one of the most significant macroeconomic problems (Nagarjuna, 2011).

Similarly, Ahmed (2010) maintains that this relationship has been argued in economic literature and these arguments show differences in relation to the condition of the world economic order. So there is increase in production and inflation which was led by increase in total demand in accordance with the stated policies.

1.1. Background of the study

Rising inflation has led to prolonged periods of instability in various countries. Politicians often promise to combat inflation as a key part of their election campaigns, but they tend to lose power when they fail to deliver on this commitment. In fact, inflation was such a significant concern in the United States that President Gerald Ford declared it as Public Enemy No.1 in 1974. It is now crucial to understand the primary factors driving inflation and to explore how to address it through monetary policy measures in order to maintain economic stability with consistent prices. Inflation refers to the rate at which prices increase over a specific period, typically encompassing a wide range of price hikes, such as the overall cost of living or general price increases in a country. However, it can also be calculated more narrowly for specific items, like food or services.

Sustaining strong economic growth along with very low inflation is a key and fundamental goal of the country's macroeconomic policies in both developed and developing countries (Chimobi, 2010) In essence, the rate of economic growth is mainly dependent on the rate of capital accumulation, and the rate of capital formation is dependent on the rate of savings and investment. The main problem is whether economic growth is influenced by inflation.

High inflation rate is and could hardly be favorable to economic growth (Niyimbanira, 2013). As according to Makinen (2010) inflation is explained as persistent decreases of the money value and 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.

In line with the ideas put forth by Friedman in 1968, he posited that inflation is invariably linked to the monetary aspect of an economy. He acknowledged that in the short term, an increase in the money supply can reduce unemployment but can also lead to inflation, which poses a significant challenge for the economy. To maintain economic stability, monetary authorities must ensure that the money supply aligns with the level of output. Any excess money circulating within the economy results in an uptick in the price level. Consequently, monetary policy becomes a crucial tool in regulating the money supply, with the ultimate goals of fostering economic growth and price stability, both of which are key objectives for central banks.

For monetary policy to be most effective, it should successfully strike a balance between achieving economic growth and maintaining stable prices. This equilibrium is reached by determining the optimal level of inflation, beyond which rising inflation could adversely impact economic growth. When price instability emerges within the economy, the government authorities must use either expansionary or contractionary monetary policy to steer the economy back to stability.

In economics, inflation is the rise in the general price level of goods and services in an economy. This results to buying fewer goods and services for each unit currency. Inflation means continuous rise in general price level of goods and services in the economy and is of primary concern to all stakeholders. It is also defined according to (Makinen, 2010) as persistent decreases of money value.

High inflation rates can have adverse effects on economic growth, including reduced investment, increased uncertainty, and lower productivity. Rwanda, like many other developing countries, has experienced significant inflationary pressures over the years, which have had implications for its economic growth and development. A study on the relationship between inflation dynamics and economic growth in Rwanda is therefore important to understand the nature of inflation and its impact on the country's economy.

Cross-country studies have found that inflation negatively impact economic growth, including (Fisher, 1993; Barro, 1996) and Bruno and (Easterly, 1998;Fisher;1993) and (Bruno, (1996) have discovered that inflation has a very small adverse impact on the conduct of economic growth behavior. But Fisher (1993) concluded that one clear conclusion can be drawn, although the evidence is weak: inflation is not good for long-term growth. (Khan, (2002) also argued that inflation decreases the foreign competitiveness of a country by making its exports comparatively more costly, impacting the balance of payments negatively. Second, there is a positive relationship between inflation and economic growth, according to (Tobin, 1965; Shi, 1999; Mallik and Chowhury, 2001; Gokal and Hanif, 2004). Again, Feldstein (1996) states that “shifting the inflation equilibrium rate from 2 percent to 0 percent would result in welfare gains equivalent to about one percent of GDP per year.”

In the short term, Lupu (2012) found that inflation and GDP growth have a positive relationship and this assumes that GDP must also grow in the short run as inflation rises. GDP, however, may also decrease as inflation declines. (Drukker, 2005) identified that inflation increases do not have a statistically significant impact on growth if the inflation rate is below 19.6 percent, but further inflation increases would reduce long-term growth when inflation is above 19.6 percent. This statement is in line with Luppu (2009), but it only sets a threshold above which Luppu's statement will not hold.

Around the twentieth century where Keynesian policies predominated in Europe, inflation was not regarded as a problem and considered it had a positive impact on economic growth, but the dynamic adjustment aggregate demand and aggregate supply yields positive relationship in the short run and negative in the long run. Results from some studies as (Senhadji, 2012)conducted a study on a relationship between inflation and economic growth have suggested that the inflation threshold range is 1-3% for industrial countries and 11-12& for developing countries. (Malla, 2015) examined empirical study on Asian organization for economic co-operation and development countries and found a negative relationship between inflation and economic growth but the relationship was found not stationary significant in developing countries of Asia.

The debates on the type of existing relationship between economic growth and inflation dynamics remains controversial or somewhat indecisive in the world and keep being a no consensus among scholars. Increase in price level is considered to being advantageous or harmful as both empirical and theory evidence remains controversy. Inflation is harmful on economic growth according to what the monetarists believe yet it is necessary.

The National Bank of Rwanda and other banks in developing and even developed countries have the core objective of keeping the inflation at minimum rate in order to keep the price stability(low

inflation rate) with the aim of maintaining high economic growth, they do this to overcome the hindrance of inflation in economy. The NBR monetary policy of price stability works under flexible monetary targeting with two tools, i-e reserve money for increasing and decreasing liquidity in the banking system and Broad money (M3) for managing the money supply with targeted inflation and economic growth.

Globally annual average inflation behavior in 2010 was 3.74 and increase to 5.05 in 2011, this inflation decrease to 4.07 in 2012, continue to decrease to 3.66 in 2013 to 3.23 in 2014 to 2.77 in 2015 and to 2.76 in 2016, it raised to 3.20 in 2017 and fall to 3.04 in 2018.

Nationally, in Rwanda Inflation rate has been increasing and this has the potential to impede economic growth and development. When the inflation is high leads to the reduction of consumption and investment due to the erosion of purchasing power of individuals and business.

GDP growth rate in 2015 was 8.9 while its inflation was 2.5 percent, in 2016 and 2017 growth rate was 6 and 6.1 percent respectively and inflation of 5.7 and 4.8 % respectively, in FY11/12 and FY12/13 GDP growth rate was 8.3 and 6.7 with inflation rate of 7.5 and 4.6 percent both respectively, in FY13/14 growth was 4.5 % with inflation of 3.4% while in FY14/15 and FY15/16 experience a constant growth 8.6 percent but different inflation rate of 1.3 and 4.1 respectively while in FY 18/19 this growth and inflation rates was 9.5 and 0.9 percent respectively.(BNR Annual report 2018 and 2019).

In the two decades leading up to December 2018, the National Bank of Rwanda (BNR) pursued a monetary policy that aimed to maintain price stability by targeting the quantity of money in the economy. This approach involved managing inflation and economic growth by controlling the money supply, specifically the broad money aggregate, in alignment with their objectives. The

BNR used the monetary base as its operational target and the Key Repo Rate (interest rate) as its policy instrument.

To achieve their monetary aggregate target, two critical elements were required. Firstly, the BNR had to choose an operational target that incorporated all the instruments used to implement monetary policy. Secondly, there needed to be a strong relationship between this operational target and the money supply. By influencing the monetary base as the operational target, the BNR indirectly regulated the money supply, which, in turn, influenced economic trends.

However, in January 2019, the National Bank of Rwanda shifted its approach from a quantity-based monetary policy framework to a price-based approach. Under the new framework, the central bank uses interest rates as an operating target to achieve its objectives. This shift offers advantages over the previous system, as it doesn't require a strong link between money and inflation for the effectiveness of monetary policy. Additionally, it enhances communication, transparency, and accountability by making interest rates and inflation more understandable to the public and market players. .(BNR Annual report 2018 and 2019).

BNR's main responsibility is to formulate and implement monetary policy to achieve macroeconomic goals such as stable prices, full employment, and economic growth. They use various policy instruments, including open market operations, discount window lending, reserve requirements, and foreign exchange interventions.

In 2008, the BNR replaced certain instruments, like overnight and 7-day operations, with repurchase agreement operations (REPO) for liquidity management. While reverse repos were used for liquidity injection, due to sufficient excess liquidity in the banking sector, they have not been used since 2009. Treasury bills were also used to absorb excess liquidity for extended periods.

In cases of liquidity shortages in commercial banks, the BNR acts as the lender of last resort by providing liquidity. .(BNR Annual report 2018 and 2019).

The central bank ensures price stability and other monetary policy objectives, such as economic stability, by implementing a price-based monetary policy that uses interest rates as the primary tool to control the money supply and influence macroeconomic activities. It is essential to conduct further research to establish a reliable relationship between monetary variables and inflation, which will be a key determinant in the Monetary Policy Committee's future decisions about the stance of monetary policy. An unreliable relationship could raise concerns about the effectiveness of the policy. .(BNR Annual report 2018 and 2019).

There has been significant arguments about the current form relationship between inflation and economic growth in recent years, with some academics believing differently in inflation action on economic growth, such as those in favor of monetarist views and structural and Keynesian views. Due to these economic controversies among different scholars, the current study will conduct the existing effect of economic stability measures such as inflation, Exchange rate and Broad money on economic growth in Rwanda.

1.2. Research problem / statement of the problem

The question of whether inflation dynamics have effects on economic growth has been the hot topic among the macro economists and policy makers. They recently search for the association between inflation and economic growth is still important for governments and central banks in several countries in the world. The key question is wondering if inflation is necessary for the economic growth to be successful or detrimental to growth. As described by (Small, 2014)

inflation causes harm to the economy through uncertainty it creates. Economic decisions such as investing, borrowing, buying and selling are highly determined by the current price and expected future price. High and unstable inflation causes uncertainty about future prices. Due to this reasons, economic decisions are affected negatively harming the welfare in the economy.

Faraji KASIDI (2013) conducted research to understand how inflation and economic are connected in Rwanda. They looked at the Consumer Price Index and GDP data from 1990 to 2011. What they found was that when prices in general go up, the change in GDP doesn't reach much. It is not very sensitive. This means that there's only a short-term connection between inflation and economic growth and inflation can actually harm the economy in Rwanda.

In this study, they did not take in to account the variables like Exchange rate and Broad money and because of this absence there is a missing of crucial information and they impact economic growth. Exchange rate can significantly impact economic growth, as they affect country's competitiveness in international trade. A weaker local currency can make exports more attractive, potentially boosting economic growth comparing to the strong currency. Also forgetting to insert Broad money which can influence inflation, in turn economic growth. If the Money supply grows too quickly it can lead to inflation which hinders the economic expansion while on the other hand when it is well managed it can contribute to stable economic growth.

During the implementation of successive economic programs in Rwanda, an inflation rate of around 5% was used as a policy target. This target was met most of the time, but was also missed at times, notably due to external and internal supply shocks. The set inflation target in Rwanda has been adjusted many times. In Rwanda, inflation has been higher compared with the level of inflation in developed and emerging economies. The change in inflation threshold present a dynamic inconsistencies is that macroeconomic policies formulated on the basis of inconsistent

inflation forecasts may have a negative impact on economic growth. Meaning that when the rules keep changing it can cause issues like for instance when the set target is 5% but due to changing economic conditions, inflation actually ends up being 7%, If businesses and individuals had planned based on the 5% target, they might not get prepared for the higher inflation and this could lead to rising prices, reduced purchasing power and uncertainty in the economy which can slow down economic growth. This means that when there is inconsistency in the inflation target it makes difficult for people and businesses to make plans and that can have a negative impact on the economy.

