T.C.

İSTANBUL KÜLTÜR UNIVERSITY

INSTITUTE OF GRADUATE STUDIES

THE IMPACT OF MONETARY POLICY INSTRUMENTS ON ECONOMIC GROWTH IN TÜRKİYE

Master Of Science Thesis

Mehmet Ahmet Gazaloğlu

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Department: Economics

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APRIL 2025

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Mehmet Ahmet Gazaloğlu

DEDICATION

- To my beloved mother and father,

Thank you for being the light that illuminated my path since childhood, for giving my life its meaning, and for guiding me with your endless love and support.

- To my beloved wife,

You have been the pillar I leaned on throughout this journey and the voice of hope that urged me never to stop, no matter the challenges. Thank you for your unconditional love, patience, and unwavering belief in me, which served as the light guiding me to this achievement.

- To my dear children, Ahmad and Lina,

You are the light of my life, inspiring me to work hard and strive for the best for your sake.

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Thank you for your constant support and encouragement, and for being my backbone in every step.

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- To the martyrs of the Syrian revolution, its detainees, its displaced, its refugees, and those who wrote its victory.
- To those who sacrificed their lives for freedom and dignity.
- To the silent strength behind every word, every page.

To everyone who played a role in my life,

I dedicate this work to all of you.

Mehmet Ahmet Gazaloğlu

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Programı	**: Uluslararası Ekonomi ve Finans**
Tez Danışmanı	**: Assoc. Prof. Deniz Dilara DERELI**
Tez Türü ve Tarihi	**: NİSAN 2025**

ÖZET

PARA POLITIKASI ARAÇLARININ ETKISI ÜZERİNDE TÜRKİYE'DE EKONOMİK BÜYÜME

Mehmet Ahmet Gazaloğlu

Bu çalışma, 2003-2024 yılları arasında Türkiye'nin ekonomik performansı üzerindeki para politikası araçlarının (iskonto oranı, para arzı ve zorunlu karşılık oranı) etkisini analiz etmeyi amaçlamaktadır. Nominal GSYH, reel GSYH ve enflasyon oranları üzerindeki bu araçların kısa ve uzun vadeli etkilerini incelemek için ARDL modeli ve nedensellik testleri gibi ileri ekonometrik modeller kullanılmıştır. Bulgular, para politikası araçlarının kısa vadede ekonomi üzerinde önemli bir etkisi olduğunu ve para arzının enflasyon ve ekonomik büyüme üzerinde kilit bir rol oynadığını ortaya koymaktadır. Ancak, bu araçların uzun vadede istatistiksel olarak anlamlı bir etkisi olmadığı tespit edilmiştir, bu da etkilerinin geçici doğasını göstermektedir. Çalışma, kısa vadeli etkileri dikkate alırken uzun vadeli ekonomik sürdürülebilirliği teşvik etmeyi amaçlayan esnek ve entegre para politikalarının önemini vurgulamaktadır. Çalışma, yerel ve küresel zorluklar karşısında ekonomik istikrar ve sürdürülebilir büyüme sağlamak için politika yapıcılara öneriler sunmaktadır.

Anahtar Kelimeler: Para Politikası, İskonto Oranı, Para Arzı, Zorunlu Karşılık, Enflasyon, GSYH.

University	**: İstanbul Kültür University**
Institute	**: Institute of Graduate Studies**
Department	**: Department of Economics**
Program	**: International Economics and Finance**
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ABSTRACT

THE IMPACT OF MONETARY POLICY INSTRUMENTS ON ECONOMIC GROWTH IN TÜRKİYE

Mehmet Ahmet Gazaloğlu

This study aims to analyze the impact of monetary policy c, including the discount rate, money supply, and required reserve ratio, on Türkiye's economic performance during the period from 2003 to 2024. Advanced econometric models, such as the ARDL model and causality tests, were utilized to examine the short- and long-term effects of these instruments on nominal GDP, real GDP, and inflation rates. The findings reveal that monetary policy instruments significantly influence the economy in the short term, with money supply playing a key role in driving inflation and economic growth. However, these instruments were found to have no statistically significant impact in the long term, indicating the temporary nature of their effects.

The study highlights the importance of designing flexible and integrated monetary policies that account for short-term effects while aiming to promote long-term economic sustainability. It offers recommendations for policymakers to achieve economic stability and sustainable growth amid domestic and global challenges.

Keywords: Monetary Policy, Discount Rate, Money Supply, Required Reserve, Inflation, GDP.

1. INTRODUCTION

1.1. Preface

While fiscal policies, which include public spending and taxation measures, play an important role in directing economic activity by influencing overall demand, monetary policies are concerned with managing and guiding money to achieve economic goals such as controlling economic growth, ensuring financial stability, and managing.

In this framework, monetary policies are essential for sustaining economic stability, especially during financial crises and economic swings. This thesis examines monetary policies in the Turkish economy, analyzing the instruments used by the Central Bank of Türkiye and their effects on economic development from 2003 to 2024.

The study examines the effects of several monetary policy instruments, including the discount rate, money supply, and reserve requirements placed on banks. These instruments are essential instruments via which central banks impact economic growth, shape investment and consumption choices, and regulate inflation rates. Economic theory posits that the discount rate profoundly impacts borrowing costs, which in turn influence investment and production techniques. Furthermore, the money supply directly influences buying power and aggregate demand. Simultaneously, the reserve requirement ratio determines the percentage of liquidity that banks are obligated to maintain, therefore influencing loan availability and the flow of capital throughout the economy.

In Türkiye, these instruments have been crucial in tackling diverse economic issues, especially amid escalating inflation rates, currency rate fluctuations, and alterations in the global economic landscape. The Turkish central bank has used these measures to attain financial stability; nonetheless, the overall efficacy of these policies continues to be a topic of contention within economic discourse, considering the fluctuating domestic and international economic circumstances.

By examining economic data and evaluating hypotheses concerning the link between monetary policies and economic expansion in Türkiye, this study aims to provide evidence-based insights that support policymakers in improving the efficiency of future monetary frameworks.

1.2. Research Problem Statement

The efficacy of monetary policy in influencing macroeconomic indicators is a vital field of research, particularly in countries like Türkiye that encounter distinct problems, including high inflation rates, currency instability, and foreign economic pressures. Although the Central Bank of Türkiye utilizes many monetary policy instruments—including the discount rate, money supply, and reserve requirements—their impact on essential macroeconomic indicators such as Gross Domestic Product (GDP), Real GDP, and inflation rates remains unclear. In the last ten years, Türkiye has seen substantial transformations in its monetary policy framework, characterized by alterations in interest rate strategies, interventions in foreign exchange markets, and a developing approach to inflation targeting. The recent advances have made the examination of monetary policy efficacy more intricate, as the consequences of these measures continue to evolve within local political contexts.

This study challenge is further confounded by the dynamic character of both local and global economic situations. The current debates among economists over the efficacy of various monetary instruments highlight the need for a comprehensive assessment. The study seeks to examine the impact of the Central Bank's monetary policies from 2003 to 2024 on the Turkish economy, specifically on economic growth, evaluated using essential economic indicators such as nominal and real Gross Domestic Product (GDP) and inflation rates. These measurements enhance the understanding of the impact of monetary policy on overall macroeconomic performance and the sustainability of growth over the research period.

1.3. Research Questions

This research aims to address the core question: **How do the monetary policy instruments employed by the Central Bank of Türkiye affect economic growth?** This inquiry will contribute to a deeper understanding of the relationship between monetary policy and economic outcomes in Türkiye, by addressing the following questions:

- How does the discount rate set by the Central Bank of Türkiye affect GDP, Real GDP, and inflation rates during the period from 2003 to 2024?

- What is the impact of the money supply determined by the Central Bank of Türkiye on GDP, Real GDP, and inflation rates during the same period?
- How do changes in reserve requirements set by the Central Bank of Türkiye influence GDP, Real GDP, and inflation rates?

1.4. Study Hypotheses

This study's assumptions, derived from the research questions, provide an analytical framework to investigate the correlation between primary monetary policy instruments and the performance of the Turkish economy from 2003 to 2024. The objective is to evaluate the influence of the discount rate, money supply, and reserve requirements on economic growth metrics, such as GDP, Real GDP, and inflation rates. The hypotheses and their testing techniques will be elaborated upon in the methodology and statistical analysis section, emphasizing the instruments and models used to fulfill the study goals and derive accurate scientific results.

Hypotheses will be developed as research statements based on the research issue and questions, originating from the primary research question or statement. Each hypothesis will be evaluated by examining two potential outcomes: either corroborating the null hypothesis (H0), which signifies no effect or relationship, or refuting the null hypothesis, thereby endorsing the alternative hypothesis (H1), which implies the existence of an effect or relationship. These hypotheses will direct the study and evaluate its outcomes to get precise findings that improve our comprehension of the research issue.

1.5. Study Purpose

This study seeks to deliver an exhaustive analysis of the effects of monetary policy instruments on various economic growth indicators, including Gross Domestic Product (GDP), Real GDP, and inflation rates, to enhance understanding of the relationship between these instruments and the Turkish economy from the third quarter of 2003 to the third quarter of 2024.

2. MONETARY POLICY

2.1. The concept of monetary policy

The scientific basis of monetary policy is provided by monetary theory. The definition of "money" is essential for any in-depth study or textbook on monetary theory and policy. However, despite extensive literature on the topic, a clear and universally accepted definition remains elusive and unresolved (Bofinger, P., et al., 2001).

Traditionally, money has been defined by its functional perspective, famously summarized by John Hicks: "Money is what money does" (Hicks, 1967). However, this functional perspective risks becoming circular if the nature of "money" itself is unclear, then identifying its functions also becomes problematic. To address these concerns, (Bofinger, P., et al., 2001) propose two alternative definitions:

1. A microeconomic approach that considers currency in circulation as a foundational point to expand into broader monetary concepts.
2. An econometric approach that defines money through analyzing the statistical characteristics of different monetary aggregates.

This theoretical framework has influenced several schools of thinking about monetary policy. Schwartz emphasizes the contention between the Currency School and the Banking School. Proponents of the Currency School advocate for systematic, rule-based monetary policies grounded in legal frameworks, whereas the Banking School supports the delegation of discretionary authority to central banks, allowing for autonomous action that may, at times, contravene legal standards. (Huerta de Soto, 2020).

Monetary policy is one of two primary tools—alongside fiscal policy—employed by governments in market economies to influence aggregate economic activity. These policies aim to steer output, employment, and price levels (Friedman B. , 2001). By targeting aggregate demand, monetary policy helps mitigate economic recessions and booms, which result from shifts in demand rather than changes in productive capacity. However, as (Juhro, S. M., & Rummel, O., 2022) argue, monetary policy does not address the supply side of the economy, as central banks lack direct control over productivity or actual economic growth.

Monetary policy is characterized as a system of instruments and methodologies used by central banks to maintain economic stability. It does this by regulating the money supply and modifying interest rates. The key objectives include providing price stability, supporting full employment, stimulating economic growth, and safeguarding the stability of financial markets and currency rates. Instruments including open market operations, changes to the discount rate, and alterations to reserve requirements enable central banks to significantly influence the economy (Mishkin, 2004).

In the same context, (Shapiro, D., MacDonald, D., & Greenlaw, S. A., 2023) stated that monetary policy serves as one of the fundamental mechanisms utilized by central banks to ensure economic stability and regulate key macroeconomic factors, including inflation, economic development, and employment levels.

2.2. Instruments of Monetary Policy

2.2.1. Open Market Operations (OMO)

(Mishkin, 2004)asserts that open market operations are a crucial tool in monetary policy, functioning as the principal method for controlling short-term interest rates and the monetary base, which in turn influences the money supply. Central banks, notably the Federal Reserve, conduct activities including the purchase or selling of government securities.

- **Types of OMOs**:

(Mishkin, 2004)identifies two main types of OMOs:

- Dynamic OMOs adjust the reserves and monetary base levels.
- Defensive OMOs counterbalance external factors that affect reserves, such as fluctuations in Treasury deposits or currency demand.

- **Execution Process**:

(Mishkin, 2004) elucidates that the Federal Open Market Committee (FOMC) establishes the objective for the federal funds rate, but the trading desk of the Federal Reserve Bank of New York implements the operations in the United States, overseeing daily changes to attain the target rate. The desk analyzes data on reserves and short-term liquidity requirements, collaborating with

primary dealers to execute transactions via the TRAPS system (Trading Room Automated Processing System), utilizing repos or reverse repos for temporary adjustments and outright purchases or sales for permanent modifications.

- **Advantages of OMOs:**

(Mishkin, 2004) outlines several advantages of OMOs:

1. Control: The Fed initiates OMOs, maintaining full control over transaction volumes.
2. Precision and Flexibility: OMOs can implement small or large changes in reserves as needed.
3. Reversibility: OMOs can be quickly reversed if necessary, enabling corrective measures.
4. Speed: OMOs have minimal delays, allowing rapid adjustments to the monetary base and reserves.

2.2.2. Discount Rate Policy

Central banks, such as the US Federal Reserve, charge commercial banks the discount rate when they lend money for short periods of time (Walsh, 2010). According to (Mankiw N. G., 2004), commercial banks are able to borrow reserves from the central bank at a rate known as the discount rate.

TThe Federal Reserve's discount policy is essential for regulating liquidity and averting financial instability. This strategy is implemented via the "discount window," a mechanism enabling banks to get loans from the Federal Reserve during periods of need. The Federal Reserve's discount loans are categorized into three types: main credit, secondary credit, and seasonal credit (Walsh, 2010). According to (Mishkin, 2004) further explains that the Fed’s discount loans come in three forms:

1. Primary Credit: This is the principal type of discount lending, offered as a permanent loan facility for solvent banks, with an interest rate (discount rate) typically established 100 basis points over the federal funds rate. It functions as a supplementary liquidity source to prevent the federal funds rate from exceeding its objective, particularly during abrupt surges in reserve demand.

2. Secondary Credit: Aimed at banks experiencing financial distress, secondary credit imposes a penalty rate (50 basis points over the discount rate) to deter riskier institutions from excessive borrowing.
3. Seasonal Credit: This is intended for small banks located in areas with seasonal economic fluctuations, such as agricultural or tourism-centric regions. The seasonal credit rate is determined by the average of the federal funds rate and the certificate of deposit rate.

In addition to liquidity management, the discount window functions as a protective measure to alleviate bank panics and financial crises, allowing the Federal Reserve to provide reserves to distressed banks during emergencies. This duty was especially crucial during the Great Depression, the 1984 Continental Illinois bailout, the 1987 Black Monday crash, and the September 11 attacks in 2001. Nonetheless, it creates a moral hazard, since banks could engage in excessive risk-taking, depending on Federal Reserve assistance during crises, especially for large institutions classified as "too big to fail." The Federal Reserve must meticulously equilibrate crisis prevention with the potential to encourage imprudent financial conduct. The discount rate not only governs short-term loans and liquidity but also pertains to other monetary policy activities, including the interest rate on repurchase (repo) transactions and the interest rate on overnight loans (Kara, M., & Afsal, M. Ş., 2018).

(Mishkin, 2004) Mishkin (2004) elucidates that several nations have implemented a "corridor" or "channel system" to regulate interest rates within a designated range. In this arrangement, central banks establish two rates: a reduced deposit rate and an elevated lending rate among banks. This approach aids in stabilizing interest rates within a certain range, hence maintaining stability in monetary markets. The corridor system is especially efficient in nations where the central bank is the principal source of liquidity for the banking sector, offering an alternative method for sustaining stable rates without the need for regular modifications to conventional instruments.

2.2.3. Required reserve

Reserve requirements are regulations that obligate banks to retain a portion of their deposits as reserves, either in the form of vault cash or as balances held with the central bank. Although

their significance has declined globally, reserve requirements continue to influence the money multiplier and serve as a tool for central banks to regulate liquidity in the economy. Adjustments to reserve requirements have a direct impact on the volume of funds banks can extend as loans, thereby influencing the overall money supply (Walsh, 2010). According to (Bofinger, P., et al., 2001), The required reserves typically comprise the following elements:

1. Rules for Calculating the Required Reserve:

These rules define how to calculate the required reserve, based on bank balance sheet positions such as loans or liabilities like deposits. In practice, liability-based reserves are the preferred solution. Generally, deposits that are part of monetary aggregates M1 to M3 serve as the basis for calculating this reserve.

2. Rules for Calculating the Actual Reserve:

After determining the reserve requirement, it is necessary to set guidelines for how banks meet this requirement. This includes specifying the timing for holding the reserve and how the reserve period aligns with the calculation period. There may be a "contemporaneous" reserve requirement, where the timing coincides with the calculation period, or a "lagged" reserve requirement, where the reserve holding period follows the calculation period.