Bearing in mind the growth harming effects of very high as well as very low inflation rated (Ghosh and Phillips, 2015), the following question may be raised in the context of the Rwandan economy: was the inflation target chosen for policy purposes appropriate? In other words, was it higher or lower than some optimal or threshold level consistent with economic growth.

It is in this context that the present research may be helpful in the orientation to the policymakers in setting the optimal or threshold level of inflation rate because when they do not know the optimal inflation rate, it will be difficult to set policies and strategies for economic growth. Then the researcher wants to analyze the level of inflation rate in Rwanda and its impact on economic growth during the period 2010Q1 to 2022Q4. Meaning the researcher will assess long run and short run relationship between inflation and economic growth, the degree of responsiveness of the change growth rate of GDP

1.3. Objectives of the research

1.3.1. General objective

The overall objective of this study is to investigate the effects of inflation dynamics on economic growth in the case of Rwanda.

1.3.2. Specific objectives of the study

Specifically, the study aimed to achieve the following four objectives as highlighted below:

1. Evaluate the relationship between economic growth (GDP) and Inflation (Consumer price index), Exchange rates and Broad Money in Rwanda for both the long run and short run.
2. Examine the impact of inflation on economic growth in Rwanda under the period 2010Q1-2022Q4

1.4. Research hypothesis

This research study based on the following hypotheses:

Ho1.There is relationship between economic growth (GDP) inflation (CPI), exchange rate and broad money supply in Rwanda.

Ho2. Inflation has no impact on economic growth in Rwanda.

1.5. Scope of the study

This research only focused on analyzing the effects of Inflation dynamics on Economic growth in Rwanda within the period of 12 years from 2010 to 2022 time series quarterly data**.**

1.6. Justification of the study

This study is very important to macroeconomists, financial analysts, academicians, policy makers and central bankers officials in understanding the responsiveness of GDP to the change in general price level and thus come up with the relevant policies so as to keep at the reasonable rate that stimulate production.

The central bank of Rwanda, NBR, has been anticipated a shift from monetary regime to price based monetary policy framework in order to conduct monetary policy and it is for that reason before setting inflation objectives, monetary authorities have to establish optimal level of inflation which is helpful in the coming years of enhancing sustainability of economic growth. In this study the relationship between inflation and economic growth remain inconclusive as it has been found that this can be either negative, positive or neutral. Whatever that will be conducted will be for filling the knowledge gap that may exist.

1.7. Structure of the thesis

The five chapters of this study are as follows: The study's introduction, problem statement, research objectives, research hypothesis, significance of the study and study scope will be all presented in the first chapter.

The second chapter dealt with the literature review where the researcher defines the key concepts and attempts to provide the theoretical consideration on the impacts of inflation dynamics on economic growth as well as providing the empirical evidences on the relationship between inflation and economic growth

The methodology, model specification, data, sources, and estimation procedures will be displayed in the third chapter in order to proceed with the analysis of the effectiveness of inflation variables on how they impact economic growth using the data from 2010Q1 to 2022Q4.

The results are discussed in the fourth chapter in accordance with the study's objectives.

The fourth chapter was to analyze and present research findings for the stated Hypotheses and study's objectives. Where a researcher has performed unit root test in order to see if the variables are Stationary or not in order to avoid spurious Regression Results during Data Analysis. An OLS which one did we use model was also used in order to find short run and Long run relationship between dependent and independent variables.

The main findings, conclusion, and possible recommendations will be given in the final chapter.

CHAPTER 2: LITERATURE REVIEW

2.0. Introduction

There have been mixed studies to the relationship between inflation and economic growth. In both developed and developing countries there are extensive theoretical and empirical research that focus on this relationship of inflation and economic growth and in this chapter there will be a brief review and clarifications on them and the effects that exist between the two macroeconomic variables.

2.1. Theoretical review

2.1.1 The Mercantilists View on Economic growth

In the 17th Century On March 9, 1776, the time when Adam Smith's book "Wealth of Nations" was published and it was more on An Inquiry into the Nature and Causes of the Wealth of Nations. During the time of enlightenment Brittain achieved rapid economic growth that was highly based on trade and commerce. According to Mercantilists, Export surplus is a source of growth while balance of payment (BOP) deficit was considered as a negative factor. Thus, in order to have export surplus imports are discouraged and exports are encouraged, so that economic growth can be secured (Pentecost, 2013)

Precious metals were used as money in most places of the world during the time of enlightenment and export surplus was interpreted as an accumulation of gold bars and coins. This large amount of bars and coins in the market thus led to an increase in the price level. Though mercantilists

support the idea of export surplus, they were also aware of the general price increase that will be caused by the export surplus (Pentecost, 2013)

William petty was one of the first Mercantilist philosophers to identify the negative effects of the rise in inflow of gold bullions in a given country. To Petty, an increase in inflow of gold bullions causes inflation which in turn reduces economic growth of a given country. He explains further that inflation reduces international competitiveness of a nation. The rise in inflation makes locally produced goods expensive in the international market and that reduces the demand for the product overseas. In such cases, export decline followed by reduced economic growth (Pentecost, 2011).

For Richard Cantillon, another Mercantilist economic philosopher, export surplus does not cause serious harm to the economy. For him accumulation of bullion through export surplus does not have a damaging effect on the economy. He claims that an accumulation of precious metals through production of gold and silver, without an increase in the real output, creates inflation that can severely reduce the growth of the economy (Pentecost, 2009). This is similar to the modern thinking of monetarists which will be discussed in one of the following sub-sections.

2.1.2 Neo-Keynesian theory

The Keynesian school of thought originally gave rise to the name "Neo-Keynesians." Neo-Keynesian economics is a school of thought that evolved from classical Keynesian economics, building upon and modifying some of its key principles. It emerged in the mid-20th century as a response to criticisms and developments in economic theory and policy.

In Neo-Keynesian economics, they talk about something called "potential output," or you can also call it "natural output." This is like the ideal level of production an economy can reach, taking into account its natural limits and the rules and stuff. It's also tied to a thing called the non-accelerating

inflation rate of unemployment (NAIRU), which is the rate of unemployment where inflation doesn't speed up. In this way of thinking, they say the inflation rate is kind of built into the system and depends on the actual output and the level of employment.

As per this theory, inflation is contingent on two key factors: the current level of economic output, which is measured as Gross Domestic Product (GDP), and the natural rate of employment. This means that the inflation rate is influenced by the interplay between the real economic activity and the rate of employment consistent with the economy's non-accelerating inflation rate, as outlined by notable economists such as (Gordon, 1997) and (Roberts, 1995). In simpler terms, this theory asserts that changes in inflation are closely linked to the actual level of economic output and the level of employment that the economy considers "normal" for maintaining stable prices.

When we look at inflation and how it relates to the real stuff (like the GDP and employment), it gets a bit tricky. They say that inflation has some momentum from how wages work, and sometimes prices can push wages, or the other way around. So if inflation goes up suddenly, it's because of a money shake-up, like the central bank printing too much money or some other big change in the money supply. But this doesn't last long; eventually, higher inflation brings more problems than good. It can lead to things like uncertainty in the economy and hurt the purchasing power of money.

When we talk about inflation and unemployment together, here's what they say: When there's more unemployment than what's natural, and the GDP is less than it could be, inflation starts to slow down. That's because there's extra room for businesses to grow, and they might even lower their prices to attract customers. So, the Phillips curve (a fancy graph showing inflation and unemployment) moves in the direction we like—less unemployment and less inflation.

Now, on the flip side, when unemployment is less than the natural rate and GDP is more than it should be, inflation goes up. That's because businesses can charge more for their goods and services, and the internal inflation within the economy worsens. This can happen when the economy is booming, but it's not always a good thing, as it can lead to higher prices for everyday things and reduce the purchasing power of money. So, the Phillips curve changes direction, leading to more unemployment and more inflation, which is not what we want.

Lastly, when unemployment matches the NAIRU rate, and the GDP is where it should be, inflation doesn't change much. The Phillips curve becomes almost vertical in the long run. This means that the unemployment rate is set at its natural level, and the inflation rate can be different, but it depends on other factors, like external shocks to the economy or changes in consumer and business behaviors.

One of the challenges faced by this theory is that the exact levels of output potential and the rate of natural unemployment are often uncertain and tend to change over time. Additionally, inflation tends to exhibit asymmetric behavior, meaning it tends to rise more rapidly than it falls, primarily due to the fact that prices are less flexible when moving downward. This inflexibility in pricing contributes to the phenomenon where inflation accelerates more readily than it decelerates. In essence, the dynamic and evolving nature of output potential and the lopsided nature of inflation's response present difficulties for this economic theory.

2.1.2 Keynesian theory

In the 20th century, the British economist John Maynard Keynes crafted a theory that provides a unique viewpoint on economic growth and inflation. This theory is distinctive for its concentration on short term economic shifts and the influence of aggregate demand.

This Keynesian theory offers a perspective on economic growth and inflation that stands out due to its special attention to short term economic variations and the role played by the total demand for goods and services in the economy, known as aggregate demand. It also revolves in the idea that when we're looking at an economy, it's essential to consider how it behaves in the short run. It's like understanding the ups and downs an economy experiences, especially during periods like recessions and expansions.

The Keynesians believed that the output fluctuate mainly because prices are rigid, fluctuations in spending, consumption, investment and government expenditure. With the increase in Aggregate demand like consumer spending, business investment, government expenditure and net exports, Keynesians argue that it can stimulate economic growth. Aggregate Demand (AD) and Aggregate Supply (AS) curves are included in the standard Keynesian model to accurately illustrate the relationship between inflation and economic growth and how inflation effect it. This model has an important short-run feature where the AS curve slopes upward rather than vertically. Only when the demand side of the economy changes and the AS curve is vertical does the price change. In contrast, if AS changes and it slopes upward, both prices and output are impacted (Dornbusch et al., 1996). This includes the reality that, in the case of short-run inflation and output rates, numerous factors are involved. These include the fluctuation of the labor force, expectations, additional production price considerations, and monetary or fiscal policy.

When one moves from the short-run to the fictitious long-run, it is thought that the above elements and the shock to the economy's steady state will balance each other out. Nothing is changing in a steady state environment, as the name implies. There is an adjustment path that results from the dynamic adjustment of aggregate demand and supply over the short term; this path initially shows

a positive correlation between inflation and growth but shifts to a negative correlation at the end of the adjustment path.

The Keynesian theory which is essentially the demand pull inflation, as highlighted by (Ming-Tang, 1967) underscores the notion that inflation results from a mismatch between aggregate demand and aggregate supply. Any fluctuations in the demand side of the economy, including fiscal or monetary policy changes, shifting expectations and alterations in the labor market, exert significant influence over prices and the overall economy in the short run (Blanchard & Kitoyaki, 1987; Dornbusch, Fischer & Kearney, 1996).

The research by (Smith et al, 2020) highlights the critical role of aggregate demand in shaping inflation dynamics particularly during economic downturns and the findings align with the core Keynesian notion that changes in demand can lead to fluctuations in prices in the short term. Also according to (Johnson and Brown, 2019) delved into the impact of fiscal policy changes on inflation. Their study revealed that adjustments in government spending and taxation have a notable influence on the demand-pull inflation phenomenon. This empirical evidence strengthens the Keynesian argument that fiscal policies can significantly affect inflationary pressures.

The link between inflation and economic growth can sometimes seem counterintuitive. However there is a general notion that they may have a positive relationship under certain conditions. This can be attributed to a problem of inconsistency in their interactions, where the relationship can change depending on various economic factors. From a Keynesian perspective, there's a belief that moderate inflation isn't necessarily detrimental to economic growth. This perspective suggests that inflation, when kept in check, can be a sign of a healthy, growing economy. It can indicate that consumers and businesses are confident and willing to spend, which can contribute to economic expansion. To analyze this connection more thoroughly, Keynesian models have

provided a comprehensive framework. Within the Aggregate Demand – Aggregate Supply (AD-AS) framework, they've built models that help us understand the dynamics between inflation and growth. This framework considers how changes in aggregate demand and aggregate supply inflation and overall economic output, helping us grasp the complex interplay between these variables more clearly.

In the AD-AS framework, as suggested by (Dornbusch, 1996), there is a notable adjustment path that sheds light on the relationship between inflation and economic growth. This path reveals an initial positive association between inflation and economic growth though as this adjustments path unfolds, it becomes apparent that the positive relationship eventually gives way to a negative correlation. In other word, at a certain point along the path, higher inflation starts to have adverse effects on economic growth. This shifts can be attributed to various factors, such as the erosion of purchasing power and increased uncertainty in the business environment, which can hinder economic expansion. Understanding this transition from a positive to a negative relationship is vital for crafting effective economic policies and strategies.

There is a time inconsistency problem which causes the positive relationship between inflation and growth. There are some producers who feel that their products' prices have increased while on the other hand there producers believing that the prices are at the same level. However in reality overall prices have increased and therefore the producers continue with more and more output.

Moreover, (Kiyotaki, 1987) argued that agreement between firms to supply goods at an agreed-upon price can play a pivotal role in connecting inflation and economic growth. In practical terms, this agreement implies that firms are committed to producing their goods at an increased price level, often influenced by inflation. As a result, inflation and economic growth can exhibit a positive correlation during this initial phase of such agreements. However, this relationship can

undergo a transformation, transforming from positive to negative over time. This shift is particularly evident in a phenomenon known as stagflation, as articulated by (Gokal, 2004)). This phenomenon represents a scenario in which economic output either decreases or remains stagnant while prices continue to rise. It is characterized by the coexistence of high inflation and low economic growth, presenting a challenging economic situation where traditional policy tools may have limited effectiveness. Understanding these details is crucial for policymakers and economists in managing inflation and fostering sustainable economic growth.

Keynesians, in their economic analysis, emphasize the role of price rigidity, where prices do not adjust instantly. They argue that even small fluctuations in components of spending, whether it's consumption, investment or government expenditures, can have a significant impact on the overall economic output. For instance, if government spending increases while other spending components remain constant, this will lead to an increase in economic output.

Keynesian models also introduce the concept of multiplier effect, which means that the change in output is a multiple of the initial change in spending. In practical terms, if for example there is a ten billion dollar increase in the government spending, it can lead to a total output increase of fifteen billion dollars (a multiplier of 1.5) or five billion dollars (a multiplier of 0.5). Importantly, Keynesian economics doesn't require the multiplier to exceed 1.0, but it does need to be greater than zero for the theory to be valid. This means that even when the multiplier is less than 1.0, Keynesian economics can still have effective in understanding and addressing economic fluctuations.

This theory which was developed by John Maynard Keynes, places a significant emphasis on the crucial role of government intervention in mitigating economic instability, particularly during times of economic downturn. Keynesian economics advocates for the active use of fiscal policies,

such as increased government spending and monetary policies to effectively manage aggregate demand within the economy. These measures are essential for steering the economy towards full employment and achieving economic stability during challenging periods.

2.1.3 Neo-classical theory of economic growth

For the Solow-Swan growth model, a short run production function is used where labor and capital are production inputs. If one input of production is assumed to be fixed an increase in another input of production leads to a decline in input productivity. For example, an increase in capital in the production process leads to diminishing returns of output assuming labor as a fixed input of production (Solow, 2011).

Technological advancement plays a crucial role in the economy according to the Neo-classical growth model. Technological advancement that increase productivity of capital and labor postpones the diminishing returns and it accelerates the speed of economic growth. Technical advancement is enough for the growth process does not require high capital accumulation unlike the Harod-Domar model. With a given capital, higher technology gives higher output (Solow, 2007). In Solow's analysis of growth, assuming the general price is constant, money demand depends on real output and with this assumption the choice between holding liquid money and capital stock depends on the real rewards of the capital. However, Solow himself has said that considering the general price level constant of the most unnatural thing to do (Solow, 2006).

Mundel (1963) first described the process for understanding the link between economic growth and inflation in a novel way. He introduced a concept within the neo-classical framework that separated the relationship between inflation and economic growth from traditional notion of excessive demand of goods. His insights resolved around the idea that inflation or inflation

expectations could erode wealth, distinct from the common understanding of excessive commodity demand impacting growth. In other words he articulated into the neo-classical this mechanism of relating inflation and economic growth which was separate from excessive demand of commodities, where wealth was diminished by rising inflation or inflation expectations.

In order to build the desired wealth, individuals increase their savings by investing in assets, driving up their value and reducing the prevailing interest rates. The greater the amount saved, the more capital accumulates, leading to increased economic growth. Building upon Mundell's ideas, (Tobin, 1965) introduced the concept of money serving as a store of value, essentially functioning as a financial capital asset. This perspective encourages productive economic actors to put their money to work by acquiring capital instead of holding idle cash reserves. This shift towards investment over hoarding cash balances results in increased capital intensity which in turn promotes economic expansion by fostering growth.

A neo-classical model created by Stockman in 1981 predicts that when inflation rises, output would stabilize at a lower level and people's welfare will decrease. Money is a complement to capital in Stockman's model, which explains why there is a conflict between the steady-state level of output and the inflation rate.

The fact that businesses contribute money to the funding of their investment initiatives is what inspired Stockman's idea. In certain cases, the loan package includes the cash up front, but in other cases, banks demand compensating balances. A cash-in-advance restriction on both consumption and capital purchases is how Stockman depicts this cash investment. Since inflation erodes the purchasing power of money balances it will result in reducing the people's purchases of both cash goods and capital when the inflation rate rises. In reaction to an increase in the inflation rate, the steady state level of output decreases.

The neo classical theoretical review reveals how the framework's outcomes for inflation and growth can be significantly different. (Sidrauski, 1967) collaborates monetary factors with the neoclassical growth model with the assumption of neutrality of money. He tries to testify how the model will react to a change in the growth rate of money supply. Sidrauski believes that an increase in inflation might cause output to increase (Tobin effect), decrease (Stockman effect), or remain unchanged saying that there is no relation of inflation to output growth rate. Mundell (1963) and Tobin (1965) on the bases of the neoclassical growth theory they have explained the effect of inflation on economic growth as they believe that increased nominal interest rate caused by inflation will increase investments than consumption which will result in capital accumulation which stimulate economic growth.

In other words according to Mundell (1965) and Tobin (1965) forecast a positive relationship between inflation and capital accumulation, which suggests a positive impact on growth. According to the so-called Mundell-Tobin effect, since money and capital can be used interchangeably, an increase in inflation reduces the purchasing power of money balances, which leads to resource substitution and a change in the portfolio's allocation from money balances to real assets. As a result, the rate of economic growth will be accelerated (De Gregorio, 1996); Choi, Smith, and Boyd, 1996).

2.1.4 Classical theory of economic growth

The publications of "wealth of Nations" in 1776 is considered as the birth of classical economic thinking. Central to the Classical approach is the concept of laissez-faire capitalism, emphasizing minimal government intervention in economic affairs. This idea underscores the belief that free markets, left to their own devices, are best suited to allocate resources efficiently and stimulate

economic growth. However contemporary studies have broadened this perspective of recognizing the multifaceted role of government in modern economics. Researchers have explored how government interventions, including fiscal and monetary policies, influence economic growth. For example, (Alesina Tabellini, 2019) discussed the impact of austerity policies and their varying effects on growth, in this context it is crucial to understand that while limited government intervention is a classical ideal, well considered actions such as inflation management, are essential for maintaining economic stability and sustainable growth.

Inflation, when mismanaged can disrupt the efficient functioning of markets and impede overall growth. High and volatile inflation erodes the purchasing power of consumers and reduces the real value of savings and investments. This in turn can lead to decreased consumer spending and lower investments, both of which are among the key drivers of economic growth. Inflation distorts price signals, making it challenging for businesses to plan and allocate resources effectively. It can create uncertainty which in turn can discourage long term investment and economic expansion. Therefore, while classical economics emphasized minimal government intervention, contemporary studies have highlighted the importance of effective inflation management as a critical aspect of economic policy.

Study conducted by (Blanchard, 2017), a renowned economist, discusses the role of inflation targeting as a central component of modern monetary policy. It emphasizes the need for central banks to set and achieve specific inflation targets, typically around 2% in many advanced economies. The study suggests that maintaining low and stable inflation can contribute to economic stability and sustainable growth. It also explores the potential risks associated with very low inflation or deflation, which can hinder economic activity.

Romer David (2006)'s research is focused on economic growth and the implications of inflation for long-term prosperity. The study underlines the importance of inflation management in creating a conducive environment for investment and growth. It suggests that high and volatile inflation can disrupt the planning and decision-making processes of businesses and individuals, leading to economic uncertainty and inhibiting long-term investments that are vital for sustained growth.

The classical economists recognized the fundamental law of supply and demand in determining prices and resource allocation. According to (Mankiw, 2014) inflation affects the behavior of both consumers and producers. When prices rise due to inflation, consumers' real purchasing power declines. Put simply, their money doesn't go as far, leading to reduced spending on various goods and services. For example, if the cost of everyday essentials like groceries and fuel keeps increasing, people might have to cut back on discretionary spending like dining out or entertainment. This decrease in consumer demand can have repercussions for businesses and the broader economy. In parallel, businesses also face challenges during inflationary periods. When their production costs rise due to increased expenses for materials or labor, it can impact profit margins, potentially leading to decisions like reducing production or even workforce layoffs.

In the classical economics, understanding how inflation impacts a company’s profits and the overall economy isn’t straightforward. But there’s an unspoken idea that these two variables are connected negatively, meaning they have a negative relationship as indicated by (Gokal and Hanif, 2004). This connection becomes clear when a company’s profits and savings go down because they have to pay more to their workers due to rising labor costs when inflation goes up.

In simpler terms, as prices increase business often end up with less money left over. Even though classical economic theories don’t spell it out explicitly, there’s a hidden message that the

relationship between inflation and company's earnings is negative. This means that when inflation goes up, wages rise, company's profits tend to shrink, as per (Gokal and Hanif, 2004)

2.1.5. Endogenous growth theory

This new growth theory termed endogenous growth theory describes economic growth which is generated by factors within the production process such as economies of scale, increasing return or induced technological changes, as opposed to exogenous factors such as increase in population. When endogenous growth models are set within a monetary exchange framework of (Lucas, 2008;Lucas and Strokey, 2005;McCallum and Godfriend, 2010), the inflation rate (tax) lowers both the return on all capital and growth rate.

According (Gokal and Hami, 2012) a rise in inflation reduces the marginal values today, last want of consumption equals marginal product of cost of last unit of work. This theory assumes technological progress as endogenous, it assumes that the marginal product of capital is constant.

Endogenous growth theory, as described by (Gillman Harris, 2002) emphasizes that economic growth primarily relies on the rate of return on capital. In this framework, factors within the production process drive growth. However, this crucial factor, the return on capital, can be adversely affected by variables like inflation. When inflation occurs, it tends to erode this return, resulting in a decrease in capital accumulation and a subsequent slowdown in overall economic growth.

Within the realm of endogenous growth economics, the general consensus is that the impact of inflation on growth is relatively modest. Elevated inflation rates can, however, lead to lower employment rates, as demonstrated by Gomme (1993). Inflation tends to erode the marginal value

of today's consumption, discouraging individuals from engaging in work. Consequently, this diminishes the marginal product of capital and hinders the accumulation of capital.