3. Functions of Required Reserves:

(Mishkin, 2004) pointed out that the functions of required reserves were primarily designed to ensure bank solvency Initially. Today, however, they serve to make the banking system dependent on the central bank, manage bank liquidity, which in turn influences short-term interest rates, and ensure a stable money creation multiplier. Required reserves remain an important tool in monetary policy, despite their reduced role in some economies.

Banks are mandated to retain a specific portion of their deposits as reserves with the central bank. An increase in the reserve requirement restricts banks' lending capacity by limiting the amount of funds they can freely utilize. When central banks raise the reserve ratio, it diminishes the overall money supply, subsequently leading to higher interest rates. Conversely, reducing the reserve requirement expands the funds available for lending, thereby increasing liquidity in the

economy and lowering interest rates. Although effective, this monetary instrument is less adaptable than other policy instruments, making reserve requirements less frequently adjusted (Mishkin, 2004).

In addition to the quantitative monetary policy instruments mentioned above, there are qualitative instruments used to achieve monetary policy objectives. These include credit rationing, selective credit control, and moral suasion.

2.3. Types of monetary policy

Expansionary and contractionary monetary policies are the two primary categories of monetary policies. The current state of the country's economy dictates which form is most suitable (Shapiro, D., MacDonald, D., & Greenlaw, S. A., 2023).

2.3.1. Expansionary Monetary Policy

During economic downturns, central banks may encourage economic growth by implementing expansionary monetary policies. Reducing interest rates, increasing the money supply, or doing both might be part of this strategy. Borrowing and investment are encouraged by falling interest rates, which boosts aggregate demand and may lead to increased production and employment (Mankiw N. G., 2004). The main goal is to keep employment and production stable, especially when the economy is sluggish and aggregate demand is low (Walsh, 2010).

According to, (Shapiro, D., MacDonald, D., & Greenlaw, S. A., 2023) central banks use expansionary monetary policy to boost economic growth and overall expansion rates, especially in times of high unemployment or economic downturns. More market liquidity is essential to this policy's goal of increasing aggregate demand. Expansionary policy is put into action by central banks via measures such as decreasing reserve requirements, buying government bonds through open market operations to infuse liquidity, and cutting interest rates to stimulate borrowing.

However, its effectiveness depends on several factors identified by (Mishkin, 2004) as follows:

1. Severity of the Economic Downturn: The more severe the recession, the less effective conventional monetary instruments may be. In extreme downturns, such as the Great

Depression, even lower interest rates may fail to stimulate demand due to a liquidity trap, where rates are already near zero and spending remains sluggish.

2. Interest Rate Levels: When interest rates are already at a low point, additional reductions yield minimal effects. However, under deflationary conditions, increasing inflation expectations and decreasing real interest rates may still contribute to stimulating economic activity.
3. Confidence and Expectations: Business and consumer confidence play a pivotal role in economic activity. When economic prospects appear uncertain, businesses and consumers may hesitate to borrow or invest, thereby weakening the policy's effectiveness. Expectation dynamics are fundamental to rational expectations theory, which posits that anticipated future conditions can significantly influence present economic decisions.
4. Credit Market Conditions: The functioning of credit markets is vital for the success of monetary policy. Impaired credit markets, often due to financial crises, can hinder the transmission of monetary policy impulses, diminishing its effectiveness.
5. Fiscal Policy: Expansionary fiscal measures, including higher government spending or tax reductions, can work alongside monetary interventions to further stimulate aggregate demand. In contrast, restrictive fiscal policies may counteract the effects of monetary policy.
6. Global Factors: In an interconnected global economy, international economic conditions and policies in other countries can affect domestic monetary policy outcomes. Global factors have become increasingly important in shaping the effectiveness of national policies

2.3.2. Contractionary Monetary Policy

Central banks use contractionary monetary policies when they want to contain inflation or prevent the economy from becoming too hot. These policies include limiting the money supply and regulating the availability of credit. This strategy aims to reduce the forces of inflation by raising interest rates, shrinking the money supply, or doing both. The cost of borrowing money rises when interest rates are high; this puts a damper on investment and consumer spending, which slows down the economy (Mankiw N. G., 2004).

When borrowing costs rise due to an increase in interest rates, capital investment and economic activity might fall. Contractionary policy also influences the interest rate structure, which connects the short-term and long-term rates. A change in investment methods that are vulnerable to changes in long-term financing costs due to higher short-term interest rates (Walsh, 2010). In the short term, this could result in job losses and reduced output, potentially creating social and political unrest (Bresciani-Turroni, 1937).

Central banks employ various instruments, such as raising interest rates to increase borrowing costs, which subsequently curbs both investment and consumption expenditures. They may also engage in selling government bonds in open markets to absorb surplus liquidity from the financial system. Another mechanism involves raising the reserve requirement ratio, which limits the availability of funds for lending within the banking sector (Shapiro, D., MacDonald, D., & Greenlaw, S. A., 2023).

2.4. Objectives of Monetary Policy

2.4.1. Achieving Price Stability (Controlling Inflation)

Maintaining stable price levels is a core goal of monetary policy across various nations. In his book *Principles of Economics*, Mankiw underscores the significance of maintaining a sound monetary system and preventing excessive money creation. He references historical cases such as German hyperinflation and the French Assignats, where uncontrolled money printing led to significant economic instability. Furthermore, he stresses that inflation reduces the buying power of money and may lead to a number of economic problems, such as skewed relative pricing, decreased investment, and unfair distributions of wealth. (Mankiw N. G., 2004).

Ensuring price stability has become a fundamental aim of monetary policy in the U.S. and Europe, driven by the negative impact of inflation on economic expansion. Rising inflation introduces uncertainty, complicating decision-making for consumers, businesses, and policymakers while disrupting future economic planning. It can also erode social cohesion as different groups compete to preserve their purchasing power. Empirical evidence suggests that inflation hampers economic growth, as observed in cases of hyperinflation in nations such as Argentina, Brazil, and Russia (Mishkin, 2004).

Although Price stability is a key objective of monetary policy, achieving it requires balancing various economic priorities. In the United States, monetary policy aims to maintain price stability alongside full employment, which results in exchange rate volatility due to the floating currency system. In China, the focus is on currency stability through strict control of monetary policy and capital flows, preventing external influences. In Europe, the adoption of the euro eliminated exchange rate fluctuations within the region but came at the cost of national monetary policy independence (Mankiw N. G., 2011).

2.4.2. High Employment

Achieving full employment while maintaining price stability is the fundamental objective of monetary policy, which is to maintain high employment. People experience less financial hardship, less loss of self-respect, and less criminality when job rates are high. Additionally, it keeps resources from being underutilized, which may lead to a decrease in GDP. Full employment, on the other hand, does not imply that there is no unemployment; rather, it denotes the normal rate of unemployment, which is usually somewhere between four percent and six percent, and it stands for the equilibrium between the supply and demand for labor (Mishkin, 2004).

According to (Blanchard, O., & Johnson, D. R., 2012) monetary policy aims to keep production steady and the unemployment rate at its natural level in order to preserve full employment. There are costs and benefits to regulating the economy, and the fact that the Federal Reserve aims for full employment means that the value of the dollar may rise and fall (Mankiw N. G., 2011).

2.4.3. Promoting Sustainable Economic Growth

Continuous economic growth is a primary goal closely linked to elevated employment rates. Low unemployment rates drive enterprises to increase capital investment, resulting in heightened productivity and improved economic performance. Conversely, heightened unemployment deters investment. Thus, monetary policies facilitate economic development by encouraging investment, which enhances the capital accessible for corporate expansion. Moreover, there is a continuous discussion on the impact of monetary policy on economic development (Mishkin, 2004).

Temporary modifications in the money supply may facilitate the advancement of sustained economic development. An upward adjustment in the asset market equilibrium schedule leads to a depreciation of the domestic currency, enhancing the competitiveness of domestically produced items relative to imported options. This depreciation enhances aggregate demand, resulting in production growth and a rise in employment. Monetary policy may encourage economic growth by affecting the exchange rate and production, therefore contributing to the overarching objective of maintaining long-term economic development (Krugman, P. R., & Obstfeld, M., 2002).

2.4.4. Interest-Rate Stability

Monetary policy aims to achieve interest rate stability, as fluctuations can create uncertainty in the economy, making future planning more difficult. These fluctuations impact consumer decisions, such as purchasing homes, and the planning of construction projects. Additionally, central banks seek to reduce sharp increases in interest rates to avoid negative reactions and pressures on their authority (Mishkin, 2004).

2.4.5. Stability of Financial Markets

Monetary policy seeks to enhance financial stability by mitigating financial crises that could obstruct the flow of capital into productive investments, thereby preventing severe economic downturns. A fundamental objective for central banks is to ensure a stable financial system, as demonstrated by the establishment of the Federal Reserve following the 1907 banking crisis. Interest rate stability plays a vital role in promoting financial resilience, as fluctuations can introduce risks for financial institutions. Higher interest rates may result in capital depreciation on long-term bonds and mortgages, which could contribute to financial institution failures, as observed during the difficulties faced by savings and loan associations in the 1980s and 1990s (Mishkin, 2004).

2.4.6. Stability in Foreign Exchange Markets

Monetary policy in U.S aims to maintain dollar stability due to its significant influence on the U.S. economy and global trade. A stronger dollar reduces the competitiveness of American industries, whereas a weaker dollar fuels inflation. Ensuring exchange rate stability assists in trade

planning and serves as a core objective of monetary policy, particularly for nations heavily reliant on foreign trade (Mishkin, 2004).

2.5. Channels of Monetary Policy Transmission to Economic Activity

2.5.1. Interest Rate Channel

Based on the data, it seems that changes to the real interest rate are the main way monetary policy affects inflation and production. Monetary policy has the power to influence real economic production so long as the central bank can control it via changes to the nominal interest rate. If the real interest rate were to increase, for example, families would be incentivized to put off spending until later, leading to a reduction in consumption now. Similarly, due to the forward-looking character of these variables, a monetary policy shock (such a rise in the nominal interest rate) leads to a fall in inflation and an expansion of the output gap right away. In addition, the production gap is more affected by long-term changes in the real interest rate than by short-term swings. When capital is considered, the fundamental interest rate transmission mechanism may impact investment expenditure; specifically, when real interest rates are high, demand for capital falls, and investment spending falls as a result (Walsh, 2010).

The equilibrium between money supply and demand, from this point of view, determines short-term interest rates. Spending habits and choices concerning production are affected by these rates because they affect long-term interest rates. To function, this system relies on the premise that there are no ideal alternatives to money, as other assets may cushion the blow of government stimulus programs. But new breakthroughs in imperfect information theory and structural changes in financial markets have shifted focus back to the role of credit markets in the transmission of money (Khan, M. S., Nsouli, S. M., & Wong, C.-H. (Eds.)., 2002).

2.5.2. Exchange Rate Channel

Lower interest rates in an open economy may cause the indigenous currency to depreciate, which makes exports more competitive and imports more expensive. A rise in aggregate demand is one outcome of this procedure, which helps boost net exports (Walsh, 2010).

According to (Mishkin, 2004) The monetary policy's transmission mechanism for exchange rates explains how changes in interest rates impact the value of the home currency, which in turn impacts net exports and economic performance as a whole. Foreign currencies are more attractive than local deposits when monetary policy reduces real interest rates. Products produced in the country become more competitively priced in global marketplaces as the value of the indigenous currency drops. As a result, net exports rise, which boosts domestic output and helps the economy thrive. By increasing both exports and aggregate demand, this mechanism is an essential cog in the wheel of monetary policy's impact on the economy's overall performance.

money supply $M\uparrow \Rightarrow$ *real interest rate* $i_r\downarrow \Rightarrow$ *dollar depreciates* $E\downarrow \Rightarrow$ *net exports* $NX\uparrow \Rightarrow$ *output* $Y\uparrow$

Recent research highlights the significant role of this exchange rate channel in the impact of monetary policy on the domestic economy.

2.5.3. Credit Channels

"Credit view" of the transmission of monetary policy, which places an emphasis on the function of credit markets. According to proponents of the credit perspective, the primary mechanism through which monetary policy influences actual economic activity is the credit market. Financial assets and liabilities, specifically the difference between financing sources that come from banks and those that don't, are said to be crucial. When agency costs separate internal and external finance, certain borrowers are more vulnerable to changes in credit conditions, and considerations like net worth and cash flow could impact investment choices. If monetary policy changes the way financial markets match borrowers with lenders or if credit rationing happens, certain borrowers won't be able to get loans no matter how much interest they're ready to pay, then the credit channel is at work. (Walsh, 2010).

In this model, the bank lending channel ensures that certain borrowers can only get loans via banks by taking use of banks' special competence in dealing with asymmetric information in the credit market. Bank deposits and reserves are increased by expansionary monetary policy, which in turn improves the availability of bank loans. Economic production rises as a result of increased investment and consumer expenditure. Because bigger companies have direct access to the stock and bond markets, monetary policy has less of an effect on smaller organizations. This

is because smaller firms are more dependent on bank loans. There has been a worldwide decrease in conventional bank lending and regulatory reforms that have made it easier for banks to obtain capital, both of which have reduced the efficacy of the bank lending channel. Regardless, the channel was essential in the US economy's revival during the recession of 1990–1991, according to (Mishkin, 2004).

In general, the credit channel operates on the premise that bank loans are not perfect substitutes for other financing methods, particularly for borrowers facing difficulties or higher costs when seeking non-bank financing. Tight monetary policy reduces the availability of bank loans, curbing spending and constraining economic activity. A key element of this channel is the "financial accelerator" effect, where monetary shocks exacerbate liquidity constraints and increase external financing costs. However, there is ongoing debate regarding the reliability of the credit channel as a predictor of economic activity, with mixed findings across various studies (Khan, M. S., Nsouli, S. M., & Wong, C.-H. (Eds.)., 2002).

2.6. Monetary policy in the framework of different economic theories

2.6.1. Classical Theory

Economists such as Adam Smith and David Ricardo established the Classical Theory, which states that markets would always achieve equilibrium unless the government gets in the way. The market maintains equilibrium when prices move in response to changes in supply and demand. Money, according to classical economics, is only a means of trade; it has no bearing on long-term production or employment. They support the idea of "money neutrality" and contend that changes in the money supply do not affect actual economic indicators.

Classical thinkers, in contrast, believe that the state should only become involved in matters that are absolutely necessary, such defense and the protection of private property rights. They contend that market equilibrium may be upset by too meddling. In addition to promoting free commerce as a way to increase wealth, the idea holds that production, especially in industries like manufacturing and agriculture, is the driving force behind national growth. be no intentional manipulation of the money supply, and stable monetary policies should be maintained (Smith, 1776).

2.6.2. Liquidity Preference Theory

John Maynard Keynes proposed the Liquidity Preference Theory in his 1936 landmark book The General Theory of Employment, Interest, and Money. It describes how, in an interest rate environment, people would rather store money or other liquid assets than less liquid ones. According to Keynes, there are essentially three reasons why people need money: the transaction motive, which is for everyday purchases, the precautionary motivation, which is for unexpected costs, and the speculative motive, which is for investments based on predictions of future interest rates.

The interest rate, which in this model represents the cost of liquidity, changes to reflect market forces that maintain a steady supply and demand for currency. People shift their wealth away from cash and toward interest-bearing investments as interest rates rise. On the other side, when interest rates go down, individuals anticipate smaller returns from other investments, which boosts the demand for money (Keynes, 1936).

2.6.3. Keynesian Theory

During the Great Depression, John Maynard Keynes laid the groundwork for what is now known as Keynesian economics. According to this school of thought, aggregate demand, or overall spending, drives the economy, not free markets. During recessions, Keynes said, demand drops, which in turn causes high unemployment. To combat this, he advocated for fiscal measures, such as public project deficit spending, to stimulate demand. When it comes to controlling economic volatility and making sure the economy is stable, Keynesians stress the need of government involvement (Keynes, 1936).

According to Keynes's theory, which he called liquidity preference, the money supply and demand dictate the interest rate.1The three main reasons that influence the need for money—the transactional motive, the precautionary motivation, and the speculative motive—are that it is a medium of exchange and a store of value. People Due to future uncertainty and the possibility of depreciation, it is preferable to have liquid assets. The possible return from investing must be considered with the ease and safety of having cash on hand. When supply and demand for cash are

in balance, that's when interest rates are determined. People are more likely to hoard funds when interest rates are high, and vice versa when rates are low (Keynes, 1936).

2.6.4. New Classical Theory

Neoclassical microeconomic theory, founded on the principle of utility maximization, originated from the marginalist revolution of the 1870s, influenced by the contributions of Leon Walras, Carl Menger, and William Stanley Jevons. This theoretical framework evolved further with Alfred Marshall's *Principles of Economics* (1890/1920), which offered a structured analysis of market dynamics, particularly the interaction between demand and supply. The core assumption of neoclassical theory is the rationality hypothesis, which posits that individuals maximize their utility when exchanging goods under scarcity. The theory uses this framework to explain both partial and total market equilibria, providing a broad and unified theoretical structure that addresses a wide range of economic phenomena. Despite its successes, neoclassical microeconomics has faced significant criticism, especially from alternative research programs like Institutional Economics and Behavioural Economics.

However, one of its key strengths, widely acknowledged by both supporters and critics, is its ability to unify diverse economic phenomena under a single descriptive and explanatory framework. This unification is so powerful that it extends beyond traditional economic areas, influencing fields like political science through Public Choice theory and even expanding to explain social issues like crime, family dynamics, law, and sex. The unification of neoclassical economics helps maintain its widespread use and dominance in economics education, making it a fundamental part of introductory textbooks worldwide (Mantzavinos, 2015).

Monetary measures that aim to increase aggregate demand, such cutting interest rates or increasing the money supply, according to new classical economists, have short-lived impacts on the economy. This view is in line with rational expectations theory, which states that businesses and people anticipate that a rise in the money supply would lead to higher prices but will have no lasting impact on production or employment. People understand that money-supply-manipulating monetary policies will speed up inflation without affecting growth or unemployment rates in the long run, as stated in the reasonable expectations theory. This is in line with what is known as the

"Policy Ineffectiveness Proposition," which argues that projected expansionary monetary measures do little to stimulate the economy because individuals swiftly adapt to them (Hoover, 1990).

In his paper "Expectations and the Neutrality of Money" (1972), Robert E. Lucas presents an economic model that explains the relationship between changes in nominal prices (inflation) and real output, focusing on the connection between monetary policy and the business cycle. The model is based on classical assumptions, such as prices being determined by market forces and economic agents acting rationally based on available information. Lucas introduces the concept of optimal expectations, where agents use all available data to predict future economic conditions, leading them to adjust their behaviour to accurately anticipate future effects.

Additionally, Lucas delves into the concept of "monetary neutrality" over the long term, positing that changes in the money supply have no impact on real variables like production or employment, but rather on price-level nominal variables. Nevertheless, in the near term, agents' actions are influenced by the inability to differentiate between real and nominal shocks, making money non-neutral and leading to tangible economic consequences. According to (Lucas, 1972), this theory suggests that changes in the money supply might have short-term effects on the actual economy, but that it will eventually return to equilibrium.

2.6.5. New Keynesian Theory

Wages and prices do not respond immediately to changes in the economy, according to new Keynesian economic theory, which is known as nominal rigidities. Several reasons contribute to this stickiness, including menu costs (the expenditures linked to changing prices) and the strategic actions taken by enterprises in an imperfectly competitive market (often represented as monopolistic competition). As a result of inefficiencies caused by imperfect competition, it emphasizes that these nominal rigidities might cause the economy to operate below its full capacity, even in the long term.

To stabilize the economy and mitigate the negative impacts of demand shocks, the government should step in since this equilibrium is suboptimal and inefficient. A negative demand shock, for example, would cause production to fall even lower from its already inefficient level

when nominal rigidities are present, which might lead to the justification of policy initiatives aimed at stimulating demand. When production starts below its efficient level, however, a positive demand shock may not need intervention. (Ball, L., Mankiw, N.G., & Romer, D., 1988).

The sticky-information model is suggested as a more practical substitute for the sticky-price model, which is often used in New Keynesian economics, and its flaws are pointed out in Theory. Firms incur costs when they change prices, leading them to do so seldom, according to the sticky-price model, which is based on the Calvo model. The New Keynesian Phillips curve follows, which forecasts the seemingly irrational result that publicized disinflations create booms. The model also has trouble explaining why inflation lasts and why it takes time for inflation to react to changes in monetary policy. Acceleration, the positive relationship between economic activity and increases in inflation, is also not captured.

On the other hand, according to the sticky-information model, businesses make price choices based on out-of-date information since news about the economy circulates slowly. The dynamics produced by this model are more consistent with reality. Economic activity and changes in inflation are positively connected, monetary policy shocks effect inflation with a delay, and recessions are always caused by disinflation, according to this theory. In contrast to the sticky-price model, the sticky-information model likewise meets the natural rate hypothesis. Despite their shared features, the Fischer contracting model and the sticky-information model both avoid the problematic assumption of long-term contracts. The authors argue that the sticky-information model provides a more convincing explanation for the macroeconomic dynamics that have been seen and they urge more investigation into its implications.

In contrast to the relatively simplistic sticky-price model, the sticky-information model provides a more complex and, maybe, more realistic framework for understanding the function of monetary policy. The slow diffusion of information in the sticky-information model causes monetary policy interventions, such changes in interest rates or money supply, to have a noticeable lag in their effects. This lag is caused by the fact that economic players, especially those who set prices, do not have instantaneous access to new information and so rely on old data when making judgments. This highlights how important it is for monetary policymakers to be credible and communicate effectively. (Mankiw, N. G., & Reis, R. , 2001) found that plausible policy changes

that are publicized in advance help to gradually modify expectations, which in turn reduces the risk of production loss during disinflation.

2.6.6. Monetary Stability Theory

Friedman's address analyzes monetary policy's role in economic stability, outlining both its potential and limitations. He argues that while widely accepted goals include high employment, stable prices, and rapid growth, there is little consensus on their compatibility or the means to achieve them. Friedman traces the evolution of thought on monetary policy, highlighting the shift from early optimism about its power to fine-tune the economy to skepticism during the Keynesian era, and ultimately, to a renewed belief in its influence, spurred by post-war economic experiences and academic research. While advocating for a significant role for monetary policy, Friedman cautions against overestimating its capabilities. He outlines two key limitations: the inability to peg interest rates and the inability to peg unemployment rates in the long run. Attempts to manipulate these variables will ultimately be thwarted by market forces and lead to undesirable consequences like inflation or deflation. Friedman proposes two guiding principles for conducting monetary policy: focusing on controllable variables, such as the quantity of money, and avoiding sharp policy shifts. He advocates for a steady and predictable approach, ideally a fixed rate of monetary growth targeting price stability (Friedman M. , 1968).

This view is supported by the insights of (Balino, T. J. T., & Cottarelli, C. (Eds.), 1994)who discuss the central bank's primary goal of monetary stability, which includes both domestic price stability and external exchange rate stability. The editors examine the shift from an emphasis on low interest rates to prioritizing inflation control, observing a direct relationship between money demand and price levels. This led to the adoption of monetary targeting strategies. While monetary targeting offers predictability and transparency, it also faces challenges in identifying a stable domestic monetary aggregate, an issue compounded by financial innovation. Despite these challenges, the concept of nominal anchors, such as inflation rate targeting or nominal income targeting, provides a reference point for guiding policy and stabilizing prices. These nominal anchors have the potential to reduce both output and inflation volatility, though central banks must continuously adapt to evolving financial landscapes, including changes in payments systems and financial supervision,

Building on Friedman's hypothesis, Hendrickson (2017) investigates and supports Milton Friedman's perspective that economic fluctuations stem primarily from imbalances in the supply and demand for money. Hendrickson examines whether variations in the money supply or money demand play a more pivotal role in economic instability. Through econometric analysis, he determines that shocks to the money supply exert a significantly greater influence on economic fluctuations than those affecting money demand. This finding reinforces Friedman's hypothesis and underscores the critical role of money supply management in ensuring economic stability (Hendrickson, 2017).

2.6.7. Modern Monetary Theory (MMT)

MMT argues that a country that issues and borrows in its own currency can spend without the limitations of tax revenue or borrowing because it can always generate more currency. This challenges conventional monetary theory's concerns about government deficits leading to crowding out private investment. MMT proponents assert that these countries face no risk of defaulting on their debt. However, critics caution that such spending could fuel inflation. MMT's view of increased fiscal space rests on the assumption of a zero natural rate of interest. This concept suggests that government debt could be eliminated if the central bank set a zero-interest rate target because there would be no need to sell sovereign debt. However, even with a zero real interest rate policy, a nominal interest rate of 2 percent necessitates significant interest payments from the federal budget. Critics argue that MMT's claims about increased fiscal space and unlimited spending lack empirical support (Coats, 2019).

The United States has a fiat monetary system, which means the government may print money whenever it wants (Mosler, 1995). As a result, neither tax collections nor borrowing can be used to limit how much the government spends. The real limit on expenditure is inflation, which happens when there is an excess of money compared to the products and services that may be purchased. As purely accounting instruments for interest rate management, worries over the national debt and deficit are groundless. This runs counter to the common belief that governments should spend money only after they have collected it via taxes or borrowed it. Instead of imposing arbitrary budgetary restrictions, policymakers need to prioritize tangible economic results like full employment and price stability.

in a fiat monetary system, like that of the United States, the government is not financially constrained and can create money at will. This means that government spending is not limited by tax revenues or borrowing. The true constraint on spending is inflation, which occurs when there is too much money in circulation relative to the available goods and services. Concerns about the federal deficit and debt are misplaced, as they are merely accounting instruments for managing interest rates. This challenges the conventional view that governments must first raise funds through taxation or borrowing before spending. Policymakers should focus on real economic outcomes, such as full employment and price stability, rather than arbitrary financial constraints.

Palley, T. (2019) critique MMT's oversimplified approach to inflation. They argue that while MMT acknowledges the need to control inflation at full employment, its reliance on fiscal policy alone and dismissal of monetary policy instruments like interest rates is problematic. He contend that raising taxes to curb inflation at full employment is politically challenging and subject to lags, making it an unreliable tool for fine-tuning. He highlight the potential for political biases to favor increased spending over tax hikes, leading to a gradual upward creep in government spending and potentially creating an inflationary bias. Moreover, MMT's neglect of the influence of expectations on financial market behavior may intensify inflationary pressures (Palley, 2019).

Ricks, M. (2016) emphasizes the government's crucial role in establishing and regulating a monetary framework. This aligns with MMT's focus on the government's power to create and control its currency. Ricks explains that even proponents of laissez-faire economics generally agree that the market alone cannot create a satisfactory monetary system, and government involvement is essential. Ricks discusses how private entities, especially shadow banks, create "money" through the issuance of short-term debt instruments that are seen as close substitutes for cash. This relates to MMT's concept of governments creating money through spending. Ricks also describes the growth of private money claims exceeding the growth of nominal GDP before the 2007 financial crisis, indicating a privatization of the money supply (Ricks, 2016).

2.6.8. Comparison of the framework of different economic theories:

Table 1 Comparison of the framework of different economic theories

Theory	Key Concepts	Monetary Policy View	Key Dates/Events

Classical Theory	-Markets naturally reach equilibrium - Money as a medium of exchange - "Money neutrality"	- Money supply does not affect employment or production. - Advocates for minimal government intervention.	1776 - Adam Smith published 'The Wealth of Nations'.
Liquidity Preference Theory	- Developed by Keynes, this theory suggests that individuals prefer holding liquid assets rather than less liquid assets, especially when interest rates are low. - The demand for money is determined by transaction, precautionary, and speculative motives.	- High interest rates reduce money demand, low rates increase money demand. - Interest rates balance supply and demand for money.	1936: John Maynard Keynes released 'The General Theory of Employment, Interest, and Money'.
Keynesian Theory	- Aggregate demand is the main driver of economic activity. - Government intervention to stimulate demand.	- Government should boost demand during recessions. - The supply and demand for money are the factors that influence interest rates. - Money serves as a repository of wealth.	1936 - John Maynard Keynes during the Great Depression.
New Classical Theory	- Rational expectations. - Policy Ineffectiveness Proposition. - "Monetary neutrality" in the long run.	- Monetary policy only has temporary effects on output and employment. - Anticipated policies lead to inflation without lasting impact on the economy.	1972 - Robert E. Lucas published 'Expectations and the Neutrality of Money'.
New Keynesian Theory	- Nominal rigidities like sticky prices and wages. - Imperfect competition leading to inefficiencies.	- Monetary policy can address inefficiencies caused by rigidities. - Interventions needed during negative demand shocks.	1988 - Ball, Mankiw, and Romer develop the sticky-price model.

Monetary Stability Theory	- Focus on controlling the money supply. - Avoid sharp policy shifts.	- Stability in money supply is key. - Advocates for targeting money supply growth to maintain price stability. - Caution against manipulating interest rates.	1968 - Milton Friedman outlines monetary stability theory.
Modern Monetary Theory (MMT)	- Governments can create money by issuing their own currency. - No risk of default on sovereign debt.	- Governments can spend freely as long as they control their currency - Inflation concerns are secondary, managed by fiscal policy, not monetary policy.	1990s -Warren Mosler published Soft Currency Economics.

Source: Author's own work .

3. ECONOMIC GROWTH

3.1. The concept of economic growth

(Shearer, 1961) highlights that economic growth is fundamentally a quantitative concept, as emphasized by Simon Kuznets. According to Kuznets, quantitative analysis is indispensable for comprehending the dynamics of growth. Economic growth is defined as an activity aimed at enhancing individual welfare, although the specific objectives of this activity often remain ambiguous and subject to multiple interpretations. Shearer also notes that the flow of goods and services serves as a primary indicator of economic welfare. However, the direct relationship between economic activity and individual well-being has not been empirically established. Consequently, growth measures often rest on untested assumptions, leading to varied definitions. Nevertheless, these indicators are widely accepted in practice because of their association with fulfilling individual desires and improving living standards.

(Shearer, 1961) further describes economic growth as a continuous rise in per capita income, reflecting an improved capacity of a country to produce goods and services. While economic growth has a quantitative dimension, it also encompasses social, institutional, and attitudinal factors. Shearer suggests focusing on the expansion of an economy's physical productive capacity, which can be analyzed through the concept of the production frontier.

An expanding economy is one in which a country's real per capita gross domestic product (GDP) rises over time(Barro, R. J., & Sala-i-Martin, X., 2004).This idea is fundamental to economics since it depicts the gradual increase in a nation's output of commodities and services. While other metrics like employment, GDP growth, and per capita income may be used to gauge growth, GDP growth is by far the most used (Fikri, Y., Mantouzi, S., Rhalma, M., & Youssef, S., 2024).

(Blanchard, O., & Johnson, D. R., 2012)define economic growth as "the steady increase in aggregate output over time," highlighting the importance of sustained expansion in an economy's productive capacity. This steady growth reflects the continuous improvement in the production of goods and services, which is central to understanding economic performance.

Economists often differentiate between nominal GDP and real GDP when attempting to quantify this expansion. Since nominal GDP is based on current prices to determine the value of economic output, it is susceptible to fluctuations in price levels (Mankiw N. G., 2011). To separate the effects of changes in quantity of goods and services, real GDP uses constant base-year prices. Real GDP is more indicative of economic health and its capacity to satisfy human needs since it does not include the impact of price changes. Economists usually use real GDP, which is the percentage change in GDP over time, to evaluate growth because of this reason.

3.2. Indicators of economic growth

Economic development is mostly assessed via Gross Domestic Product (GDP), serving as a principal indication of a society's economic welfare. As (Mankiw N. G., 2011) explains, "GDP measures the total income of the nation. It is the most closely watched economic statistic because it is thought to be the single best measure of a society's economic well-being." GDP not only reflects the current level of economic prosperity but also provides a basis for measuring long-term economic progress.

(Blanchard, O., & Johnson, D. R., 2012)emphasize that nominal GDP often increases due to both rising production levels and inflation, which can obscure real changes in output. Real GDP, on the other hand, isolates actual growth by adjusting for inflation, making it a more reliable measure of an economy's productive capacity.

Furthermore, the growth in GDP from one year to the next can stem from two key factors, as noted by (Mankiw N. G., 2011):

1. Increased Output: This indicates real economic growth, where the economy produces more goods and services.
2. Higher Prices: This reflects inflation, which may not necessarily indicate an improvement in economic performance.

As (Acar, 2019) highlights that GDP trends serve as a key measure of economic well-being. An increasing GDP typically reflects strong economic performance and growth, whereas a declining GDP indicates stagnation or economic difficulties. However, to gain a comprehensive perspective on economic growth, GDP should be analyzed alongside other critical indicators, including employment, investment, and human development.