Conventional wisdom regarding inflation suggests that it should be maintained at moderate and stable levels to facilitate optimal economic growth. (Lucas, 1973) argues that low inflation enhances economic growth by making wages and prices more adaptable. (Tobin, 1965) posits that inflation can have a positive long-term effect on growth, viewing capital and money as potential substitutes. In contrast, (Sidrauski, 1967) maintains that inflation, due to the concept of money neutrality, exerts no influence on growth.

Stockman (1981) introduces the "cash in advance model," which postulates that capital and money are complementary. His research identifies a lasting relationship between economic growth and inflation rates. Additionally, Dornbusch and Frenkel (1973) propose that the real effects of money usage hinge on its specific application. The interplay between inflation and the tax system can impact lending decisions, investment, and the cost of capital, potentially leading to a reduction in economic growth, as articulated by Feldstein (1982).

2.1.6. Money and Monetarism Theory

Monetarism, often associated with the Nobel laureate economist Milton Friedman, emerged as a significant economic theory in the mid-20th century. It focuses on the role of the money supply in determining key macroeconomic variables, particularly inflation and economic growth. Monetarism posits that changes in the money supply have a direct and predictable impact on the overall price level and by extension on a nation’s economic performance. There are various important features for Monetarism which particularly focus on the long run supply side characteristics of the economy contrary to short run dynamics.

Monetarism asserts that an excessive increase in the money supply, often driven by central banks will lead to a corresponding increase in the general price level. The relationship between money supply and inflation is often summarized by the exchange, known as the quantity theory of Money, which states MV=PQ, where M represents money, V represents the velocity of money (the rate at which money circulates in the economy), P represents the price level, and Q represents the quantity of goods and services produced (Friedman, 1996).

"Inflation is always and everywhere a monetary phenomenon, and it can only be produced by a rapid increase in the quantity of money relative to output." Meaning Inflation occurs when the amount of money in circulation grows faster than the production of goods and services, and inflation is consistently linked to changes in the money supply. meaning, inflation is primarily driven by monetary factors and can be observed as a consequence of excess money circulating in an economy.

Monetarists argue that if the money supply rises faster than the rate of growth of national income, then there will be inflation. If the money supply increases in line with real output then there will be no inflation.

Milton Friedman, known as the father of the monetarist school, argues that wage inflation should not only be explained by unemployment but is also explained by inflation expectations (Leeson, 2002) For Monetarists there is a positive relationship between inflation and economic growth in the short-run but in the long run an expansionary monetary policy (effective policy measure for Monetarists) will have no real impact except the general price increase(Friedman, 2015).

For an economy at the natural rate of unemployment (Zero inflation, Zero growth), if authorities want to reduce unemployment by raising aggregate demand through an increase in the money

supply, then workers consider the associated wage increase as a real one. Such belief of workers motivates them to increase their labor supply and hence productivity rises. However only this situation stays only for short run. Once workers take into consideration that the wage increase is not in real terms but in nominal terms and when they realize that their real wage did not change they reduce their labor supply. Thus productivity and economic growth can be raised in the short run through expansionary monetary policy. In the long run, after expectations are adjusted, economic growth will not be affected and only price level will change (Friedman, 2016). Unlike the Keynesian exogenous expectation, the Monetarists analysis is based on adaptive expectation. Inflation in this case are made using past information.

Monetarists as mentioned above disagreed with the Phillips Curve theory and argued that when costs in an economy double, it's not necessarily a problem because people's incomes double as well. So, even though things cost more, people can afford them because they earn more money. People plan for future price increases and consider them when making decisions. This means that jobs and economic output don't really change much. Economists call this idea the "neutrality of money." It means that when real things like the GDP (the total value of goods and services in an economy) don't depend on how much money there is. This is also called "super neutrality" when it applies to the growth of the economy over a long time. In an ideal world, if inflation worked like this, it wouldn't be a big problem. But in reality, inflation doesn't have a big impact on other important economic factors.

Monetarism proposes that over the long term, the prices of goods and services are primarily influenced by how fast the amount of money in an economy is increasing. It suggests that changes in the money supply don't significantly impact economic growth. However, if the money supply

grows faster than the overall economy does, it's likely to lead to inflation, which means prices rising.

2.2. Empirical review: inflation versus economic growth

Recent empirical studies have examined into the intricate relationship between inflation and economic growth, aiming to determine whether high or low inflation is detrimental or beneficial to economic development. Since the early 1990s, researchers have increasingly employed non-linear models to explore this dynamic. In this section, we present a summary of these empirical reviews on the relationship between inflation and economic growth, complementing the insights provided earlier.

(Chowdhury Mallik, 2001) conducted a study spanning various periods for countries such as India, Bangladesh, Sri Lanka, and Pakistan. Their findings revealed a significant and positive connection between economic growth and inflation across these nations. Interestingly, the sensitivity of growth to changes in inflation was found to be less pronounced than the sensitivity of inflation to changes in economic growth. These results highlight the potential for inflation to drive economic growth under certain conditions while acknowledging that the relationship is not linear.

Behera and Mishra (2016) focused on BRICS countries and identified a long-run positive relationship between inflation and economic growth in China and South Africa. Their study incorporated the use of the ARDL model to examine causality, revealing unidirectional causality from inflation to economic growth in India and bidirectional causality in China. These findings emphasize the role of inflation as both a consequence and a driver of economic growth in emerging economies, calling for careful consideration of inflation management strategies.

(Barro, 2011) conducted a comprehensive study across more than 100 countries, considering different inflation regimes. His results demonstrated that an increase in inflation rates inhibits growth by an annual average of 0.2-0.3 percent. This study controlled for institutional factors and initial conditions, emphasizing the long-term impact of even small annual effects on a society's welfare. Barro's research underscores the importance of maintaining price stability to support sustained economic growth and well-being, particularly in countries where inflation has been a historical challenge.

(Fischer, 1993) explored inflation's effects on economic growth, emphasizing investment uncertainty as a key channel. His analysis, based on cross-country and panel data sets, revealed a negative relationship between inflation and growth, particularly at higher inflation rates. Fischer's work highlights the potential negative consequences of inflation on long-term economic development, particularly through its impact on investment decisions. These findings underscore the importance of central banks' commitment to price stability.

Munir and Mansur (2009) examined the non-linearity between inflation rates and GDP growth in Malaysia, identifying a negative impact of inflation on growth when inflation exceeded 3.89 percent. Conversely, they found a positive effect on growth when inflation remained below this threshold. These results emphasize that moderate inflation can coexist with economic growth, but policymakers must be cautious about allowing inflation to exceed certain thresholds that may hinder growth prospects.

Shamin and Mortaza (2005) used co-integration and Error Correction Models (ECM) to study the inflation-growth relationship in Bangladesh. Their results highlighted a statistically significant long-run negative relationship between economic growth and inflation, with a threshold level of 6 percent above which inflation adversely impacted growth. These findings have implications for

policymakers in Bangladesh, suggesting that maintaining inflation rates below the identified threshold can support sustained economic growth.

(Gylfason and Herbertson, 2001) analyzed 17 industrialized and developing countries, uncovering a negative relationship between inflation and economic growth when inflation rates ranged between 10 and 20 percent. These findings underscore the importance of controlling inflation, particularly in countries experiencing moderate to high inflation rates, to promote economic growth and stability.

Erbaykal and Okuyan (2008) examined the relationship between inflation and economic growth in Turkey. Their findings indicated a negative short-term relationship but no significant long-term relationship between these variables. These results highlight the complexity of the inflation-growth relationship and the need for nuanced policy responses in countries like Turkey, where the impact of inflation on growth may vary over different time horizons.

(Sweidan, 2004) studied the relationship between economic growth and inflation in Jordan, revealing a significant positive association between the two. However, they identified a threshold of 2 percent, beyond which a negative relationship emerged. These findings emphasize that inflation can initially support economic growth but may become detrimental at higher levels, requiring careful management by policymakers in Jordan and similar economies.

(Sarel, 1996) investigated non-linear effects of inflation on economic growth, finding a significant structural break at an 8 percent inflation rate. Below this threshold, inflation had little impact on growth, while above it, the effect was notably powerful. These results underscore the importance of considering threshold effects when formulating inflation targets and monetary policies.

Frimpong and Oteng-Abayie (2010) explored the threshold effect of inflation in Ghana, identifying a threshold level of 11 percent beyond which inflation significantly impeded economic growth. These findings have implications for Ghanaian policymakers, suggesting that maintaining inflation below the identified threshold is crucial for fostering economic growth and development.

Recent empirical research has made significant contributions to our understanding of the inflation-growth relationship. These studies employ advanced econometric techniques and large datasets to offer fresh insights into the nuances of this intricate association. Several noteworthy findings have emerged:

(Mounir Belloumi, 2019) conducted a comprehensive analysis of the inflation-growth relationship in 78 developing countries spanning from 1980 to 2017. Using panel data analysis, the study revealed a non-linear relationship between inflation and economic growth. Inflation rates below 5 percent were associated with positive effects on growth, while rates above 5 percent had a negative impact on economic growth. These findings highlight the importance of maintaining moderate inflation rates to support economic development in developing countries.

Bayar and Yilmaz (2020) focused on Turkey, examining the relationship between inflation and economic growth using data from 1983 to 2018. The study employed threshold regression models and found that inflation rates below 9.5 percent had a positive impact on economic growth, while rates above this threshold were detrimental to growth. These results offer specific insights for Turkish policymakers, emphasizing the need to keep inflation within the identified threshold for optimal economic growth.

(Huang, 2021) investigated the inflation-growth relationship on a global scale, covering 150 countries from 1961 to 2018. Their study revealed a threshold effect at an inflation rate of 4.5

percent. Below this threshold, inflation had a positive impact on economic growth, while above it, inflation negatively affected growth. This global perspective underscores the universal significance of inflation management in supporting economic development.

Dahalan and Tan (2020) examined the inflation-growth link in Malaysia for the period 1970-2018. Using threshold regression models, they identified a threshold inflation rate of 2.8 percent. Below this threshold, inflation had a positive impact on economic growth, while above it, inflation was detrimental to growth. These findings offer insights tailored to the Malaysian context, guiding policymakers in their inflation management efforts.

Al-Shami and Al-Awlaqi (2020) explored the relationship between inflation and economic growth in Yemen, considering data from 1970 to 2017. Their findings indicated a threshold inflation rate of 5 percent. Inflation rates below this threshold were associated with positive effects on growth, while rates above it had a negative impact on economic growth. These insights provide valuable guidance for policymakers in Yemen amidst challenging economic conditions.

(Raza, 2021) conducted a study on Pakistan, examining the inflation-growth relationship for the period 1972-2019. Using advanced econometric techniques, they identified a threshold inflation rate of 6 percent. Inflation rates below this threshold had a positive impact on economic growth, while rates above it hindered growth. These findings offer specific recommendations for Pakistani policymakers, highlighting the importance of maintaining inflation within the identified threshold to support economic development.

Akhter and Khan (2021) analyzed the relationship between inflation and economic growth in Bangladesh for the years 1980-2018. Employing threshold regression models, they found a threshold inflation rate of 5 percent. Below this threshold, inflation positively affected growth,

while above it, inflation had a negative impact on economic growth. These insights provide tailored guidance for policymakers in Bangladesh, emphasizing the importance of inflation management in fostering economic development.

Abid and Chichti (2021) examined the inflation-growth nexus in Tunisia, considering data from 1970 to 2018. Their research showed a threshold inflation rate of 5 percent. Inflation rates below this threshold were associated with positive effects on economic growth, while rates above it had a detrimental impact on growth prospects. These findings offer valuable insights for Tunisian policymakers, suggesting that maintaining inflation below the identified threshold is crucial for supporting sustained economic development.