3.2.1. Nominal GDP

An economy's aggregate production is most often measured by its Gross Domestic Product (GDP), which forms the backbone of national income accounting. It is the market worth of all final products and services created within a nation's boundaries during a certain time frame. The idea of "value-added," which is the net contribution to production, is fundamental to GDP. The value of value-added is calculated by subtracting the value of intermediary items used from the overall value of output, as explained by (Blanchard, O., & Johnson, D. R., 2012). Each level of production has an economic contribution, and this differentiation highlights them all.

(Mankiw N. G., 2011) reinforces this understanding, defining GDP as "the market value of all final goods and services produced within a country in a given period." This definition underscores GDP's role in capturing the total income generated within an economy. (Blanchard, O., & Johnson, D. R., 2012) further elaborate, describing GDP as "the sum of incomes in the economy during a given period," reinforcing its dual role as a measure of both production and income.

Although GDP is the most commonly utilized measure of economic activity, it is crucial to differentiate it from Gross National Product (GNP). As noted by (Krugman, P. R., & Obstfeld,

M., 2002), GNP extends beyond GDP by including net factor income from abroad—income earned by residents from foreign assets minus payments made to foreign entities within the country. This distinction emphasizes that GDP focuses solely on the volume of production within a country's borders, making it the preferred measure for most countries, including the United States, which adopted GDP as its primary indicator in 1991.

There are a few different ways to estimate the entire value of output using the existing market prices during a certain time. One is nominal GDP, which is also called currency GDP, GDP in current currency, or GDP in current prices (Blanchard, O., & Johnson, D. R., 2012). Nominal GDP is better for assessing the size of the economy than real GDP for evaluating actual growth since it does not compensate for inflation.

3.2.2. Real GDP

One important metric for measuring economic development is real GDP. It provides a more realistic picture of the size and performance of an economy by measuring the entire market value of goods and services produced inside a nation's boundaries during a certain time, taking inflation into account. Real GDP allows for more accurate comparisons of economic production across time and between countries by removing the impact of price movements. To get at the real GDP, we use relative prices as a weight for all final products output. These prices might change over time to reflect how the economy is doing.

In the United States, real GDP is commonly calculated using chained dollars, often with 2005 as the base year. This method, known as real GDP in chained (2005) dollars, ensures consistency by adjusting nominal GDP to remove inflation's influence. In this approach, real GDP equals nominal GDP in the base year, offering an accurate measure of the economy's actual production (Blanchard, O., & Johnson, D. R., 2012).

The growth rate of real GDP is super important because it helps us track how the economy is doing over time. When real GDP is growing, it means the economy is expanding, but if it's shrinking, that points to a recession. The yearly percentage change in real GDP is an important measure for evaluating a country's economic condition (Blanchard, O., & Johnson, D. R., 2012).

Real GDP is calculated using the GDP deflator formula:

$$Real\ GDP_t = \frac{Nominal\ GDP_t}{GDP\ Deflator_t}$$

This measure is also known by various names, including GDP in constant currency, GDP adjusted for inflation, GDP in chained prices, or GDP in fixed prices. It serves as an essential metric for comparing the relative economic scale of different countries; for example, a nation with double the GDP of another is considered twice as large economically. Periods of sustained positive growth are referred to as expansions, while negative growth periods are termed recessions. Thus, real GDP remains an indispensable measure for tracking economic conditions and assessing long-term and short-term trends in a country's economic performance (Blanchard, O., & Johnson, D. R., 2012). Real GDP is particularly important for short-term economic analysis, as it provides the most comprehensive view of economic activity. It allows economists to monitor fluctuations and trends in economic output effectively (Mankiw N. G., 2011).

To calculate single-period GDP growth, according to (Samuelson, P. A., & Nordhaus, W. D., 2010) the following formula is used:

$$\%\text{Growth of } Real\ GDP_t = \frac{Real\ GDP_t - Real\ GDP_{t-1}}{Real\ GDP_{t-1}} * 100$$

3.2.3. GDP per Capita

One of the most important measures of a country's average level of living is its real GDP per capita. To get it, take a country's real GDP and divide it by its population. By controlling for population size, this metric makes it possible to compare nations or historical periods based on the amount of economic production available per person, which is a more direct indicator of personal wellbeing and quality of life. To what extent does a country's economic development lead to higher living standards for its citizens? This indicator may assist with that. (Blanchard, O., & Johnson, D. R., 2012).

3.2.4. Inflation Rate

According to(Blanchard, O., & Johnson, D. R., 2012), denotes a persistent increase in the overall price level, while the inflation rate quantifies the velocity of this price escalation. A sustained decrease in prices is termed deflation.

Contemporary inflation theories classify inflation as demand-pull inflation, which results from excessive demand. Demand-pull inflation arises when aggregate demand exceeds the economy's productive capacity, resulting in elevated prices as supply fails to satisfy demand, whereas supply-shock inflation is triggered by increasing production costs. These categories underscore the many factors contributing to inflation and its ramifications for policy formulation (Samuelson, P. A., & Nordhaus, W. D., 2010).

Economists often use two primary metrics to determine the inflation rate: the GDP Deflator and the Consumer Price Index (CPI). The GDP Deflator, an indicator, indicates variations in the prices of all products and services included in GDP. The CPI, conversely, focuses on the price fluctuations of a collection of consumer goods and services often acquired by families.

The GDP Deflator

One important metric for gauging the general level of prices in an economy is the GDP deflator. When prices are held constant at the base year level, real GDP isolates output, whereas nominal GDP captures both the quantities and prices of products and services. From these two metrics, we get the GDP deflator, which only accounts for product and service prices (Mankiw N. G., 2011).

The GDP deflator P_t is calculated as the ratio of nominal GDP to real GDP for a given year t:

$$P_t = \frac{Nominal\ GDP_t}{Real\ GDP_t}$$

This measure provides insight into how changes in nominal GDP are influenced by price changes versus real production growth. By rearranging the equation, nominal GDP can be expressed as:

$$\boldsymbol{Nominal\ GDP_t = P_t * Real\ GDP}$$

As noted by (Blanchard, O., & Johnson, D. R., 2012), Inflation plus the rate of real GDP growth equal the rate of nominal GDP growth. So, a rise in either real GDP or prices, or both, may

lead to an increase in nominal GDP. An increase in prices is considered the cause of a disparity between nominal and real GDP growth.

The inflation rate, derived from the GDP deflator, measures the percentage change in the price level from one year to the next. It is calculated using the formula:

$$Inflation\ Rate_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

This formula illustrates how the GDP deflator functions as a broad measure for analyzing the interplay between nominal GDP, real GDP, and inflation.

Consumer Price Index (CPI)

The Consumer Price Index (CPI) measures the cost of goods and services purchased by a typical consumer (Mankiw N. G., 2011).

The Consumer Price Index (CPI) quantifies the average prices of goods and services used by people within the economy, emphasizing a consumption basket that reflects the expenditure habits of the average urban consumer. The basket is frequently revised based on comprehensive analyses of consumer expenditure, generally every decade. The Consumer Price Index (CPI) is established at a baseline of 100 throughout the reference period, indicating that the figure lacks intrinsic economic value but serves to monitor price fluctuations over time (Blanchard, O., & Johnson, D. R., 2012).

The CPI is calculated using the following formula, once a base year is chosen (Mankiw N. G., 2011):

$$CPI = \frac{Price\ of\ basket\ of\ goods\ and\ services\ in\ current\ year}{Price\ of\ basket\ in\ base\ year} \times\ 100.$$

The inflation rate, which measures the percentage change in the price level between two consecutive years, is derived from the CPI using this formula:

$$Inflation\ rate\ in\ year\ 2 = \frac{CPI\ in\ year\ 2 -\ CPI\ in\ year\ 1}{CPI\ in\ year\ 1} \times\ 100$$

The Relationship Between CPI and GDP Deflator

The CPI measures the cost of goods consumed by households, while the GDP Deflator measures the prices of all goods produced within the economy, whether sold to consumers, firms, or exported.

Both indices are used to track inflation, but they can differ in certain periods, such as in the 1970s in the USA when oil prices rose. In that case, imported goods (like oil) increased faster than domestically produced goods, causing the CPI to rise faster than the GDP Deflator (Figure 1) (Blanchard, O., & Johnson, D. R., 2012)

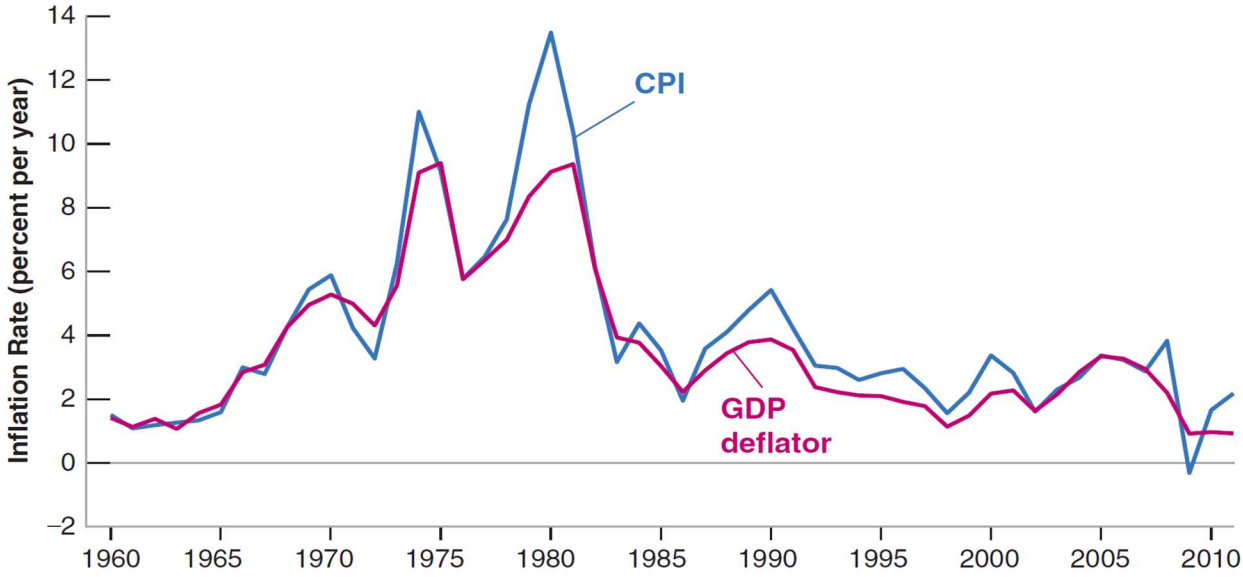

Figure 1 Inflation rate, using the CPI and the GDP deflator, 1960–2010.

Source: (Blanchard, O., & Johnson, D. R., 2012)

Despite these differences, the CPI and GDP Deflator usually move in the same direction, with the difference between them typically being small (Blanchard, O., & Johnson, D. R., 2012).

3.3. Methods of Measuring GDP

To analyze how the economy allocates its scarce resources, economists examine the distribution of GDP across different spending categories. As (Mankiw N. G., 2011) explains, GDP (which denoted as *Y*) is divided into four components: consumption (C), investment (I), government purchases (G), and net exports (NX):

$$Y = C + I + G + X$$

According to (Samuelson, P. A., & Nordhaus, W. D., 2010)This model helps assess whether the economy is expanding or contracting and identifies risks like recessions or inflation . GDP can be measured in two distinct ways:

3.3.1. The Goods Flow (Flow-of-Product Approach)

- **Production Approach**

The Flow-of-Product Approach calculates GDP by summing the value of final goods and services consumed each year. Only final goods, which are directly used by consumers, are included. Households spend their income on these goods and add together all the consumption dollars spent on these final goods equals the GDP. Market prices are used to value these goods, reflecting their relative economic worth based on consumer preferences for each product. (Samuelson, P. A., & Nordhaus, W. D., 2010)

- **Value-Added Approach**

The Value-Added Approach prevents duplicate counting by include just final items in GDP and excluding intermediate goods used in their manufacture. It quantifies the value contributed at each level of manufacturing, guaranteeing that costs for intermediate items acquired from other enterprises are deducted. (Samuelson, P. A., & Nordhaus, W. D., 2010).

3.3.2. Earnings or Income Approach

Earnings or Income Approach calculates GDP by measuring the total income generated through business costs, including wages, rents, profits, and interest. These business costs are also the earnings received by households, providing another method to calculate GDP based on the factors required to produce final goods and services (Samuelson, P. A., & Nordhaus, W. D., 2010).

3.4. The Impact of Monetary Policy on Economic Growth

3.4.1. The Impact of Monetary Policy Instruments on GDP

Monetary policy significantly influences GDP through its ability to alter interest rates, which in turn affect consumption and investment decisions. Central bank adjustments to interest

rates directly impact borrowing costs, either stimulating or restraining economic activity. While classical economic models suggest monetary neutrality, (Galí, 2008) explains that the New Keynesian framework highlights the role of price and wage stickiness, which allows monetary policy to have short-term effects on GDP. However, as prices and wages fully adjust over time, these effects dissipate.

Changes in aggregate demand are the mechanism by which monetary policy and GDP are related. (Walsh, 2010) describes how monetary policy shocks, such as interest rate adjustments, cause shifts in consumption and investment, which influence overall output levels. The response of GDP to these shocks often follows a hump-shaped pattern, where the peak effect emerges several quarters after the initial intervention. This delay reflects the time needed for households and firms to adapt to new economic conditions, underscoring the importance of forward-looking decision-making in aligning monetary policies with economic cycles.

When the economy is in a slump, monetary policy instruments like monetary expansion, which increase liquidity and decrease interest rates, are very useful for boosting aggregate demand. As a result, the equilibrium level of GDP rises and the aggregate demand curve moves to the right. The effectiveness of monetary policy in averting economic collapse and bolstering recovery is shown by these processes (Samuelson, P. A., & Nordhaus, W. D., 2010).

3.4.2. The Impact of Monetary Policy Instruments on Real GDP

Monetary policy primarily affects real GDP by influencing real interest rates and leveraging nominal rigidities. (Walsh, 2010) highlights that sticky prices and wages enable monetary interventions to exert significant short-term effects on real output.By modifying nominal interest rates, central banks shape the real cost of borrowing, thereby impacting consumption and investment choices. While monetary policy exhibits short-term non-neutrality as real GDP responds to aggregate demand changes, its long-term effects diminish as prices and wages become flexible. This underlines the importance of timing in monetary policy to support growth and mitigate recessions.

Expansionary monetary policy drives economic growth by increasing consumer spending, encouraging investments, and raising real GDP. However, excessive reliance on such policies can

result in rising inflation if not managed carefully. On the other hand, contractionary monetary policy helps stabilize prices and reduces aggregate demand, but overuse may lead to economic slowdown, emphasizing the need for a balance between price stability and growth (Shapiro, D., MacDonald, D., & Greenlaw, S. A., 2023).

Reserve requirements also play an indirect role in influencing economic activity by managing banking sector liquidity and the money supply. Lower reserve requirements enhance lending and investment, boosting GDP, while higher reserves limit liquidity, aiding inflation control but potentially restraining economic growth. This makes reserve requirements a vital tool for balancing growth and price stability (Walsh, 2010).

Nominal GDP targeting provides another framework for responding to demand shocks and shifts in money velocity. This policy approach accommodates changes in monetary supply to stabilize inflation and promote sustainable real GDP growth. By aligning inflation control with economic expansion, nominal GDP targeting underscores the dual role of monetary policy in achieving macroeconomic stability (Sumner, 2014).

3.4.3. The Impact of Monetary Policy Instruments on Inflation

Controlling inflation is a key objective of monetary policy, as stable inflation forms the foundation for economic stability. (Galí, 2008) emphasizes the significance of inflation targeting, highlighting its role in anchoring expectations and maintaining price stability. Using the New Keynesian Phillips Curve, Galí explains how monetary interventions influence inflation by adjusting aggregate demand. However, he also points out the trade-offs that central banks face between stabilizing inflation and promoting economic growth, requiring careful calibration of policies.

As to (Walsh, 2010), more than 30 economies throughout the globe have embraced inflation targeting, making it an essential component of contemporary monetary frameworks. A climate conducive to investment and economic development over the long run may be created by this approach, which aims to stabilize prices and reduce uncertainty. Inflation is kept within target levels and supply and demand are balanced via the use of instruments like as interest rate changes and open market operations. While central banks have the challenge of balancing inflation control

with economic growth promotion, Walsh points out that there are typically trade-offs involved in attaining stable inflation. For monetary policy to continue to inspire trust, there must be open dialogue and believable promises.

When negative demand shocks cause recessions, central banks may expand monetary policy to prevent inflation from falling below target levels, thus stabilizing both inflation and employment. Conversely, during positive demand shocks, contractionary monetary policy may be necessary to prevent inflation from exceeding target levels. (Blanchard, O., & Johnson, D. R., 2012) highlight the challenges of such decisions, as central banks must often choose between allowing inflation to rise temporarily or accepting short-term increases in unemployment to maintain long-term price stability.

Monetary policy also has its limits, as it cannot sustain output beyond potential levels for extended periods. (Samuelson, P. A., & Nordhaus, W. D., 2010) warn that excessively low interest rates can lead to overheating in the economy, resulting in inflationary pressures. This underscores the importance of using monetary instruments judiciously to balance inflation control and overall economic stability.

4. LITERATURE REVIEW

4.1. The impact of monetary policy instruments on GDP

1- (Davceva, L., Hourvouliades, N., & Komic, J., 2018)

Focus of the Study:

Interest and inflation rates' impacts on GDP in Bulgaria, Romania, and FYROM from 2000 to 2014 are examined in this paper. To determine the impact on economic growth and the degree to which monetary policy follows inflationary trends, it examines the relationship between interest rates, GDP, and inflation, as well as the interaction between interest rates and inflation in every nation.

This research looks at the relationship between GDP, interest rates, and inflation over the long run using Johansen's cointegration test. It also uses the Granger causality test to find out which way the variables are causally related.

Results:

Bulgaria: The analysis finds a weak negative relationship between interest rates and GDP also between inflation and GDP, indicating that these variables have a limited impact on economic development. Inflation and interest rates are positively correlated in the research, suggesting that Bulgaria's monetary policy follows basic principles by reacting to fluctuations in inflation.

Romania: The analysis shows a higher negative association between interest rates and GDP, indicating a bigger influence on economic growth. The near-perfect positive link between interest rates and inflation implies Romania's monetary policy regularly monitors price trends.

FYROM: This country displays a negligible correlation between inflation and GDP, but a strong negative correlation between interest rates and GDP, indicating that interest rates substantially affect economic growth. However, the weak correlation between interest rates and inflation in FYROM implies that its monetary policy does not closely track inflation.

2- (Aron, J., & Muellbauer, J., 2001)

Focus of the Study

The effect of changes in interest rates on production in South Africa is the subject of this research. Changes in monetary policy, especially the move toward a more market-oriented strategy in the 1980s, are examined, along with the implications of real and nominal interest rates on future growth in production. Examining how interest rates impact South Africa's economic performance is the primary objective of the research.

Methodology

A one-equation multi-step forecasting model was used to predict outcomes in this research. A smooth non-linear stochastic trend is included into this model type, which is analogous to a VAR system. This model was used instead of a VAR because VARs have the potential to miss important variables or delays, and they are also prone to predict failure because of missed structural

breakdowns. By conducting structural break tests, using a stochastic trend to detect changes in underlying capacity trends, applying general-to-specific model selection procedures, and limiting the nature of longer lags to prevent over-parameterization while still allowing the examination of longer lags, the study's authors attempted to mitigate the model's limitations.

Results

The study finds that increases in both nominal and real interest rates negatively affect future output growth in South Africa. The detrimental effect of real interest rates persists due to their influence on investment and capital stock. The study also highlights a significant shift in the 1980s when South Africa moved to a more market-oriented monetary policy, which reduced the negative impact of interest rate hikes on output by facilitating easier refinancing for borrowers. High real interest rates in the 1990s contributed to poor output performance, suggesting the need for alternative policies to manage inflation effectively, including competition policies and labor market reforms.

3- (Saiti, D., & Trenovski, B., 2021)

Focus of the Study

From 2004–2021, this research looks at the Republic of North Macedonia's nominal GDP and how different interest rates, both short- and long-term, affected it. National Bank of the Republic of North Macedonia (NBRNM), Ministry of Finance (MoF), and State Statistical Office (SSO) data were used by the researchers on a quarterly basis. Interest rates on treasury bills are used to represent short-term interest rates in the research, while rates on government bonds are employed to represent long-term interest rates. The SSO database was used to gather current prices (in millions of denars) in order to determine the nominal GDP.

Methodology

The researchers employed a Vector Error Correction Model (VECM) to examine the data. VECM models are applied when a group of variables is stationary at I(1) and shares a long-term relationship (i.e., they exhibit cointegration). These models enable researchers to assess both short-run and long-run characteristics of cointegrated series.

Results

- A robust negative linear link (correlation) between nominal GDP and both short-term and long-term interest rates was discovered by the researchers in the RNM. When comparing short-term and long-term interest rates, the link was somewhat stronger for the former.
- Additionally, they discovered that long-term interest rates do not affect GDP, but short-term interest rates do in a statistically significant negative way in the long term.
- The influence of long-term interest rates on GDP was negligible in the near run. At the 10% level of statistical significance, however, a causal association between short-term interest rates and economic growth was seen.

4- (Al-Habashneh, F. M., 2022)

Focus of the Study

The purpose of this research was to examine the connection between Jordan's private sector GDP and both the narrowed and expanded measures of the country's money supply. Examining the effects of monetary policy changes on real gross domestic product and interest rates was the primary goal of the study. Their focus was on studying how interest rates, investment, and private sector output were impacted by expansionary monetary policy and a rise in the money supply.

The researchers also aimed to evaluate the effectiveness of monetary policies implemented in Jordan to stimulate private sector output from 1990 to 2019. The study analyzed the instruments utilized by the Jordanian central bank to foster economic growth by regulating the overall money supply available to banks, consumers, and businesses.

Methodology

The research on the impacts of Jordan's money supply used a rigorous process that included many checks and balances to guarantee accurate findings. Using the Augmented Dickey-Fuller test, the researchers first checked whether the data was stationary; following the first difference, they found that it had become stationary. After that, they determined that the variables were in a state of long-term equilibrium by testing for cointegration using the Johansen technique. After that, they used a Granger causality test to find out which way the variables were related. Researchers

concluded by analyzing the data using a fully modified ordinary least squares (FM-OLS) regression model. Researchers opted for the FM-OLS approach rather than the Johansen method due to the fact that the former employs a single equation estimate strategy, which is seen by some to be more effective than the latter's multivariate cointegration technique.

Results

- Both the narrow money supply and the expanded money supply had a positive and statistically significant effect on real GDP. This finding supports the study's hypothesis and is in line with economic theory.
- The real interest rate had a negative and statistically significant effect on real GDP. This finding also supports the study's hypothesis and is in line with economic theory.
- Real domestic savings had a positive but statistically insignificant effect on real GDP.
- The FM-OLS model demonstrated strong explanatory power, as indicated by the R-squared values of 0.983 for the narrow money supply model and 0.987 for the expanded money supply model.

5- (Barışık, S., & Çetintaş, H., 2008)

Focus of the Study

This research looks into how changes in reserve requirements have affected investment and economic growth in Türkiye. Specifically, it analyzes the period from 1987 to 2004, during which 23 adjustments to reserve requirement ratios took place. The research is driven by the notion that reserve requirements serve as a powerful monetary policy instrument capable of generating rapid and widespread effects on the banking sector and the broader economy.

Methodology

Using an Autoregressive Distributed Lag (ARDL) model, the research makes use of quarterly time series data covering the years 1987–2004. This particular econometric method is chosen because of its capacity to grasp both the short-term and long-term connections between variables. Factors such as reserve requirement ratios, reserve volumes, monetary base changes, private sector credit, and ISE index variations are all part of the model.

Results

The findings indicate that in the short run, there is no statistically significant relationship between reserve requirement changes and economic growth or investments. However, in the long run, a statistically significant link between reserve requirement adjustments and investment levels is observed. This suggests that modifications in reserve requirements exert a more substantial impact on economic activity over an extended period.

The authors further highlight that short-term effects of reserve requirement policies primarily influence banking sector liquidity and financing public debt. Additionally, the study finds that gross domestic product (GDP) is highly responsive to reserve requirement changes, with the long-term results revealing a 6.68% contraction in GDP following an increase in reserve requirements.

6- (Abdullah, 2020)

Focus of the Study

Between 2006 and 2018, this research analyzes how monetary policy in Türkiye affected economic development. The study's stated goal was to dissect the relationship between Türkiye's GDP per capita and interest rates, inflation, and the money supply. The study agrees that GDP is a good measure of economic health and points out that monetary policy choices affect demand and supply in the economy, which in turn affects GDP growth.

Methodology

This analysis uses quarterly data from the Central Bank of Türkiye and the World Bank. The Augmented Dickey-Fuller (ADF) unit root test determines data stationarity. The Autoregressive Distributed Lag (ARDL) model is used to analyze monetary policy and economic growth based on test results. To assess model variable co-integration, the F-bounds test is used. An Error Correction simulate (ECM) is used to study short-run dynamics and simulate convergence to long-term equilibrium.

Results

The results show that in the short term, interest rate, inflation, and money supply are the most important monetary policy factors influencing economic development in Türkiye. There is a statistically significant negative relationship between interest rates and money supply on per capita GDP in the near run. On the other hand, there was no statistically significant relationship between inflation and economic growth over the medium or long term. In addition, the research shows that the model doesn't always converge to a long-term equilibrium, which means that economic fluctuations in the short run could not always get correct on their own.

4.2. The impact of monetary policy instruments on Real GDP

1- (Abdullahi, N. Y., Yusuf, A. H., & Sunusi, I. H., 2023)

Focus of the Study

This research sought to analyze the impact of monetary policy on economic growth in the nations that make up the West African Monetary Zone (WAMZ). It was published in the Lapai Journal of Economics. The impact of interest rates, inflation, and money supply on real GDP growth was the primary emphasis of the study. The main goal was to investigate how these instruments of monetary policy may be best used to promote economic development and growth in the WAMZ area. To gauge economic expansion, real gross domestic product (RGDP) served as the dependent variable.

Methodology

The study used a quantitative approach, employing both ordinary least squares (OLS) and panel regression analysis on annual data collected from 2002 to 2022 for the six WAMZ member countries. The researchers chose OLS regression due to its common usage in similar studies exploring the link between monetary policy and economic growth.

They focused on the following variables: Real Gross Domestic Product (RGDP): Served as the dependent variable representing economic growth, Broad Money Supply (M2): An independent variable reflecting the overall money circulating in the economy. Interest Rate (INTR): An independent variable representing the cost of borrowing, and Inflation Rate (INFR): Another independent variable capturing the rate of price increases in the economy

The researchers performed several statistical analyses, including descriptive statistics, correlation matrix analysis, fixed-effect tests, random-effect tests, and a Hausman test (Durbin-Wu-Hausman test) to determine the most suitable model (fixed or random effects) for their data. This method enabled them to evaluate both the individual and combined impacts of the selected monetary policy variables on economic growth.

Results

The analysis revealed a few key findings:

- The money supply and interest rates exert a positive and statistically significant effect on real GDP growth in the WAMZ countries. A 1% increase in money supply is associated with a 0.62% rise in economic growth, indicating that an expansion of the money supply may stimulate economic activity. A 1% increase in interest rates corresponded with a 0.01% growth in GDP.
- Negative Impact of Inflation: Conversely, inflation had a negative and significant effect on economic growth. A 5% increase in the inflation rate was found to reduce economic growth by 0.01%. This result highlights the detrimental consequences of high inflation on economic performance.
- Random Effect Model Preference: The Hausman test indicated that the random effect model was the more appropriate model for this analysis, suggesting that the unobserved factors influencing economic growth were not correlated with the independent variables.

The results are consistent with those of other studies that have looked at this same question, such as Alavinasab (2016), Tarawalie and Kargbo (2020), and Mpuure and Abille (2020). Inflation has a negative effect on economic growth, whereas the money supply has a favorable effect, according to all of these research. In order to stimulate economic development in the WAMZ area, the research found that expansionary monetary measures, such raising the money supply and maybe making strategic adjustments to interest rates, are essential. But it also stressed the need of controlling inflation to keep prices stable and promote long-term development.

2- (Oseni, I. O., & Oyelade, A. O., 2023)

Focus of the Study

This research looks at how fiscal and monetary policy affected economic growth in Nigeria. It was published in the African Journal of Economic Review. The writers' overarching goal is to learn how various policy instruments affect national economic activity. Two primary aspects are highlighted by the research:

- Fiscal Policy's Role in Economic Growth: This research delves at the ways in which taxes, borrowing, and government expenditure impact the expansion of the Nigerian economy as a whole.
- Monetary Policy's Impact on GDP Growth: This study delves at how the Central Bank of Nigeria oversees monetary policy, which includes actions like controlling the money supply and modifying interest rates, to propel GDP growth.

The study seeks to determine whether fiscal or monetary policy is more effective in fostering economic growth in Nigeria.

Methodology

This study integrates a theoretical framework with econometric modeling to analyze the connection between policy measures and economic growth.

- Theoretical Groundwork: Well-respected economic model Solow's growth theory provides an explanation for sustained economic development over the long run by pointing to variables including rising capital, a larger labor force, and improved technology. This theory forms the basis of the study. The research uses the Solow model to examine the effects of factors including the money supply, interest rates on loans, government spending, and tax income on economic growth.
- Model Specification: The authors utilize a linear regression model modified from the Solow-Swan model (1956) to capture the dynamics of economic growth in Nigeria.

Results

According to the research, the most important variables impacting Nigeria's economic development are the following: gross capital creation, total number of workers, wide money

supply, and lending interest rate. Lending interest rates have a negative and statistically significant impact on GDP, in contrast to the positive and significant effects of gross capital creation, total employment, and wide money supply. It follows that higher lending interest rates may slow economic development, whereas private investment, employment, and an increase to the money supply may all promote it. In their analysis of Nigeria, the writers conclude that monetary policy yields better results than fiscal policy.

3- (Özer, M. O., 2020)

Focus of the Study

Using quarterly data from 1998:Q1 to 2018:Q3, this study examines the money neutrality theory in Türkiye. According to this theory, key real economic indicators like production and employment are unaffected by changes in the money supply over the long run. Three separate money supply variables—M1, M2, and M3—and their long-term relationships to real GDP are the focus of this research.

Methodology

In order to assess the interdependence of the variables, the research used a Fourier technique, namely the Fourier ADF unit root test and the Fourier ADL cointegration test. In order to improve the findings' trustworthiness, the Fourier method is well-known for its efficiency in detecting and accounting for non-linear structural alterations in time series data.

The first thing to do is use the Fourier ADF unit root test to see whether the variables are stationary. Time series analysis relies on the concept of stationarity, which states that statistical variables like mean and variance should not change throughout the course of a study. While all variables are non-stationar in the outset, the results show that after the first differencing, they all become stationary.

Subsequently, the study utilizes the Fourier ADL cointegration test to explore the existence of a sustained relationship between real GDP and various money supply indicators. Cointegration suggests that despite individual variables being non-stationary, their linear combination can attain stationarity, implying the presence of a long-term equilibrium connection. The study evaluates

models incorporating one, two, and three independent variables (representing different money supply indicators) to analyze cointegration.

Results

No matter how many money supply measurements are included in the models, the results of the Fourier ADL cointegration test never reject the null hypothesis of no cointegration. This major result implies that none of the money supply variables (M1, M2, M3) that were considered had a statistically meaningful long-term association with real GDP.

These findings provide strong support for the money neutrality hypothesis in Türkiye for the analyzed period. This implies that monetary policy actions taken by the Central Bank of the Republic of Türkiye exert only a limited long-term effect on real economic output.

The study concludes that expansionary monetary policies in Türkiye predominantly influence the general price level (inflation) rather than fostering real economic growth. This underscores the importance of controlling monetary expansion to achieve inflation targets and emphasizes the need for policies focused on factors beyond money supply to foster sustained economic growth.

4- (Abdulkadr, A. A., Asnakew, Y. W., Sendkie, F. B., Workineh, E. B., & Asfaw, D. M., 2024)

Focus of the Study

Examining how monetary policy has affected Ethiopia's economic growth is the primary objective of the research. The dynamics of the short and long term are both taken into account in this study. The research focuses on the supposed connections between the development of Ethiopia's economy and monetary policy variables such as interest rates, reserve requirements, open market activities, and money supply.

Methodology

Using time series data spanning 1993–2022, the research used a quantitative analytical methodology. Different empirical designs, including descriptive and inferential, were used. We used econometric analysis and descriptive statistics like trend graphs. Two models were used: the

Error Correction Model (ECM) and the Autoregressive Distributed Lag (ARDL). Prior to estimate, we performed stationarity testing using the Augmented Dickey-Fuller test and lag length determination with the Akaike Information Criterion (AIC). Additionally, a battery of post-estimation tests were performed, covering topics such as stability, autocorrelation, heteroscedasticity, co-integration, and Granger causality.