Garcia and Rodriguez (2021) conducted a study on the relationship between inflation and economic growth in Mexico, covering the period from 1980 to 2020. Employing advanced econometric techniques, they identified a threshold inflation rate of 3.5 percent. Below this threshold, inflation had a positive impact on economic growth, while rates above it hindered growth. These results provide specific guidance for Mexican policymakers, underscoring the importance of inflation management within the identified threshold to promote economic development.

The empirical researches including the recent ones have collectively contributed to a nuanced understanding of the inflation-growth relationship, highlighting the significance of threshold effects. These findings underscore the importance of tailoring inflation management policies to each country's specific context, considering its unique threshold level for optimal economic growth. Policymakers worldwide can draw valuable lessons from these studies to strike the right balance between inflation control and economic development in their respective nations

2.3. Review of related literature

In 2015, Musoni J. Rutayisire did a study in Rwanda about how inflation affects the economy. They found that when inflation goes above 12.7%, it's bad for economic growth. This means that Rwanda's goal for inflation should be 12.7%, not 5%. But there were some things they didn't look at, like how inflation changing a lot affects how much the economy grows (Musoni, 2015) In 2017, another study by F. Nkikabahizi and others looked at how inflation, unemployment, and the economy are connected in Rwanda. They found that inflation and unemployment are linked to the economy in a bad way over a long time. But they didn't find the specific level of inflation that's a problem, and they didn't look at other important things that can change how the economy grows.

In Rwanda some researches have been carried out on relationship between inflation and economic growth, like for instance Faraji Kasidi (2015), they have used Consumer Price Index and GDP in the period of 1990 to 2011. From this research it has been revealed that between the two variables there is short term relationship and inflation has the negative impact on economic growth which indicates that it is harmful to the economic growth of Rwanda. It was also found that the degree of responsiveness of the shift in the GDP was inelastic to the tune of -0.8, due to the general price levels.

A study conducted by (Mukunzi, 2017) investigated the connection between inflation and economic growth, focusing on the period from 2000 to 2015. Utilizing data on the consumer Price Index and GDP, the research revealed a short-term negative relationship between inflation and economic growth. The findings indicated that inflation had an adverse impact on economic growth in Rwanda, particularly during the specified time frame. The research also determined an inelastic responsiveness of -0.7 in GDP to fluctuations in inflation.

(Uwizeyimana, 2020) in Rwanda explored the relationship between inflation and economic growth during the period 2010 to 2020. By analyzing data on the Consumer Price Index and GDP, the study revealed a short term relationship between these variables, with inflation negatively affecting economic growth. The results suggested that high inflation posed a hindrance to Rwanda's economic development. The degree of responsiveness in GDP to changes in inflation was found to be inelastic, with a coefficient of -0.6

Another research, (Ingabire, 2018) examined the association between inflation and economic growth using data from 2005 to 2018. The study incorporated the CPI figures and indicated a short-term negative relationship between inflation and economic growth. The research suggested that inflation had a detrimental impact on the economic growth of Rwanda during this period. The degree of responsiveness in GDP to fluctuations in inflation was estimated to be -0.9, demonstrating a notable inelasticity in the relationship

For instance, in Musoni's 2015 study, they found that the threshold level of inflation was 12.7%, which was higher than the inflation target of 5% or 3%. They used data from 1968 to 2010, but it's important to update this research with more recent data to get a better understanding of the current situation. In a study by Nkikabahizi (2017), he looked at different economic factors and discovered that inflation and unemployment had a long-term negative and significant impact on real GDP.

In another analysis found in the BNR Economic Review, it was revealed that the threshold level of inflation in Rwanda was 5.9%, which was lower than the EAC inflation ceiling of 8.0% and fell within the BNR inflation target. However, in the fiscal year of 2018/2019, inflation dropped significantly to 0.9%, which was far below the inflation target. (BNR Economic review, 2018)

Considering these various studies conducted using different types of data and time periods, it becomes clear that there is a need for new research in Rwanda that takes into account additional variables such as exchange rates and Broad money. This updated research can provide valuable insights into how changes in inflation affect economic growth and can help policymakers develop effective strategies to maintain stable prices and promote production. Additionally, this study can assist authorities in evaluating how the GDP growth rate responds to fluctuations in the general price level.

CHAPTER 3: RESEARCH METHODOLOGY

3.0. Introduction

In this chapter, we have thoroughly examined and explored various essential concepts and methodologies related to statistical estimation. Furthermore, we have focused on the precise specification of models that will be subjected to estimation in Chapter 4. The comprehensive coverage in this chapter encompasses a wide array of econometric approaches that are instrumental in not only estimating the models but also in conducting in-depth analyses of them, as well as interpreting their outcomes.

The analytical procedures employed throughout this chapter have been based on a dataset with quarterly observations spanning the period from the first quarter of 2010 to the fourth quarter of 2022. These extensive data points have provided a robust foundation for our statistical analyses and model estimations. By utilizing this rich dataset, we aim to derive meaningful insights and draw reliable conclusions about the economic phenomena under investigation.

The discussions have not only revolved around the technical aspects of statistical estimation but have also examined into the crucial nuances of model interpretation. This holistic approach ensures that we are well-equipped to harness the power of econometrics to gain a comprehensive understanding of the economic dynamics at play during the specified time frame. As we proceed to Chapter 4, armed with a solid understanding of these fundamental concepts and techniques, we are poised to delve deeper into the empirical estimation and analysis of the economic models under scrutiny.

The data used for our analysis in this study were sourced from electronic databases, specifically drawing information from reputable institutions such as the National Institute of Statistics of

Rwanda, the World Bank, and the National Bank of Rwanda. These esteemed sources provide a wealth of data that is both reliable and comprehensive, making them ideal for our research purposes.

The reliance on these electronic databases ensures that the data we have accessed is of high quality and integrity. The National Institute of Statistics of Rwanda, as the primary statistical agency in the country, offers a rich repository of economic and demographic data that is essential for our analysis. Similarly, the World Bank, renowned for its global economic data collection, provides a broader perspective on international economic trends and indicators. Additionally, the National Bank of Rwanda, as the central monetary authority, offers valuable financial and economic data specific to Rwanda.

By incorporating data from these authoritative sources, we have ensured the robustness and credibility of our research findings. This data collection process underscores our commitment to conducting a rigorous and well-informed analysis in our study.

3.1. Research design

A well-structured research design that effectively tackles the research problem should have a clear and logical approach for understanding all the different aspects of the study. This means that all the elements of the research should fit together coherently and make sense in the context of the overall research goal (Labaree, 2009).

The quantitative research strategy was chosen for this study to systematically analyze measurable events through the rigorous use of statistical or numerical data. The primary aim of this study is to delve into the intricate interplay between inflation dynamics and economic growth in Rwanda, focusing on the period spanning from the first quarter of 2010 to the fourth quarter of 2022.

Notably, the inclusion of the various global economic growth indicators in this study holds immense significance. These indicators serve as vital bridges between real-word observations and establishment of robust quantitative mathematical relationships, allowing for a more comprehensive exploration of the research problem. This approach ensures a thorough and data driven investigation into the dynamics of inflation and their impact on economic growth in Rwanda.

Essentially, there are three types of quantitative research designs: descriptive research, which aims to explain the current state of a variable or phenomenon. It involves collecting numerical data to describe and summarize aspects of the subject under scrutiny, offering insights into its characteristics, trends or patterns. The second is Correlation design, which uses statistical analysis to examine the relationship or association between different variables; it investigates whether changes in one variable correspond to changes in another, providing valuable insights into the degree and direction of their connection, this design is particularly useful in uncovering patterns in interdependence within datasets.

The third research design is experimental design, which calls for the application of the scientific method to establish the cause-and-effect relationship. This design is concerned with determining causality by manipulating one or more variables while controlling for other factors. This allows researchers to draw conclusions about the cause and effect relationships between variables, experiments often involve the implementation of treatments or interventions to observe their impact on the outcome of the interest.

Each of these quantitative research designs serves distinct purposes and offers various approaches to examining and understanding phenomena, contributing to the richness and depth of empirical research across different fields.

Descriptive research is unique in the quantity of variables it uses. Descriptive studies aim to determine "what is," so observational and survey methods are frequently used to gather descriptive data. Descriptive studies can involve several variables for interpretation, like other research styles, but they only require one variable, unlike other methods (Borg & Gall, (1989), which seek to test the relationship between variables.

The descriptive study used data from multiple different time series and an econometric model to investigate the relationship between the variables under analysis. Examples of tests that could be used in a descriptive study to evaluate correlations between multiple variables include Pearson's Product Moment Correlation, regression, or multiple regression analysis, which matched this research.

An econometric model was employed as the analytical framework to thoroughly examine the relationship between the variables under analysis, Specifically, statistical tests such as Pearson's Product Moment Correlation which helped in quantifying the strength and direction of the linear associations between two continuous variables, regression analysis which was skillfully applied to explore how one or more predictor variables related to the outcome variable of interest, or multiple regression analysis were particularly relevant and applicable to this research due to versatility in assessing correlations between multiple variables within the context of a descriptive study.

3.2. Techniques and instruments for data collection

Time series Secondary data were employed in the study and this was made better by the ease with which secondary data from government databases could be accessed as well as by the fact that it was in line with the findings of earlier researchers who had also employed secondary data, such as Fasoranti (2012) and Kosimbei(2013).

The data were collected from the National Bank of Rwanda (NBR) database, The National Institute of Statistics (NISR) and also from the Ministry of Economics and Finance (MINECOFIN). Several prior inflation and economic growth studies used Secondary time series data, although, as seen in the empirical analyses, the time frame and geographical location varied from one study to another. Therefore, this analysis aligned with the approaches taken in prior studies.

3.3. Estimation techniques

The researcher used the statistical method called Ordinary Least Square (OLS) in combination with the field of econometrics and the E-Views software to calculate the model's parameters. This method was chosen because it was suitable for testing hypotheses involving the dependent variable. The parameter values obtained through this process were then used to determine the significance of the model.

Since this study dealt with data collected over time (time series), several important steps were taken. First, the researcher checked of the variables showed any trends or patterns over time by analyzing their stationarity. Additionally, they examined whether the variables were co-integrated, meaning they moved together in the long run. Finally, they looked at the time series characteristics of the variables, considering how they have changed over different time periods.

These steps were crucial in ensuring the accuracy and validity of the analysis, especially when dealing with time series data and using E-Views made it possible to even perform the analyses effectively.

3.4. Model specification

The McCallum (1980) model will be used in this study because the majority of the other literatures used this model to examine the link between government spending and economic growth, This model was chosen because it has extensively been utilized by researchers in similar studies. In order to examine the analysis of the impacts of inflation dynamism on economic growth in Rwanda 2010Q1-2022Q4. This decision was made to provide a more comprehensive understanding of the factors influencing economic growth and inflation in Rwanda during the mentioned period.

The following function was derived from the relationships between explained and explanatory variables:

GDP = f (CPI, EXR, M3)……

This function will be converted into the econometric model as it will be the estimation of the co-integration equations by VAR;

To have: $LGDP = \beta_0 + \beta_1 LCPI + \beta_2 LEXR + \beta_3 LM3 + \mu t$

Where: LGDP= Logarithm of Gross Domestic Product,

LEXR= Logarithm of exchange rate,

LCPI= Logarithm of Consumer Price Index and

LM3 = Logarithm of Broad money supply

β_0 : Intercept of the regression model

$\beta_{1:}$ Slope for CPI in the regression model

$\beta_{2:}$ Slope for exchange rate in the regression model

β_3: Slope for Broad money supply in the regression model

3.5. Definition and measurement of variables

3.5.1. Economic Growth (GDP)

This represents the annual growth rate of the Gross Domestic Product (GDP), signifying the percentage change in the value of goods and services produced within a specific economy over a defined time frame. It is calculated by assessing the yearly total output across all sectors of the economy, as stated by Kosimbei(2013).