Results

The study's authors discovered that the money supply's impact on Ethiopia's real GDP growth varied between the short and long term. There was a negative and statistically significant relationship between money supply increases and real GDP growth in the near term. According to the authors, this unfavorable consequence might be because a rise in the money supply could cause inflation or asset bubbles, which in turn could cause economic instability.

However, in the long run, increases in the money supply had a positive and statistically significant effect on real GDP growth. The authors propose that this positive effect may be attributed to a growing money supply's ability to increase consumer confidence and spending, enhance the availability of cash in the financial system., and facilitate trade and transactions.

In addition to what was mentioned about this study above, the study also stated that the effect of reserve requirements on real GDP growth in Ethiopia differed in the short run and the long run.

Short Run: The short-term impact of higher reserve requirements on real GDP growth in Ethiopia is positive and statistically significant. This seems backwards, as banks usually have less money to lend when reserve requirements are raised. This beneficial short-term effect is, however, explained by the sources in several ways, including fiscal restraint, prudent lending practices, and inflation management.

Long Run: Reserve requirements have a detrimental and statistically significant long-term effect on Ethiopia's real GDP growth. If the reserve requirement is raised by 1%, real GDP will fall by 0.109 % over time. Reduced lending, reduced consumer spending, and increased vulnerability to shocks are the elements that contribute to this negative long-term impact.

5- (Çetin, M., 2022)

Focus of the Study

From 2006:Q1 to 2021:Q4, the research looks at how monetary policy affected economic growth in Türkiye over the long run. To what extent can monetary policy choices in Türkiye affect economic growth, by extension, people's well-being? That was the question the researchers set out to answer.

Methodology

Key macroeconomic factors were examined in the research using a Vector Autoregressive (VAR) Model. In their quarterly analysis, the researchers looked at data from two sources: the Electronic Data Distribution System (EVDS) of the Central Bank of the Republic of Türkiye and the FRED Economic Data from the Saint Louis Federal Reserve. In addition, the model's long-term equation was estimated using the Johansen Cointegration Test, and the model's convergence to its long-term equilibrium was measured using an Error Correction Model. They used the Variance Decomposition, Impulse Response Analysis, Granger Causality, and CUSUM Structural Break tests for our short-term studies.

Results

Only the M3 money supply was shown to have a long-term statistically meaningful effect on GDP, according to the research. Raising the money supply has a stimulative effect on national income. Over the long term, there was no statistically significant relationship between interest rates and the US dollar exchange rate. Consistent with growth literature, we find that, over the long term, the labor force participation rate and gross fixed capital creation both have positive and statistically significant associations with GDP. The research shows that if Türkiye adopted an expansionary monetary policy, the country's national income would rise in the long time.

4.3. The impact of monetary policy instruments on Inflation

1- (Christopoulos, D., McAdam, P., & Tzavalis, E., 2023)

Focus of the Study

Published in the Economic Review of the Federal Reserve Bank of Kansas City, this paper investigates whether the current inflation regime affects the impact of interest rate increases, a crucial component of monetary policy. The study's primary objective is to determine if, in times of low inflation and high inflation, the U.S. economy responds differently to changes in the federal funds rate. Evaluating the reliance of monetary policy on states is the main objective.

Methodology

The researchers use a threshold vector autoregression model (TVAR), which allows for different parameter values and model responses depending on whether a threshold variable exceeds a certain value. In this case, the threshold variable is a 20-month moving average of inflation, representing a measure of inflation expectations. The model estimates a threshold value for expected inflation, dividing the data into high-inflation regimes (when expected inflation exceeds the threshold) and low-inflation regimes (when expected inflation is below the threshold).

The study focuses on four monthly variables commonly used to examine the transmission of monetary policy:

- Federal funds rate: means the interest rate that the Federal Reserve has established as its objective.
- Industrial production: Serves as a measure of real output growth in the economy.
- Inflation: Measured by the 12-month change in the consumer price index.
- Excess bond premium: A measure of firms' borrowing conditions.

The researchers use a Cholesky ordering to implement unexpected monetary changes (or shocks) in a theoretically consistent manner. This involves ordering the variables in the TVAR to simulate the impact of a policy shock on the other variables.

Results

As a starting point, the TVAR model predicts inflation of 4.05%. If the predicted inflation rate is more than 4.05%, then the economy is said to be in a high-inflation condition. If it is less than 4.05%, then the economy is said to be in a low-inflation state. According to the model, when

inflation is high, the economy is less stable and responds more slowly to changes in monetary policy than when inflation is low.

- In the low-inflation state, output and inflation revert to their baselines more quickly and with less volatility after an interest rate shock.
- In the high-inflation state, the responses of inflation and output are more volatile and persistent, taking longer to return to their baselines.
- Monetary policy must be more aggressive in high-inflation regimes, with larger interest rate increases needed to influence output, inflation, and borrowing conditions.
- The study concludes that interest rates must be held higher for longer in a high-inflation state to bring inflation back down relative to a low-inflation state.

These findings suggest that the effectiveness of monetary policy in stabilizing the economy is influenced by the prevailing inflation environment. Policymakers need to consider the inflation regime when making decisions about interest rate changes.

2- (Olgun, M. E., 2022)

Focus of the Study

The connection between interest rates and inflation in Türkiye is investigated in this article that was published in the Journal of Administrative Sciences. The writers zero down on the Turkish economy to find out whether the Fisher or Neo-Fisher impact is more common. The Fisher effect posits a causal chain connecting inflation rates to interest rates, implying a positive link between nominal interest rates and projected inflation. On the other hand, according to the Neo-Fisher effect, inflation will rise in the short and long term if nominal interest rates are permanently raised.

Methodology

For Türkiye, the writers utilize monthly data from 2012–2021. In order to determine the strength of the correlation between the inflation rate in Türkiye and the weighted average cost of funding rate set by the Central Bank of the Republic of Türkiye (CBRT) throughout the research period, the authors utilize a time-varying parameter robust Granger-causality method (TVP-GC). This method takes structural breaks into consideration.

The researchers examine the possibility that weighted average cost of funding (WACF) delays do not have a Granger causal effect on consumer price index (CPI). Exploratory Wald (ExpW), Mean Wald (MeanW), Nyblom, and Quandt Likelihood Ratio (SupLR) are the four alternative test statistics that the researchers utilize to evaluate this null hypothesis.

Results

The study finds a bidirectional causal relationship between WACF and CPI, suggesting that both the Fisher and Neo-Fisher effects are present in Türkiye. However, the strength of this relationship varies over time.

- The Neo-Fisher effect appears to be more prominent after 2018, especially after the CBRT significantly increased its benchmark interest rate in September 2018 and November 2020.
- The Fisher effect, where inflation Granger-causes interest rates, appears to weaken after 2016.

These findings indicate that the relationship between interest rates and inflation in Türkiye is complex and can shift over time, influenced by factors such as changes in monetary policy.

The study uses a VAR model to further analyze the relationship between WACF and CPI, including other variables such as the exchange rate and credit growth. The results of the VAR model confirm both the Fisher and Neo-Fisher effects.

The study's results carry significant implications for policymakers in Türkiye. The results suggest that interest rate policies should be implemented with caution, taking into account the potential for both Fisher and Neo-Fisher effects. Furthermore, relying solely on interest rates to combat inflation may be insufficient, and policymakers may need to consider other instruments to manage inflation effectively.

3- (Akbaş, Y. E., Dönmez, Z., & Can, E., 2024)

Focus of the Study

This research examines the impact of many factors on inflation in the (BRIC-T) countries (Brazil, Russia, India, China, and Türkiye) from 1995 Q1 to 2022 Q4, including currency rates, interest rates, and production levels. It is published in the Review of Economics and Political

Science. The reliability of the cost channel and the exchange rate pass-through (ERPT) effect, as well as the impact of production levels on inflation rates, are the primary areas of investigation.

How much a change in a country's exchange rate impacts the pricing of its imports and exports is called Exchange Rate Pass-Through (ERPT). The cost of imported items goes up when a currency loses value, which in turn causes inflation at home to rise. A "valid" ERPT impact would be one in which a change in the exchange rate causes a change in the inflation rate that is statistically significant.

The cost channel explains the impact of interest rate changes on firms' production expenses and, ultimately, inflation. When the central bank raises interest rates, firms encounter higher borrowing costs, leading to increased input expenses and, consequently, higher prices for goods and services.

Methodology

- The study utilizes panel data from 1995 Q1 to 2019 Q4, obtained from the IMF's International Financial Statistics (IFS) database5.
- This timeframe was selected because market liberalization efforts gained significant traction in the 1990s, with all BRIC-T nations becoming WTO members, influencing their economic structures.
- Data from 2020 onwards was excluded due to potential distortions arising from the COVID-19 pandemic.
- The study employs econometric techniques such as the panel unit root test with multiple breaks, LM bootstrap panel cointegration test, CCE estimator, and AMG estimator.
- These methods are specifically chosen to account for structural breaks, cross-section dependency, heterogeneity, and potential biases in the data.

Results

- The ERPT effect is found to be valid in Türkiye, Brazil, Russia, and India, suggesting that exchange rate fluctuations significantly impact inflation in these countries.

- However, the ERPT effect is not significant in China, potentially due to its managed exchange rate regime, which might shield domestic prices from global currency fluctuations.
- The cost channel, where interest rate hikes lead to increased inflation, is observed only in China, possibly because of high financing costs within firms' expenses.
- In contrast, Türkiye and Russia show a negative correlation between interest rates and inflation, implying a functional monetary transmission mechanism, where central banks regulate inflation by adjusting interest rates.
- The study also finds that output growth (as measured by IPI) positively affects inflation in all five BRIC-T countries. This suggests that economic expansion, especially when reliant on imported inputs or characterized by low value-added production, can contribute to inflationary pressures

4- (Dekkiche, 2022)

Focus of the Study

The purpose of this research is to analyze the correlation between Egypt's money supply and inflation rate. Using a panel of Vector Error Correction (VEC) models, it examines the relationship between the money supply and inflation using a co-integration study. The study's overarching goal is to fill a knowledge gap by calculating the impact of money supply on inflation in Arab nations like Egypt.

Methodology

The World Bank provided the yearly time series data used in the research, which covers the years 1990–2019, for Egypt. As a proxy for inflation, the research makes use of the CPI. Researchers checked for stationarity using the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) unit root tests. If a long-run link between the variables was found, it was confirmed using the Johansen-Juselius co-integration test. Lastly, the short-term and long-term impacts of Egypt's money supply on inflation were estimated using a Vector Error Correction Model (VECM). Researchers examine the variables' long-term equilibrium connection as well as their short-term modifications using the VECM. To find out which way the money supply affects the inflation rate, they utilized the Granger Causality test.

Results

A major takeaway from the study is that, at least in the near term, changes in the money supply have a favorable and statistically significant effect on inflation. According to Fisher's quantitative theory of money, there is a direct correlation between increases in the money supply and growing inflation. This finding is in line with that idea.under particular, the research found a one-way causal link, which means that under Egypt's short-term economic model, changes in the money supply come before changes in inflation. Earlier research in Malaysia (Ghazali et al., 2009), Jordan (Batarseh, 2021), Kenya (Kiganda, 2015), and Indonesia (Sasongko & Huruta, 2018) reached similar conclusions. This conclusion, however, runs counter to research that has shown no correlation between monetary expansion and price increases in Jordan (Mishal & Abu-Dallo, 2014) and Nigeria (Amassoma et al., 2018).

5- (Lee, C.-W., & Huruta, A. D., 2021)

Focus of the Study

The study examines the relationship between money supply, GDP growth, and inflation volatility in 40 countries during two specific periods: 2002 and 2014The authors seek to examine the validity of the Quantity Theory of Money (QTM), a well-known economic theory that asserts a direct link between money supply and price levels.

The study seeks to answer the following key questions:

- Does a rise in the money supply contribute to greater inflation volatility?
- Does GDP growth mitigate the inflationary impact of money supply increases?
- Do empirical findings support the predictions of the QTM?

Methodology

The study utilizes a quantitative approach with cross-sectional data from 40 countries in 2002 and 2014. The data includes money supply (M2), GDP growth, and inflation (GDP deflator growth). The researchers used an unrestricted regression model to analyze the relationship between these variables. The study also applied joint hypothesis testing (Strong and Weak Wald Tests) to

evaluate the Quantity Theory of Money. To address heteroskedasticity, the study employed heteroskedasticity-corrected estimates using the White test.

Results

The study's findings highlight the significant role of money supply in driving inflation volatility but contradict the strict predictions of the QTM:

- Impact of Money Supply: The unrestricted regression results reveal a positive and statistically significant relationship between money supply growth and inflation volatility in both 2002 and 2014. This suggests that increases in money supply tend to fuel higher price instability.
- Role of GDP Growth: The study finds a positive but statistically insignificant relationship between GDP growth and inflation volatility, indicating that GDP growth does not have a substantial effect on mitigating inflation.
- Rejection of QTM Predictions: Both the Strong and Weak Wald tests reject the null hypotheses, implying that the empirical data do not fully support the specific coefficient restrictions implied by the QTM.

The study concludes that while money supply plays a crucial role in determining inflation volatility, the QTM might not hold strictly in the analyzed context8. The authors suggest that future research should explore alternative methods like Two-Stage Least Squares (2SLS) to further examine the QTM's joint hypothesis testing

6- (Das, B., Baishya, U., & Baruah, B., 2024)

Focus of the Study

The research analyzes the determinants affecting the inflation rate in India from 1981 to 2021. The authors recognize the conventional focus on money supply and national income as primary determinants of inflation in underdeveloped countries. They acknowledge the substantial influence of international crude oil prices, given that India imports more than 85% of its domestic fuel requirements. In addition to these conventional elements, the research examines the influence of several macroeconomic variables, such as GDP growth rate, exchange rates, current account balance, and lending interest rates.

The research seeks to understand how these variables, individually and collectively, influence the inflation rate in India, considering the country's economic transformations and global events during the study period.

Methodology

Data for India's yearly time series from 1981–2021, obtained from Macrotrends and the World Bank database, is used in the analysis. The CPI was the inflation index that the researchers utilized. They used the Augmented Dickey-Fuller test to check for stationarity. In order to find the long-term correlations between the variables, the ARDL Bounds test was useful. In the end, the short-term and long-term effects of several variables on India's inflation rate were evaluated using the Quantile ARDL model and the Autoregressive Distributed Lag (ARDL) model.

Results

The study reveals that both supply-side and demand-side factors significantly impact India's inflation rate. The key findings include:

- Money supply and oil prices: According to monetary theory, there is a positive correlation between inflation and money supply (M3). This highlights the complicated transmission of shocks to global oil prices to local inflation, since the impact of international oil prices on inflation may be positive or negative depending on the lag time.
- GDP growth: Contrary to the traditional view, GDP growth negatively affects inflation, indicating that economic expansion in India may not necessarily fuel inflationary pressures. This finding suggests potential for growth-oriented policies without triggering significant inflation.

The study advocates for a balanced policy approach to managing inflation in India, combining flexible monetary policy, effective exchange rate management, and strategies to reduce dependence on imported goods, especially crude oil.

7- (Oleksy-Gebczyk, A., 2024)

Focus of the Study

Inflation in Poland is the subject of Aneta Oleksy-Gebczyk's work, which seeks to provide a macroeconomic analysis. The study is motivated by the need to understand the nature of the rapid inflation Poland experienced, particularly from 2020 to 2023, and to identify effective strategies to mitigate it.

Specific Objectives:

- Identify the nature of inflation in Poland: The study seeks to determine the underlying causes of inflation, particularly focusing on whether it is primarily monetary or non-monetary in nature. This distinction is crucial as it dictates the effectiveness of different policy responses.
- Analyze the effectiveness of anti-inflationary tools: The study evaluates the effectiveness of both monetary and non-monetary policy instruments employed by the Polish government and central bank to curb inflation.
- Substantiate anti-inflationary policy directions: The research aims to provide evidence-based recommendations for policymakers on the most effective strategies to slow down inflation in Poland, considering the unique circumstances of the country's economic environment.

Methodology

The methodology employed in the study on inflation in Poland involves analyzing statistical data on key economic indicators. This includes examining trends in the Consumer Price Index (CPI), Producer Price Index (PPI), and the GDP deflator. Using a comparison technique and data from sites like Statista, the research also compares the inflation rate of Poland to other European nations. Additionally, the study incorporates expert estimates and forecasts from institutions like the National Bank of Poland. Graphical representations, such as graphs and diagrams, are used to visualize the data and present the findings clearly. Finally, the study employs a generalization method to synthesize the information gathered and draw comprehensive conclusions about the nature of inflation in Poland and potential policy responses.