3.5.2. Consumer Price Index

The Consumer Price Index (CPI) is the instrument to measure inflation in the economy. It is used to estimate the average variation in price of products consumed by households between two periods of time (Mankiw, 2009).

3.5.3. Exchange rate (EXR):

In Finance, exchange rate is the rate at which one currency will be exchanged for another currency. Currencies are most commonly national currencies. The exchange rate is also regarded as the value of one country's currency in relation to another currency (Mankiw, 2009).

3.5.4. Broad Money (M3):

Broad money (M3) includes currency, deposits with an agreed maturity of up to two years, deposits redeemable at notice of up to three months and repurchase agreements, money market fund shares/units and debt securities up to two years (Mankiw, 2009).

3.6. Tests of unit root and Stationarity

3.6.1. Time series property of the data

Because this study will employ time series data, which by nature may show some strong patterns, the non-random disposition of the series may make it difficult to use econometric tests like the F and t tests. This is due to the fact that they may result in the rejection of a hypothesis that would not otherwise have been rejected. To avoid such circumstances, this study plans to do stationary and co-integration tests.

The non-stationarity of time series data in empirical research is a recurring issue. The study tested for stationarity to prevent estimation and erroneous outcomes. The stationarity of variables is necessary to use standard estimating or testing techniques in a dynamic time series model (Verbeek, (2004). A stationary series, according to (Brooks, (2008), is one that has a constant mean, constant variance, and constant auto-covariance for each given lag. The Augmented Dickey Fuller method was utilized in the study to determine the order of integration and test for stationarity. Estimating the equations is required for the (ADF) test for stationarity in a series of, let's say, GDP data.

A pattern or non-stationary behavior can be seen in a number of time series. A false regression can be caused by regressions using a series if it is non-stationary and a stationary co-integration relationship is not connected with other non-stationary series. The ability of spurious regression to depict erroneous associations between variables makes it deceptive. Before carrying out any empirical estimation, it is crucial to carry out pre unit root testing in order to comprehend the underlying data creation process and use the proper approach.

. There are numerous methods that can be used to analyze the stationarity of time series results. However, the most popular methods/ approaches are the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) tests. We solely used the ADF test in this study.

Stationary unit Root test In actuality, selecting the best unit root test is challenging. Ender (1995) suggested using the unit root test as a secure substitute for the Augmented Dickey Fuller (ADF) (1981) test. The Augmented Dickey Fuller (ADF) test is frequently used for unit root analysis. To test stationarity, we will therefore run the ADF test, a widely used unit root test method, using the variables CPI, EXR, M3, and GDP for Rwanda. At the level of the pattern, the intercept term, and the first difference, the unit root tests were run. The ideal lag was selected using the Akaike knowledge Criterion (AIC).

3.6.2. Johansen Approach

Engle and Granger are evolving the idea of co integration. Co-integration is when two or more sets of data that aren't stationary on their own, but when combined in a certain way, they become stationary. There are two common methods of checking if the co-integration is happening, the first one is called the Enger- Granger test, it is used when looking at one set of data. The second is Johansen set that is used when dealing with multiple sets of data.

So this study uses Johansen co-integration method/technique as it is dealing with CPI, EXR, M3 and GDP as multiple sets of data.

The Johansen co-integration method is widely recognized as the go-to approach for assessing whether two or more time series exhibit a long-term relationship, which is often referred to as co-

integration. Before applying the Johansen co-integration test, it is essential to ascertain whether the time series are in their original form or have been transformed to become stationary.

To use Johansen co-integration effectively, it's crucial that the time series involved are first made stationary, typically through differencing or other transformations. This step ensures that any underlying trends or patterns do not interfere with the co-integration analysis, as it primarily focuses on the relationships between stationary series.

The primary null hypothesis assessed with the Johansen co-integration test involves determining whether there are co-integrating relationships among the series.

CHAPTER 4: RESEARCH FINDINGS AND INTERPRETATIONS

4.1. Introduction

In this chapter, the researcher would like to anal the econometric relationship between inflation dynamics and economic growth in Rwanda for the period of the study in order to verify the research hypotheses of the study. To reach on goals (objectives), the researcher has developed different points like: introduction to econometrics, specification of the model, expected signs, data processing, model estimation and diagnostic tests by using the data of Rwandan economy on the period from 2010Q1 to 2022Q4.

The chapter would like to present the procedures involved in the Johansen (1988). The co-integration technique has been chosen as the preferred parameter estimation technique for ,using VAR as an econometric model used to measure long run relationship between variables under study. This is because of its several advantages over alternative techniques. Based on the co-integration approach, the error correction model, which contains information on both the long run and short run relationship between variables, is estimated. The estimated model has to pass all the diagnostic checks which involve serial correlation, autocorrelation LM test, white heteroscedasticity test and residual normality test, stability test etc. Having familiarize ourselves with the estimation techniques, we now apply these techniques to Rwandan data in order to achieve the objectives of this study as are set out in Chapter one.

4.3. Models specification

The analysis of the economic phenomenon is based on some underlying logical structure known as a model. The model is a simplified version of the reality, the model describes the behavior of the variables in the system and it is the basic frame work of the analysis. The model is in form of

equation, composed by dependent variables and independent variables which are related Gujarati (1985). The startup of the model is the specification of a mathematical model. The mathematical model is an equation that expresses relation between dependent variable and independent variables; the changes the dependent variable are explained 100% by changes occurred in independent variables.

Once we assume that all changes in dependent variable are not 100% explained by changes in dependent variables, we have to add on the mathematical model a term to represent other factors that may have influence on the dependent variable .The model becomes an econometric model because of this error term. Normally, we do not find a neat relationship among variables that is why we introduce a disturbance term or error term to represent other factors that may have influence on dependent variable. (Gujarati,1985).

To address this issue, this chapter is based on the study of effects of inflation dynamics on economic growth in Rwanda, the researcher can't ignore that economic growth is explained by many variables, but here researcher is going to analyze this effect by considering some of the variables including: inflation, exchange rate, and Broad money supply

The regression model is expressed as follow:

$$\mathbf{LGDP_t = \beta_0 + \beta_1 * LCPI_t + \beta_2 * LEXR_t + \beta_3 * LM3_t + \mu_t}$$

Where,

LGDP: Logarithm of Gross Domestic Product

LCPI: Logarithm of Consumer Price Index

LEXR: Logarithm of exchange rates

LM3: Logarithm of broad money supply

B_1, β_2 and β_3 are parameters of model

B_0 is constant or intercept

μ_t is standing for error term

4.4. Test of data/ OLS REGRESSION

In order to measure all economic relationship between variables, the researcher likes to use time series require the econometric tests. After demonstrate our expected signs, the following point emphasizes those tests in order to get econometric results which allow us to make discussions.

4.4.1. Expected Signs

$ß_1 > 0$: this means that the explanatory variable $LCPI_t$ is positive related to LGDP. That is to say that when there is an increase in $LCPI_t$ it is experienced an increase in LGDP.

$ß_2 < 0$: this means that the explanatory variable $LEXR_t$ is negative related to LGDP. That is to say that when there is depreciation of $LEXR_t$ it is experienced an increase in LGDP.

$ß_3 > 0$: this means that the explanatory variable $LM3_t$ is positive related to LGDP. That is to say that when there is an increase in $LM3_t$ it is experienced an increase in LGDP.

4.4.2. Stationary test

The stationary test is done more firstly because it indicates the stationary series and non-stationary series. The E-views 7 software enables the researcher to use the tests of ADF and PP test and the results allow the researcher to determine whether or not the regression is spurious.

This information serves in knowing the methodology to be used; when the series is stationary the researcher uses the Ordinary Least Square (OLS) as methodology while when the series is not stationary the researcher uses co-integration test.

Table4. 1.Unit root test at level

Series	**Model/Equation**	**ADF**			**PP Test**		**Conclusion**
		Lag	$\tau_\tau, \tau_\mu, \tau$	ϕ_3, ϕ_1	**Lag**	$\tau_\tau, \tau_\mu, \tau$	
LCPI	Intercept and trend	3	-3.35*	5.70	3	-3.4*	**LCPI is not stationary at level**
	Intercept	3	-3.002**	9.015	3	3.11**	
	None	3	-0.007	-	3	0.48	
LEXR	Intercept and trend	3	-92	1.125	3	-0.92	**LEXR is not stationary at level**
	Intercept	3	0.05	0.003	3	-0.133	
	None	3	1.51	-	3	1.37	

LM3	Intercept and trend	3	-1.5	1.20	3	-1.85	**LM3 is not stationary at level**
	Intercept	3	-0.34	0.017	3	-0.34	**LM3 is not stationary at level**
	None	3	2.90	-	3	2.15	**LM3 is not stationary at level**
LGDP	Intercept and trend	3	-1.32	1.24	3	-1.30	**LGDP is not stationary at level**
	Intercept	3	0.084	0.007	3	-0.024	
	None	3	1.80	-	3	1.87	

Source: Elaborated by the researcher, 2023

(*), (**) & (***) represent respectively 10%, 5% and 1% level of significance. The LCPI, LEXR, LM3 and LGDP series are not stationary at level, and then researcher should test the Stationary at the first difference.

Table4. 2. Unit root at first difference

Series	**Model**	**ADF**			**PP Test**		**Conclusion**
		Lag	$\tau_\tau, \tau_\mu, \tau$	ϕ_3, ϕ_1	**Lag**	$\tau_\tau, \tau_\mu, \tau$	
LCPI	Intercept & Trend	9	-10.42***	54.35	9	-13.74***	

	Intercept	9	-10.46***	109.44	9	-11.64***	**LCPI** is stationary at its first difference
	None	9	-10.56***	-	9	-11.67***	
LEXR	Intercept & Trend	9	-5.05***	12.83	9	-5.02	**EXR** is stationary at first difference
	Intercept	9	-4.81***	23.17	9	23.17***	
	None	9	-4.716***	-	9	-4.71	
LM3	Intercept & Trend	9	-3.89**	7.58	9	-3.83**	**LM3** is stationary at first difference
	Intercept	9	-3.95***	15.6	9	-3.89***	
	None	9	-3.4***	-	9	-3.38***	
LGDP	Intercept and trend	9	-6.36***	20.3	9	-6.4***	**LGDP** is stationary at first difference
	Intercept	9	-6.2***	39.24	9	-6.26***	
	None	9	-5.86***	-	9	-5.86***	

Source: Elaborated by the researcher, 2023

(*), (**) & (***) represent respectively 10%, 5% and 1% level of significance.

The table indicates that the all series are non-stationary at their level meaning that all series are not integrated of order zero I(0) so researcher taking the first difference of the variables, the test

show that all variables becomes stationary at the same order of first difference which mean that ,these series are integrated of order nine,I(9). We can run the Johannsen test of Co-integration

4.4.3. Johansen co-integration test

In literature, co-integration test, eg Engle and Granger (1987),Johannsen and Juselius (1990),pesaranetal (2001) etc. are used to ascertain the presence of potential long run equilibrium relationship between two or more variables.