Results

The study's results indicate that Poland experienced a rapid surge in inflation in 2021 and 2022, reaching its highest point since 1997. This rise in inflation was primarily driven by external

factors, including the war in Ukraine, rising global energy and food prices, and disruptions to supply chains. Conventional monetary policy measures, such as increasing interest rates, were found to be ineffective in curbing inflation due to its predominantly non-monetary nature. The Polish government's Anti-Inflationary Shield, which involved reducing VAT rates on essential goods, helped to curb inflation but came at a cost to the state budget

Additionally, the effects of increasing the reserve requirement ratio are analyzed in the research. This measure caused banks to withdraw almost 19% of their entire liquidity. In addition to increasing the primary policy rate, this approach boosted deposit interest rates, which enticed people to move their money from checking to savings accounts. The research does not, however, examine how changes to reserve requirements affect inflation in any particular way.

5. TURKISH ECONOMICS

5.1. Introduction

Türkiye is among the world's top 20 economies, with a GDP of $1.024 trillion in 2023, ranking 17th globally, according to the International Monetary Fund (IMF, 2024). The Turkish economy is characterized by its diversity, with significant contributions from the industrial and service sectors, alongside a strong agricultural base. Over the past two decades, Türkiye has implemented substantial economic reforms, achieving an average GDP growth rate of 5.4% between 2002 and 2022. This growth significantly improved real income per capita and markedly reduced poverty levels (World Bank, 2024).

The function of the Central Bank of the Republic of Türkiye (CBRT) in preserving economic and financial stability is vital. The CBRT has used monetary instruments, including the interest rate corridor, liquidity management, and reserve requirements, since it adopted the inflation-targeting framework in the early 2000s. Its goal is to strike a balance between controlling inflation and promoting economic development(Kara, M., & Afsal, M. Ş., 2018).

exchange rate volatility, which undermines foreign investment and market confidence. According to (OECD Economic Surveys: Türkiye 2023, n.d.) the Turkish economy encountered significant difficulties in 10/2022, with an annual inflation rate (Y-O-Y) of 85.51%, the highest

since 1998. Additionally, the Turkish lira depreciated by more than half against the US dollar from early 2021 onward, negatively affecting foreign direct investment (FDI) inflows, which remained below the GDP share observed in OECD nations. Frequent economic fluctuations in Türkiye, as measured by GDP growth standard deviation, are four times greater than the OECD average. These fluctuations heighten uncertainty, discourage investment, and obstruct sustainable economic growth goals.

5.2. Turkish Monetary Policy

5.2.1. Framework of Monetary Policy

In Türkiye, monetary policy is all about making choices that affect the supply and demand for money in order to achieve economic goals including job creation, price stability, and overall economic development. According to the CBRT Law, the major goal of monetary policy in Türkiye is to attain and maintain price stability. The CBRT is in charge of executing this policy.

In Türkiye, the Monetary Policy Committee (MPC) meets at pre-arranged intervals to decide on monetary policy. The decisions of the MPC are announced at 2:00 p.m. on the day of the meeting. Within five working days, a description of the meeting and the committee's evaluations are published, demonstrating the openness of the country's monetary policy (Monetary Policy, n.d.).

The Central Bank of the Republic of Türkiye states that Türkiye's monetary policy framework has seen substantial modifications since the 2001 financial crisis to achieve price stability and sustained economic development. In 2001, the Central Bank of the Republic of Türkiye (CBRT) implemented a floating exchange rate system, transitioning from an exchange rate-based stability scheme. This alteration enabled the market to ascertain the value of the Turkish lira and afforded flexibility in the control of monetary policy.

Following the crisis, the CBRT’s role was redefined through amendments to its governing law. The Bank was tasked with achieving price stability as its primary objective while being granted independence in choosing monetary policy instruments. The establishment of the Monetary Policy Committee (MPC) institutionalized decision-making, enhancing transparency

and accountability. Additionally, the CBRT was prohibited from financing public deficits, reinforcing fiscal discipline.

Inflation targeting became a central component of the framework. Initially implemented as an implicit regime between 2002 and 2005, it evolved into an explicit inflation-targeting framework in 2006. Under this regime, inflation targets are set jointly with the Government for a three-year period. The CBRT communicates these targets to the public and employs a ±2% uncertainty band to account for external shocks. The Bank is required to explain deviations from the target and outline corrective measures.

After the global financial crisis of 2008-2009, the CBRT expanded its focus to include financial stability alongside price stability. New instruments, such as the Reserve Options Mechanism and adjustments to the interest rate corridor, were introduced to manage capital flow volatility and strengthen the monetary transmission mechanism. In 2016, the CBRT simplified its policy stance, aiming for greater clarity and effectiveness in addressing inflationary pressures.

Transparency and communication remain key pillars of the framework. The CBRT publishes quarterly Inflation Reports, holds regular Monetary Policy Committee meetings, and engages with stakeholders through presentations and technical briefings. These efforts ensure public understanding and reinforce confidence in monetary policy (Central Bank Monetary Policy Framework, n.d.).

5.2.2. Instruments of Monetary Policy

CBRT employs several key instruments to regulate economic activity:

- **Interest Rate Policy:**

The policy rate serves as the primary mechanism to control liquidity and inflation. Periodic adjustments directly impact borrowing costs and consumer spending.

The Central Bank of the Republic of Türkiye (CBRT) fulfills its role as a lender of last resort by borrowing from or lending to the markets, using interest rate decisions as a tool to influence market conditions. These decisions are made during pre-scheduled Monetary Policy

Committee meetings and are published on the CBRT's website at 2:00 pm on the same day, along with the reasoning behind them.

The primary policy rate of the CBRT became the one-week repo rate on 1 June 2018. The borrowing rate for Late Liquidity Window operations is fixed at 0%, while the overnight borrowing rate is 150 basis points below the policy rate and the lending rate is 150 basis points above the policy rate. The CBRT updated its monetary policy framework on October 22, 2020, and set the overnight lending rate 300 basis points higher than the Late Liquidity Window rate (Central Bank Interest Rates, n.d.).

Türkiye's Central Bank (CBRT) has experienced significant fluctuations in interest rates between 2003 and 2024. Discount rates began at 29% in Q3 2003 and gradually decreased to 5.5% by Q4 2012, reflecting efforts to lower borrowing costs during that period. Starting in 2013, rates saw temporary increases, peaking at 10% in Q1 2014, followed by a period of relative stability between 7.5% and 8% from 2015 to mid-2018. However, economic turbulence prompted CBRT to raise interest rates sharply to 24% in Q3 2018.

In recent years, the volatility persisted, with rates dropping to 8.5% in Q1 2023 before surging dramatically to 30% in Q3 of the same year and reaching 50% by mid-2024. These shifts highlight CBRT’s measures to address varying economic challenges.

- **Reserve Requirements:**

The Central Bank of the Republic of Türkiye (CBRT) employs reserve requirements as a key tool in its monetary policy. Since the last quarter of 2010, a revised policy framework has been in place to mitigate macro-financial risks while maintaining a favorable inflation outlook. This framework positions reserve requirements as an active instrument alongside the one-week repo auction rate.

Liabilities subject to reserve requirements are calculated biweekly on Fridays, based on banks’ balance sheet components. These include deposits, funds from repo transactions, loans, securities issued, and other liabilities, excluding obligations to the Treasury, the Central Bank, and certain domestic institutions. Key categories include:

- Deposits and participation funds, including those converted from foreign exchange or gold.

- Funds from repo transactions, excluding Borsa İstanbul markets.
- Loans not guaranteed by the Treasury.
- Securities issued (net).
- Subordinated debt and other liabilities, such as credit card debt to merchants and borrower funds of investment banks.

The maintenance period for these reserves begins two weeks after calculation and lasts 14 days. Reserves are held in Turkish lira for domestic liabilities, US dollars for dollar-denominated liabilities, and US dollars or euros for other foreign currencies. Precious metal accounts can be backed by standard gold. Additionally, the CBRT offers remuneration for Turkish lira reserves under specific conditions, allowing flexibility in monetary policy implementation.

The required reserve ratios in Türkiye have shown significant changes over the years as part of the Central Bank of the Republic of Türkiye's (CBRT) monetary policy framework. Between Q3 2003 and Q4 2009, the ratios remained stable at 6%, reflecting a period of consistency. However, starting in 2010, CBRT began actively adjusting these ratios to respond to changing economic conditions. In 2011, the ratios rose significantly, peaking at 13.24% in Q2 2011, as part of the CBRT's efforts to manage liquidity and inflation risks. From 2012 to 2017, the ratios stabilized within the range of 10% to 11%, indicating a balanced monetary policy approach.

A sharp decline occurred after 2018, with the ratios dropping to a low of 3.51% in Q4 2019. During the pandemic, the ratios fluctuated between 3.77% in Q2 2020 and 7.71% in Q4 2021. In recent years, the ratios experienced sharp volatility, surging to 14.33% in Q3 2023 before stabilizing at 13.46% in Q3 2024.

These changes highlight CBRT’s active use of reserve requirements as a flexible tool to address both domestic and global economic challenges.

- **Open Market Operations (OMO):**

According to Articles 52 and 56 of the Central Bank Law, the main monetary policy tool of the Central Bank of the Republic of Türkiye (CBRT) is open market operations (OMO). This tool is used to control market liquidity and keep short-term interest rates in line with the policy

rate. You can't utilize OMOs to fund the Treasury or any other public entity; they're just for monetary policy purposes.

OMO instruments include deposit facilities, repos, reverse repos, outright purchases, outright sales, and liquidity bills. Deposit facilities allow banks to lend or borrow Turkish lira within predefined limits via the Interbank Money Market at CBRT-announced interest rates. Repo transactions are used to inject temporary liquidity into the market, while reverse repos are conducted to withdraw excess liquidity. For permanent liquidity adjustments, the CBRT uses outright purchases to address shortages and outright sales to reduce surpluses. Additionally, liquidity bills with up to 91-day maturity are issued to absorb excess liquidity and enhance monetary policy effectiveness. Turkish lira deposit purchase auctions are also conducted to sterilize market liquidity effectively.

These operations provide the CBRT with the flexibility to address both temporary and long-term liquidity needs, ensuring smooth functioning of the financial system (Open Market Operations, n.d.).

To control liquidity and keep the currency stable, the Central Bank of the Republic of Türkiye (CBRT) primarily uses open market operations (OMO). The M1, M2, and M3 monetary aggregates, which show the structure of the money supply and the various degrees of liquidity in the economy, are all heavily impacted by these processes.

Money Supply Aggregates and Analysis:

M1 (Narrow Money): M1 includes the most liquid components, such as currency outside banks and demand deposits. In September 2024, M1 grew annually by 37.3%, primarily driven by Turkish lira demand deposits, which contributed 4.17% to overall monetary growth. This highlights the immediate liquidity available for transactions.

M2 (Broad Money): M2 expands on M1 by including time deposits in Turkish lira and foreign currencies. The annual growth rate of M2 in September 2024 was 38.77%, reflecting the rising savings within the economy. Time deposits in Turkish lira contributed 19.83% to this growth, while foreign currency time deposits added 4.48%.

M3 (Broadest Money): M3, which encompasses M2 along with other components like money market funds, repo transactions, and debt securities, represents the broadest measure of money supply. In September 2024, M3 reached 16.3 trillion TRY, marking a 42.3% annual growth rate. The main contributors were time deposits (24.3%) and demand deposits (13.1%), demonstrating the role of deposits in shaping overall liquidity. (Monetary Developments, 2024)

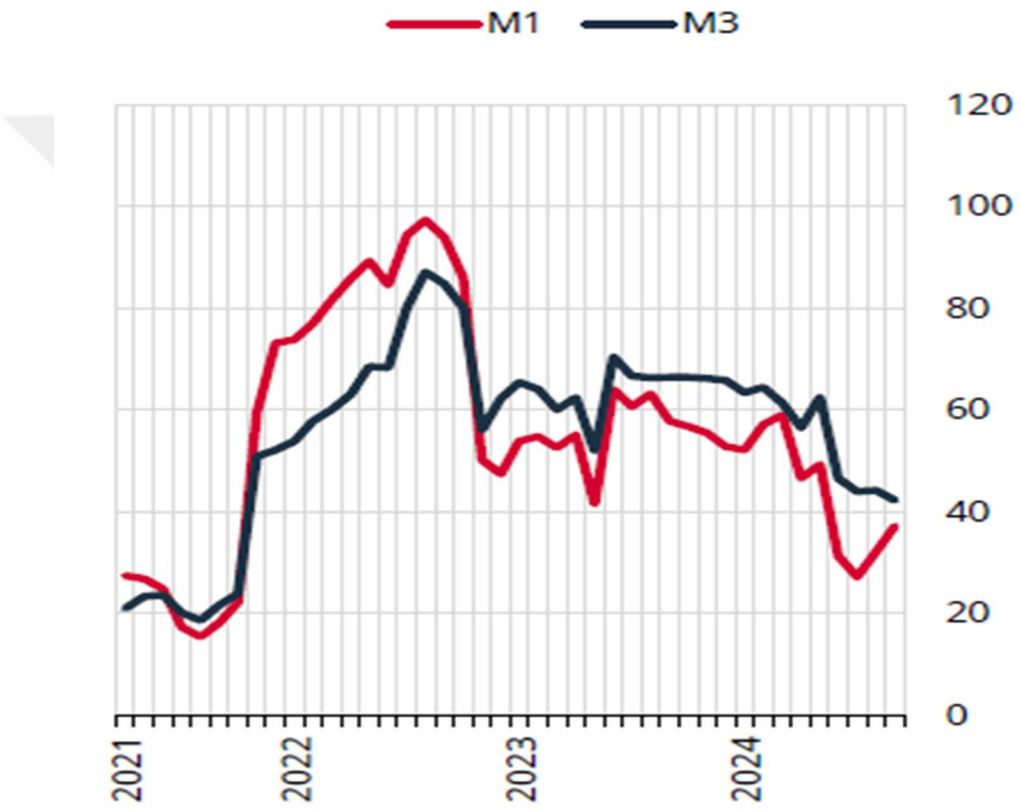

Figure 2 Monetary Aggregates (September 2024, Annual % Growth)

Source: CBRT

Long-term Trends in M3:

From Q3 2003 to Q2 2024, the Turkish money supply (M3) increased significantly, from 81.6 billion TRY to 16.3 trillion TRY. Key observations include:

Accelerated growth during periods of economic expansion, such as in 2021-2024, reflecting higher liquidity injections. A notable increase in 2023, with M3 reaching 14 trillion TRY by Q4, driven by strong credit demand and rising deposits.

Open Market Operations and Their Role:

CBRT uses OMO instruments to manage these aggregates effectively:

- Repo and Reverse Repo: Inject liquidity during shortages or withdraw excess liquidity, stabilizing short-term market rates.
- Outright Purchases and Sales: Address structural liquidity imbalances by permanently increasing or reducing liquidity.
- Liquidity Bills: Absorb surplus liquidity with up to 91-day maturity, enhancing monetary policy effectiveness.

The interplay between these instruments and money aggregates (M1, M2, M3) underscores the CBRT's strategic approach to maintaining economic stability by aligning monetary supply with market demands (Monetary Developments, 2024).

5.3. Turkish Economic Growth

The GDP of Türkiye increased somewhat in the third quarter of 2024, rising 2.1% year-on-year in chain-linked volume index terms. The gross domestic product increased by 53.3%, passing 11.9 trillion TRY (357.9 billion USD).

5.3.1. Sectoral Contributions:

Construction led the growth with a remarkable 9.2% increase, followed by financial and insurance activities (6.2%) and agriculture, forestry, and fishing (4.6%). Other sectors, including real estate (2.5%) and information and communication (2.2%), also contributed positively. However, declines were observed in industry (-2.2%) and other service activities (-2.4%).

5.3.2. Expenditure Approach:

Household consumption rose by 3.1%, whereas government consumption and gross fixed capital formation decreased by 0.9% and 0.8%, respectively. Exports grew modestly by 0.8%, while imports dropped significantly by 9.6%.

5.3.3. Income Distribution:

Compensation of employees saw a substantial increase of 76.3%, raising its share in Gross Value Added to 36.4% from 31.9% in the previous year. Conversely, the share of net operating surplus/mixed income declined to 45.1% from 47.8%.

Despite sectoral growth disparities and a slight contraction in seasonally and calendar-adjusted GDP (-0.2% compared to the previous quarter), the Turkish economy demonstrated resilience through increased household spending, reduced imports, and sectoral advancements, particularly in construction and finance (Central Bank Interest Rates, n.d.).