Null hypothesis: there is no co-integration among LGDP, LCPI, LEXR and LM3

Alternative Hypothesis: there is co-integration among LGDP, LCPI, LEXR and LM3

Table4. 3Johansen co-integration test of determinants (trace)

Date: 10/19/23 Time: 22:30

Sample (adjusted): 10Q1 22Q3

Included observations: 51 after adjustments

Trend assumption: Linear deterministic trend

Series: LGDP(-1) LCPI LEXR(-1) LM3

Lags interval (in first differences): 1 to 1

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.587573	59.20988	47.85613	0.0030
At most 1	0.411155	28.21054	29.79707	0.0753
At most 2	0.234096	9.674825	15.49471	0.3066
At most 3	0.009678	0.340376	3.841466	0.5596

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**

None *	0.587573	30.99934	27.58434	0.0175
At most 1	0.411155	18.53571	21.13162	0.1111
At most 2	0.234096	9.334449	14.26460	0.2594
At most 3	0.009678	0.340376	3.841466	0.5596

Max-eigenvalue test indicates 1 co-integrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table4. 4. Trace statistics Test

VARIABLES	**Eigen value**	**Trace Statistics**	**Critical value(0.05)**	**Probability**
None *	0.5875	59.2	47.8	0.000
At most 1 *	0.41115	28.21054	29.79707	0.0753
At most 2	0.234	9.67	15.49471	o.30
Atmost 3	0.009	0.34	3.841466	0.55

- Trace test indicates 1cointegratingeqn(s) at the 0.05 level
- Denotes rejection of the hypothesis at the 0.05 level
- MacKinnon-Haug-Michelis (1999) p-values

We have two possible hypotheses:

H0:There is no Co-integration among variables LGDP, LCPI, LEXR, and LM3 according to the first result (none*)

***H*1**: There is Co-integration among variables LGDP, LCPI, LEXR, and LM3 according to the first result (none*). About the results atmost1 and at most2 trace statistics must be less than critical value and probability must be greater than 5%.

Looking the table above (none*), we expect to accept H1 if trace statistics is greater than critical value and probability must be less than 5% ,basing on the result above, we have sufficient evidence to reject Ho at 5% level of significant in favor of H1 ,means that there is one co integrated equation at 0.05 level and all four variables have long run association ship.

4.4.4. Long run model

Table4. 5. Long run output

Dependent Variable: LGDP

Method: Least Squares

Date: 10/19/23 Time: 22:50

Sample: 10Q1 22Q4

Included observations: 52

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCPI	0.004555	0.025240	3.180475	0.0579
LEXR	-0.215877	0.057867	-3.730602	0.0007
LM3	1.755956	0.157747	11.13145	0.0000
C	-17.66298	2.850457	-6.196542	0.0000

R-squared	0.950369
Adjusted R-squared	0.945989
F-statistic	217.0166
Prob(F-statistic)	0.000000

Source: Eviews7 (2023)

The results show that all variables are statistically significant as indicated by their p-values: 0.057 for CPI, 0.0007 for exchange rate and 0.0000 for broad money supply.

$LGDP_t$= - 17.66298 - 0.0045*$LCPI_t$-0.215*$LEXR_t$+ 1.75*$LM3_t$

R-squared: R^2 =0.95

Adjusted R-squared: Adjusted R^2=0.945

$ß_1$= 0.0045: This means that in the long run inflation is positively related to Gross Domestic Product indicator as it is explained by expectation.

When inflation changes by 1%, GDP increases by 0.0045%, other things being constant (Ceteris Paribus).

$ß_2$= -0.215: This means that in the long run Exchange Rates is negatively related to Gross Domestic Product indicator as expected. The appreciation of exchange rate by 1%, GDP decreases by 0.215%, other things being constant (Ceteris Paribus) as appreciation renders exports more expensive.

$ß_3$= 1.75: This means that in the long run broad money supply is positively related to Gross Domestic Product indicator as it is explained by expectation. When money supply increases by 1%, GDP increases by 1.75%, other things being constant (Ceteris Paribus) and this is in the short run.

R^2 = 0.95 and Adjusted R^2 = 0.945, show us the goodness of fit of the estimated model. Up to 95% of long-run fluctuations in GDP is influenced by changes in inflation, exchange rate and broad money supply.

After the determination of the co-integrating relationship, the next step is to estimate the short-run relationship between inflation and economic growth using Vector error correction model (VECM).

The short-run model coefficients measure the dynamics of the model, the VECM measures the speed of adjustment to the long run equilibrium which is taking place.

4.4.5. Vector Error Correction Model (VECM)

Table4. 6. Vector Error Corrections Estimates

Vector Error Correction Estimates

Date: 10/19/23 Time: 22:40

Sample (adjusted): 10Q1 22Q3

Included observations: 51 after adjustments

Standard errors in ( ) & t-statistics in [ ]

Co-integrating Eq:	CointEq1
LGDP(-2)	1.000000
LCPI(-1)	-0.289923
	(0.06356)
	[-4.56122]
LEXR(-2)	-0.069220
	(0.09243)
	[-0.74885]
LM3(-1)	-0.577906
	(0.29102)
	[-1.98581]
C	-1.797428

Error Correction:	D(LGDP(-1))	D(LCPI)	D(LEXR(-1))	D(LM3)
CointEq1	-0.326914	3.451928	0.040611	0.099458
	(0.11326)	(1.43766)	(0.07608)	(0.12538)
	[-2.88640]	[2.40107]	[0.53378]	[0.79328]
D(LGDP(-2))	0.115768	-1.440140	-0.113642	-0.087039
	(0.13723)	(1.74188)	(0.09218)	(0.15191)
	[0.84363]	[-0.82677]	[-1.23281]	[-0.57298]
D(LCPI(-1))	-0.034499	-0.654449	0.012155	-0.036488
	(0.02486)	(0.31557)	(0.01670)	(0.02752)
	[-1.38765]	[-2.07384]	[0.72782]	[-1.32584]
D(LEXR(-2))	0.341382	-0.046026	0.319456	-0.046900
	(0.25061)	(3.18109)	(0.16835)	(0.27742)
	[1.36221]	[-0.01447]	[1.89762]	[-0.16906]
D(LM3(-1))	0.443095	14.03764	-0.410019	0.733406
	(0.49616)	(6.29796)	(0.33329)	(0.54923)
	[0.89306]	[2.22892]	[-1.23021]	[1.33532]
C	0.009145	-0.324969	0.060666	0.020073
	(0.02880)	(0.36553)	(0.01934)	(0.03188)
	[0.31759]	[-0.88904]	[3.13617]	[0.62971]
R-squared	0.708762	0.449013	0.500594	0.101490
Adj. R-squared	0.658548	0.354015	0.414489	-0.053425

R-squared: 0.708

Once the long term relationship is obtained, it is interesting to estimate a partial adjustment model (or a short term relationship) between inflation and economic growth under this study. The most important thing in the short run results is speed of adjustment term (VECM). It shows how much time would be taken by the economy to reach at long run equilibrium. Negative sign of speed of adjustment term shows that the economy will converge towards long run equilibrium after taking 32% annually adjustment in short run, the value 0.326 shows that Gross Domestic Product adjusts to restore 32 percent of disequilibrium from the previous year to the current year, this implies that it will take 3 years and 1month for the economy to come back to equilibrium.

The value of R-squared (R^2) shows that about 70 % of the variation in Gross Domestic Product is explained by the combined effect of all variables considered. It also indicates that the explanatory variable contributes in explaining the economic growth..

The inflation has statistical significant effect on economic performance, this attributed to fact short run price fluctuation have a positive effect on economic performance.

The effect of exchange rate on export is statistically significant on economic growth. This could have been due to high susceptibility of export to price fluctuation which enhances the gains a rising out local currency depreciation which has significant effect on economic performance.

The broad money supply of the current period has a positive and significant effect on the current period's economic performance.

4.4.6. Diagnostic tests

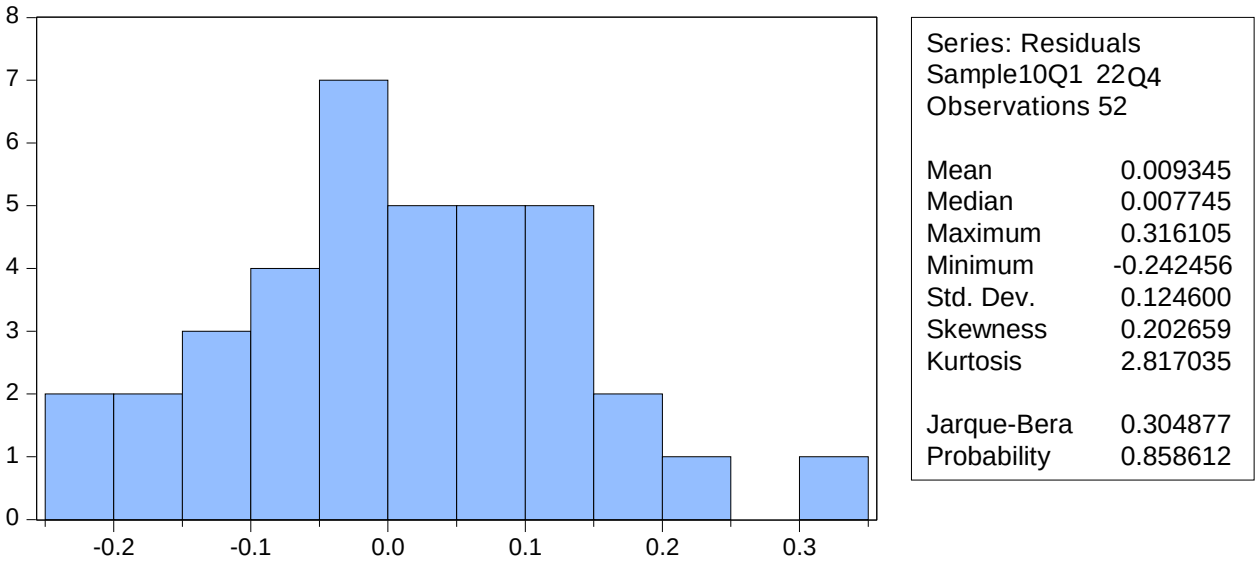
After the error correction model the other tests are necessary to see whether the assumption of tradition regression is confirmed. These tests are related to residual series:

4.4.7 Normal distribution test, Heteroscedasticity test, Autocorrelation test, Stability test

4.4.7.1. Residual Histogram Normality test

With the assumption of normality, the test of Jarque- Bera will show us if the residual at a given period of time are not only correlated but also distributed normally. The test for normality of residuals plays a crucial role, because it precise the statistic distribution of estimators. It's due to this hypothesis that inference statistic could be realized. The results of this test are shown at the graph below:

Figure4. 1: Normality distribution test



Source: Eviews7 (2023)

As probability of Jarque-Bera equals 0.8586 respected by 85.6% which is greater than 10% reference of significance level, suggesting that residuals are normally distributed, and this reflects the good quality of the model.

4.4.7.2. Heteroscedasticity test

Table4. 7. Heteroscedasticity Test

Heteroscedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.744386	Pro-ch-squre0.67
Obs*R-squared	3.149711	

Source: Eviews7 (2023)

H_o: Homoscedastic model

H_1: Heteroscedastic model

The probability is greater than 5%; the null hypothesis of homoscedasticity is not rejected means the errors of homoscedasticity are accepted. The observed estimations by OLS are optimal. The tests show the homoscedasticity because their probabilities are greater than 5% means that errors are constant.

4.4.7.3. Autocorrelation test

This test shows whether the model contains problems of autocorrelations of residuals. It means that errors of the period t affect the errors of the next period t_{+1}.

We use the view of probabilities.

Table4.8.Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.560553	Prob. F(2,31)	0.5766
Obs*R-squared	1.084973	Prob. Chi-Square(2)	0.5813

Source: Eviews7 (2023)

The probability of obs*R-squared is 0.58% greater than 10% means that the model does not contain the problems of residuals autocorrelation.

Table4. 9. Serial Correlation

Date: 10/20/23 Time: 00:15

Sample: 10Q1 22Q4

Included observations: 52

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. | . |	. | . |	1	0.037	0.037	0.0561	0.813
. |*. |	. |*. |	2	0.103	0.102	0.4934	0.781
. | . |	. | . |	3	-0.042	-0.050	0.5686	0.904
**| . |	**| . |	4	-0.241	-0.252	3.1113	0.539
. | . |	. | . |	5	0.034	0.065	3.1648	0.675
. | . |	. | . |	6	-0.049	0.003	3.2781	0.773
. | . |	. | . |	7	0.043	0.013	3.3676	0.849
. | . |	.*| . |	8	-0.051	-0.113	3.4975	0.899
. | . |	. | . |	9	-0.023	-0.002	3.5258	0.940
. |*. |	. |*. |	10	0.147	0.173	4.6780	0.912
.*| . |	.*| . |	11	-0.114	-0.127	5.4017	0.910
. |*. |	. | . |	12	0.074	-0.002	5.7212	0.929
***| . |	***| . |	13	-0.359	-0.367	13.473	0.412
. | . |	. |*. |	14	-0.006	0.130	13.475	0.489
.*| . |	.*| . |	15	-0.098	-0.116	14.109	0.517
.*| . |	.*| . |	16	-0.102	-0.108	14.819	0.538

Source: Eviews7 (2023)

H_0 = Absence of autocorrelation

H_1= presence of autocorrelation.

These two tests applied to our model, the results show that the null hypothesis is not rejected.

4.4.7.4. Stability test

These tests are operated on dynamic models to test their stability. In this dissertation we have used Ramsey Reset and Cumulative Sum test.

4.4.8.5. Ramsey test

Table4. 10. Ramsey test

Ramsey RESET Test

Equation: SREQ

Specification: D(LGDP) D(LCPI) D(LEXR) D(LM3) RESID01(-1)

Omitted Variables: Squares of fitted values

	Value	Df	Probability
t-statistic	0.156617	32	0.8765
F-statistic	0.024529	(1, 32)	0.8765
Likelihood ratio	0.028351	1	0.8663

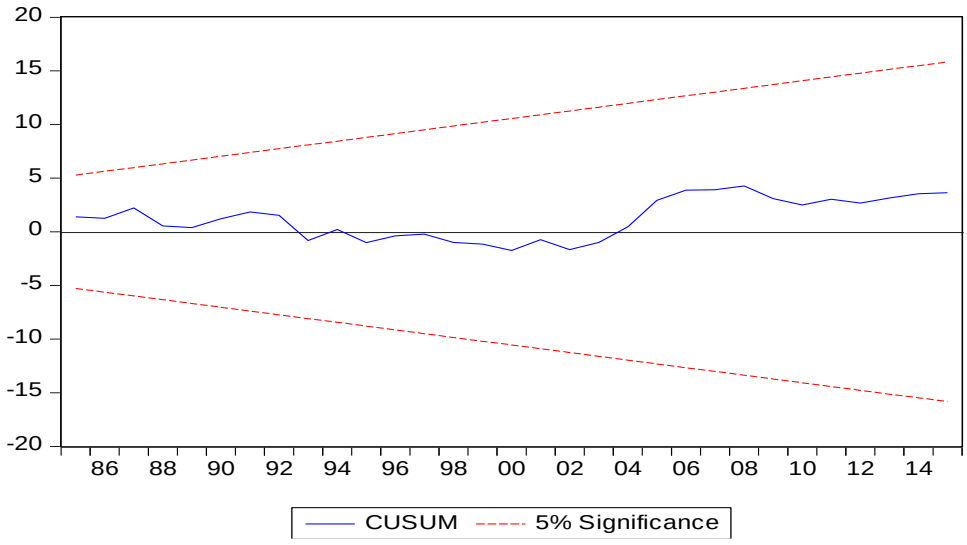
Source: Eviews7 (2023)

For our model, there is a good specification of the model to the reference of significance at 10% where in the test modal, the probability is greater than 10%. The probability of Log likelihood is greater than 10%; explained by 0.8663 respected by 86.83% then the model is correctly specified.

4.4.7.6. Recursive estimates CUSUM test

This cumulative sum test shows graphical navigation of variables of the method within a perspective of judging the stability of parameters. When the curve goes out of the corridor, the coefficients of the model are not stable; otherwise, the coefficients of the model are stable.

Figure4. 2. CUSUM test



Source: Eviews7 (2023)

By judging the above graph, it is clear that the parameters are stable because the navigating blue line of graph does not cross the borders (the straight lines represent critical bounds at 5% significance level. This indicates that inflation, exchange rate, broad money supply and economic growth of Rwanda have been moving in a stable trends during the period under study 2010Q1 to 2022Q4.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

The overall objective of this study is to investigate the effects of inflation dynamics on economic growth in the case of Rwanda. The period of 2010Q1 to 2022Q4 periods, focusing more on hypothesized drivers such as consumer price index, exchange rate, broad money supply as the major factors that influence economic growth. Furthermore it is also at tests the stability of exports function that could serve as a guide to policy makers in stabilizing Rwandan economy.

This study has revealed in detail the effect of exchange rate, inflation and money supply on economic performance in Rwanda using an Econometric Analysis between the period 2010Q1-2022Q4. The macro economic variables used were, LCPI, LEXR, LM3 as exogenous variables and LGDP as endogenous variable. Different literatures both Economic theory and empirical investigation have resulted in a number of facts and arguments that indicates the effect of inflation dynamics on economic growth in Rwanda.

5.2. Conclusion

This study investigated the effects of inflation dynamics on economic growth in the case of Rwanda. We were motivated by several questions raised by the present objectives and the framework for the implementation of fiscal policy in Rwanda. Our point of interest was that an understanding of the forces driving and perpetuating economic growth in Rwanda.

In order to determine both the long and short run properties of the models, the Johansen co-integration and error correction methods were preferred to the other techniques. These techniques

were chosen because of the advantages they have over those alternative techniques. In the applying these methods, the time series was subjected to both informal and formal tests for stationarity.

Evidence of co-integration allowed the estimation of which simultaneously provided the parameter estimates for both the long and short run. In long run cases, the estimated models were robust and passed all the relevant diagnostic tests. The results conform to theoretical literature reviewed for the study. Thus, the empirical findings of the present study show that there is long-run relationship between inflation and economic growth in Rwanda.

The Vector Error Correction (VEC) modeling technique was employed to determine the relationship between inflation and economic growth both in the short and the long run. This stage involves estimating the Vector Error Correction Model (VECM). It contains information on both the long run and short run relationship between variables. The empirical results have shown that, all the variables in the model are statistically significant to explain economic growth.

In fact, we show that the existence of the long-run economic growth equation can only be firmly established when exchange rate, inflation and broad money supply are considered in the model.

When CPI changes by 1%, GDP increases by 0.0045%, other things being constant (Ceteris Paribus). GDP is significantly explained by the CPI, because it is statistically significant at 1% level of significance.

The depreciation of exchange rate by 1%, GDP increase by 0.215%, other things being constant (Ceteris Paribus). In the long run exchange Rates significantly explains GDP, because it is statistically significant at 5% level of significance.

When money supply changes by 1% in increase, GDP increases by 1.75%, other things being constant (Ceteris Paribus). GDP is significantly explained by broad money supply, because it is statistically significant at all levels of significance.

$R^2 = 0.70$, show us the goodness of fit of the estimated model. Up to 70% of short-run fluctuations in economic growth are influenced by changes in consumer price index, exchange rate and broad money supply.

5.3. Recommendations

Based on the findings of the study the following recommendations are made.

- Since economic growth was found to be more sensitive with macro- economic variables such inflation, exchange rate and broad money supply, it is important for Rwanda to concentrate on controlling the inflation rate at a moderate level since a moderate rate of inflation stimulates the economy of the country.
- Exchange rate has been found to have a negative impact on economic performance. Therefore, Rwanda should adopt devaluation policy to promote exports and discourage imports which leads to economic performance.
- Improved infrastructure that is road network, communication, and electricity availability. Improving the overall infrastructure will lead to expansion of production which will further lead to an increase in output and ultimately expand the economy.
- Enhance the domestic enabling environment for potential exporters (in terms of infrastructures, regulation, access to finance, insurance, fiscal policies)
- Foster the strategic cooperation between private and public actors and among domestic producers, exporters, and policymakers to promote the economy.

- Improve the productivity and technological content of domestic goods, and provide incentives to nurturing innovation; facilitate the access to credit; serve to build the country image in foreign markets (through marketing, information provision, advocacy);offer targeted and tailored assistance, and rely on continuous evaluation; are supported by monetary and fiscal policies designed to improve the enabling environment; and stimulate institutional development, also considering institutional Complementarities.

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APPENDICES

APPENDICES: DATA USED IN THE STUDY

DATES	CPI Quatery Changes	RGDP (in Billions Frw)	Exchange rate	M3 (in Billions in Frw)
2010 Q1	83.720	1191	578.111	518.14
2010 Q2	83.720	1192	576.916	533.09
2010 Q3	85.290	1244	578.884	564.21
2010 Q4	84.560	1294	577.175	593.96
2011 Q1	87.160	1291	593.964	630.08
2011 Q2	89.850	1263	594.523	674.61
2011 Q3	90.950	1373	594.830	715.42

2011 Q4	91.960	1386	595.629	752.02
2012 Q1	94.280	1400	607.441	805.09
2012 Q2	95.160	1399	609.626	850.50
2012 Q3	96.070	1471	609.058	838.13
2012 Q4	95.170	1503	610.456	860.24
2013 Q1	97.350	1465	633.735	894.90
2013 Q2	98.680	1510	636.835	905.03
2013 Q3	100.970	1509	635.050	961.91
2013 Q4	98.640	1560	638.253	1012.39
2014 Q1	100.680	1554	663.833	1046.95
2014 Q2	100.100	1578	668.631	1154.65

2014 Q3	101.140	1643	670.198	1203.57
2014 Q4	100.720	1643	673.060	1229.28
2015 Q1	101.500	1678	705.144	1266.04
2015 Q2	102.850	1724	705.578	1351.47
2015 Q3	104.840	1776	707.639	1410.36
2015 Q4	105.290	1808	708.228	1477.78
2016 Q1	106.170	1858	757.653	1504.20
2016 Q2	108.550	1871	756.874	1497.52
2016 Q3	110.950	1833	770.976	1521.53
2016 Q4	112.960	1841	766.398	1567.59
2017 Q1	114.380	1862	810.428	1618.04

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2017 Q2	113.730	1904	817.401	1685.14
2017 Q3	115.120	1955	816.870	1747.59
2017 Q4	113.710	1973	819.656	1782.77
2018 Q1	115.360	2043	841.457	1860.21
2018 Q2	117.000	2053	851.077	1888.79
2018 Q3	116.520	2093	852.147	1942.63
2018 Q4	115.000	2163	852.785	2039.36
2019 Q1	116.640	2169	879.132	2086.66
2019 Q2	118.020	2306	885.149	2151.76
2019 Q3	120.100	2322	886.970	2213.36
2019 Q4	122.200	2345	888.662	2327.94

2020 Q1	134.600	2249	923.213	2433.70
2020 Q2	135.300	2018	926.634	2531.73
2020 Q3	139.000	2236	930.307	2674.14
2020 Q4	139.600	2330	929.824	2775.64
2021 Q1	138.000	2328	969.370	2873.43
2021 Q2	136.700	2434	969.204	2987.28
2021 Q3	136.100	2462	976.719	3130.22
2021 Q4	135.600	2570	975.109	3277.69
2022 Q1	143.100	2512	1009.227	3463.86
2022 Q2	155.600	2616	1014.313	3638.88
2022 Q3	165.100	2709	1018.616	3765.23

2022 Q4	179.200	2756	1016.067	3881.45

Source: MINECOFIN, BNR