5.3.4. GDP Current Prices and Real GDP Trends

Türkiye's GDP Current Prices exhibited significant growth over the analyzed period, reflecting both nominal increases in economic activity and the effects of inflation. Starting at 131 billion TRY in Q3-2003, GDP at current prices reached approximately 9.9 trillion TRY by Q2-2024. This steep rise underscores the effects of inflation and currency devaluation, especially in periods of heightened inflationary pressures.

In contrast, Real GDP, which accounts for inflation adjustments, presents a more stable growth trajectory. For example, real GDP rose from 213 billion TRY in Q3-2003 to over 543 billion TRY in Q2-2024. This pattern highlights underlying economic growth despite inflationary distortions. Key milestones include periods of robust growth in 2010 and post-2017, driven by expansionary policies, but were later moderated by external and domestic shocks.

5.3.5. Inflation Dynamics

The inflation rate (CPI Q-O-Q) exhibited significant fluctuations throughout the period. In the early 2000s, Türkiye experienced relatively moderate inflation, ranging from 0.7% to 4.0% per quarter. However, after 2018, inflation escalated sharply, reaching a quarterly peak of over 28% in Q1-2022. On a year-over-year (Y-O-Y) basis, inflation peaked at an astonishing 75.45% in May 2024, far exceeding the Central Bank's one-week repo interest rate of 50% during the same period (Central Bank Interest Rates, n.d.).

This escalation reflects the effects of currency devaluation, loose monetary policies, and external factors such as global commodity price shocks. Periods of lower inflation were often

associated with tighter monetary policies, including higher discount rates. For instance, in Q4-2018, the central bank raised the discount rate to 24%, stabilizing inflation temporarily but slowing real GDP growth.

The Central Bank of the Republic of Türkiye (CBRT) prioritizes price stability as its primary objective, considering it a prerequisite for sustainable economic growth and employment. While supporting government policies on growth and employment, CBRT's main contribution lies in maintaining low and stable inflation. Price stability enables economic agents to make informed decisions, improving resource allocation efficiency. Moreover, reduced inflation risk lowers real interest rates, thereby encouraging investment and fostering economic growth. (Economic Growth and Employment, n.d.).

6. METHODOLOGY

6.1. Research Objectives

This study aims to analyze the relationship between key monetary policy instruments in Türkiye, such as the discount rate, money supply (M3), and required reserves ratio, and critical economic growth indicators. These indicators include GDP in Current Prices, Real GDP in Chain Linked Volume, and inflation rate (measured by the % change in the Consumer Price Index, CPI). In order to shed light on the short-term and long-term effects of monetary policy on economic performance, this research seeks to comprehend the interrelationships between these factors.

6.2. Data Sources and Type

The analysis utilizes quarterly time-series data covering the period from the third quarter of 2003 to the second quarter of 2024. The data were obtained from secondary sources, including the Electronic Data Delivery System and databases of the Central Bank of the Republic of Türkiye, ensuring reliability and consistency. The study includes three dependent variables—GDP Current Prices, Real GDP, and inflation rate—and three independent variables—discount rate, money supply (M3), and required reserves ratio.

6.3. Definition and Measurement Variables

6.3.1. Discount Rate:

Within an inflation-targeting framework, the Central Bank of the Republic of Türkiye (CBRT), represented by the Monetary Policy Committee (MPC), uses the discount rate—also known as the interest rate—as its principal tool to guide monetary policy. The MPC gathers extensive data on inflation, trade balance, economic activity, government spending, and global events before deciding on monetary policy. In the event of a deadlock, the Governor's vote breaks the tie and the decision is final.

The MPC sets monetary policy strategies and inflation targets in collaboration with the government, while also implementing measures to stabilize the Turkish lira. To ensure transparency, MPC decisions and summaries are published on the Central Bank's website, with meetings held on a pre-announced schedule.

As of June 1, 2018, the one-week repo rate has been set as the Central Bank's main policy rate. (Central Bank Interest Rates, n.d.)

The discount rate data was collected quarterly at the end of each quarter throughout the study period.

6.3.2. Money Supply (M3):

The entire liquidity of the Turkish economy may be better understood with the help of **M3**, a more comprehensive measure of the money supply. As a result, the Central Bank of Türkiye is better equipped to assess economic trends, inflationary pressures, and financial system stability while making monetary policy choices.

M1 includes currency in circulation outside banks, as well as demand deposits in Turkish lira (TRY) and foreign currency (FX) that can be easily accessed. **M2** expands on **M1** by including time deposits in both TRY and FX, which are less liquid than demand deposits but still easily convertible into cash. **M3** encompasses **M2** and further includes additional financial instruments such as funds received from repo transactions, money market funds, and debt securities issued by the government or financial institutions (Monetary Developments, 2024).

The Money Supply (M3) data was collected quarterly at the end of each quarter throughout the study period.

6.3.3. Required Reserves Ratio

The required reserves in Türkiye are the minimum amount of reserves that banks must hold against their liabilities, calculated every two weeks on Friday. Banks with leverage ratios below the specified thresholds are subject to additional reserve requirements, as outlined in the relevant Communiqué. The maintenance period for required reserves begins on Friday following the two-week calculation and lasts for 14 days. For liabilities denominated in Turkish lira, the required reserves must be held in Turkish lira.

The Required Reserves Ratio data was collected quarterly at the end of each quarter throughout the study period for required reserves in terms of Turkish lira for Turkish lira liabilities (Reserve Requirement Ratios, n.d.).

6.3.4. Gross Domestic Product (GDP) Current Prices:

Presented below is Turkey's GDP calculated using the expenditure method at current prices. Every three months, the Central Bank of the Republic of Turkey (CBRT) updates its website with new GDP statistics. Sourced from Türkiye's official statistical organization, TÜİK, the data includes GDP numbers and other national economic indicators. (Quarterly Gross Domestic Product, Quarter II: April-June, 2024, 2024).

The GDP data was collected quarterly at the end of each quarter throughout the study period.

6.3.5. Real Gross Domestic Product (GDP)

Real Gross Domestic Product (GDP) in Türkiye is measured using the chain-linking method. This method links the annual variable base year instead of a fixed constant price.

In 2008, Türkiye updated its base year from 1987 to 1998, in line with European System of Accounts (ESA 95). This update, chain-linking method, enhanced the accuracy of GDP estimates (Pre-Accession Economic Programme2008, 2009).

The Real GDP data was collected quarterly at the end of each quarter throughout the study period.

6.3.6. Inflation Rate

The inflation rate is a vital economic indicator that reflects variations in the general price level of an economy, usually quantified by the percentage change in the Consumer Price Index (CPI). In Türkiye, inflation is determined using the Consumer Price Index (CPI), with the base year established as 2003 (Electronic Data Delivery System, n.d.). This research generated the Consumer Price Index (CPI) for each quarter by averaging the monthly CPI values within that quarter, and the quarterly inflation rate was determined as the percentage change in the CPI from the preceding quarter.

The quarterly percentage change in the CPI signifies the inflation rate in this research.

6.4. Analytical Framework

The study employs advanced econometric tools to capture both short-term and long-term dynamics. Data analysis was conducted using Python and R for their robustness and efficiency in processing time-series data and executing statistical models.

6.5. Statistical Tests and Modelling Approaches

6.5.1. Stationarity Testing:

When examining the time-series data, this research took into account the variables' stationary qualities. We used the ADF unit root test to check for the existence of unit roots.

The ADF Supplemental Test: Verifying the stationarity of every variable is essential for carrying out a trustworthy time-series analysis. Regression results based on non-stationary series might be deceiving since the apparent importance is more due to trends than true causation. Making sure time-series variables are stationary before estimating them is crucial for avoiding these kinds of biases(Gujarati, D. N. & Porter, D. C., 2008).

One of the most popular Unit Root tests, the Augmented Dickey-Fuller (ADF) test, is based on the following equation:

$$y_t = c + \beta t + \alpha y_{t-1} + \phi \Delta Y_{t-1} + e_t$$

Where:

y_{t-1} = lag 1 of time series , y_{t-1} = first difference of the series at time (t-1)

Essentially, it has an analogous null hypothesis to that of the unit root test. The coefficient of Y(t-1) is 1, indicating the existence of a unit root. If not rejected, the series is considered non-stationary. By assessing the null hypothesis—that the series has a unit root—that which makes the ADF test non-stationary—that which tests stationarity.

$\boldsymbol{H_o}$: ϕ=1 (The time series has a unit root; it is non-stationary.)

$\boldsymbol{H_1}$: ϕ<1 (The time series does not have a unit root; it is stationary.)

Where: ϕ represents the coefficient associated with the lagged level of the series in the test equation.

To achieve stationarity, it was required to take the first difference for all the variables after The first difference of all the variables was stationery except the GDP Current Prices and the Money Supply, therefore, a second difference was taken for them after it all Money supply achieved stationarity with other variables but GDP current prices needed a third difference to achieve it and all the variables are statistically stationary

6.5.2. Variance Inflation Factor (VIF)

Multicollinearity Testing: Multicollinearity among the independent variables can distort regression results by inflating the variances of estimated coefficients. Before a variable may be included in a regression study, its Variance Inflation Factor (VIF) must be less than five. This is done to determine the degree of multicollinearity, which is often set at five. (Akinwande, O., Dikko, H. G., & Agboola, S. , 2015). In particular, the variance inflation factor for the j^{th} predictor is:

$$VIF_i = \frac{1}{1-R_i^2}$$

where R_i^2 is the R^2-value obtained by regressing the j^{th} predictor on the remaining predictors (Detecting Multicollinearity Using Variance Inflation Factors, n.d.).

6.5.3. Modeling Approach: ARDL Model

Autoregressive Distributed Lag (ARDL) Model: Various approaches exist for testing long-term relationships between variables, including the Johansen & Juselius (1990) cointegration

test and the Engle & Granger (1987) cointegration test. When examining cointegration, the ARDL model, introduced by Pesaran & Shin (1995), proves valuable for handling variables with different integration orders, I(0) and I(1) (Pesaran et al, 2001).

The ARDL model is selected for its efficacy in accommodating both I(0) and I(1) series inside a unified framework, rendering it appropriate for our mixed time-series data. The ARDL method facilitates the evaluation of both short-term and long-term correlations between monetary policy tools and economic metrics. The ARDL model was then employed to evaluate both the long-run and short-run dynamics between the variables. The model equation is:

$$\Delta y_t = \alpha + \sum_{i=1}^{q} \beta_i \Delta y_{t-i} + \sum_{j=0}^{p} \gamma_j \Delta x_{1t-j} + \sum_{j=0}^{p} \delta_j \Delta x_{2t-j} + \sum_{j=0}^{p} \phi_j \Delta x_{3t-j} + \varepsilon_t$$

Where:

α is intercept.

The coefficients $\beta_i, \gamma_j, \delta_j, \& \phi_j$ for all j represents the relationship.

εt is the error term.

The model equations for each dependent variable are as follows:

For GDP Current Prices (GDP):

$$\begin{aligned} GDP_t = \alpha &+ \beta_1 \, \mathrm{L(GDP, 1)} + \cdots + \beta_{10} \, \mathrm{L(GDP, 10)} + \gamma_0 \mathrm{DISC}RRT + \gamma_1 \, \mathrm{L(DISC_{RT}, 1)} + \cdots \\ &+ \gamma_{10} \, \mathrm{L(DISC_{RT}, 10)} + \delta_0 \mathrm{M3} + \delta_1 \, \mathrm{L(M3,1)} + \cdots + \delta_{10} \, \mathrm{L(M3,10)} + \phi_0 \mathrm{RR} \\ &+ \phi_1 \, \mathrm{L(RR, 1)} + \cdots + \phi_{10} \, \mathrm{L(RR, 10)} + \varepsilon_t \end{aligned}$$

Where:

α : This is the intercept term, representing the constant in the regression model. It captures the baseline value of GDP when all other variables are zero.

β_i (for $i = 1,2, \ldots ,10$): These are the coefficients for the lagged values of GDP. Each β_i represents the effect of the i^{th} lag of GDP on the current GDP.

γ_i (for $i = 0,1,2,\dots,10$): These are the contemporaneous and lagged DISC_RT coefficients. γ_0 is the coefficient for the current value of DISC_RT, and γ_i (for $i > 0$) are for the lagged values of DISC_RT.

δ_i (for $i = 0,1,2,\dots,10$): These are the contemporaneous and lagged M3 coefficients. δ_0 is the coefficient for the current value of M3, and δ_i (for $i > 0$) are for the lagged values of M3.

ϕ_i (for $i = 0,1,2,\dots,10$): These are the contemporaneous and lagged RR coefficients. ϕ_0 is the coefficient for the current value of RR, and ϕ_i (for $i > 0$) are for the lagged values of RR.

ε_t: The error term, capturing the part of GDP_t that is not explained by the included variables and their lags. It accounts for random shocks or other external influences on GDP_t not captured by the model.

For Real GDP:

$$\begin{aligned}\text{R\_GDP}_t = {} & \alpha + \beta_1\,\text{L}(\text{R}_{\text{GDP}}, 1) + \cdots + \beta_{10}\,\text{L}(\text{R}_{\text{GDP}}, 10) + \cdots \\ & + \gamma_0\,\text{DISC\_RT} + \gamma_1\,\text{L}(\text{DISC\_RT}, 1) + \dots + \gamma_{10}\,\text{L}(\text{DISC\_RT}, 10) + \delta_0\text{M3} \\ & + \delta_1\,\text{L}(\text{M3},1) + \cdots + \delta_{10}\,\text{L}(\text{M3},10) + \phi_0\text{RR} + \phi_1\,\text{L}(\text{RR}, 1) + \cdots \\ & + \phi_{10}\,\text{L}(\text{RR}, 10) + \varepsilon_t\end{aligned}$$

Where:

α : This is the intercept term, representing the constant in the regression model. It captures the baseline value of Real GDP when all other variables are zero.

β_i (for $i = 1,2,\dots,10$): These are the coefficients for the lagged values of Real GDP. Each β_i represents the effect of the i^{th} lag of Real GDP on the current Real GDP.

γ_i (for $i = 0,1,2,\dots,10$): These are the contemporaneous and lagged DISC_RT coefficients. γ_0 is the coefficient for the current value of DISC_RT, and γ_i (for $i > 0$) are for the lagged values of DISC_RT.

δ_i (for $i = 0,1,2,\ldots,10$): These are the contemporaneous and lagged M3 coefficients. δ_0 is the coefficient for the current value of M3, and δ_i (for $i > 0$) are for the lagged values of M3.

ϕ_i (for $i = 0,1,2,\ldots,10$): These are the contemporaneous and lagged RR coefficients. ϕ_0 is the coefficient for the current value of RR, and ϕ_i (for $i > 0$) are for the lagged values of RR.

ε_t: The error term, capturing the part of R_{GDP_t} that is not explained by the included variables and their lags. It accounts for random shocks or other external influences on R_{GDP_t} not captured by the model.

- For Inflation (CPI):

$$\begin{aligned}\text{CPI}_t = \; & \alpha + \beta_1 \text{ L(CPI, 1)} + \beta_2 \text{ L(CPI, 2)} \\ & + \beta_3 \text{ L(CPI, 3)} + \beta_4 \text{ L(CPI, 4)} + \gamma_0 \text{DISC}RT \\ & + \delta_0 \text{M3} + \delta_1 \text{ L(M3,1)} + \delta_2 \text{ L(M3,2)} + \delta_3 \text{ L(M3,3)} \\ & + \delta_4 \text{ L(M3,4)} + \delta_5 \text{ L(M3,5)} + \delta_6 \text{ L(M3,6)} + \delta_7 \text{ L(M3,7)} \\ & + \delta_8 \text{ L(M3,8)} + \varepsilon_t\end{aligned}$$

α: The intercept term represents the baseline value of CPI_t when all other explanatory variables and their lags are zero. It captures the constant component of the model.

β_i (for $i = 1,2,3,4$): These are the coefficients for the lagged values of CPI. Each β_i represents the effect of the i^{th} lag of CPI (e.g., CPI_{t-1}, CPI_{t-2}, etc.) on the current CPI_t. These coefficients measure the persistence or memory effect of past CPI values on the current CPI.

γ_0 : The coefficient for the contemporaneous value of DISC_RT, indicating the effect of the current value of this explanatory variable on CPI_t. It shows how the current discount rate impacts CPI_t.

δ_i (for $i = 0,1,2,\ldots,8$): These are the coefficients for the contemporaneous and lagged values of M3. Specifically:

δ_0 : The coefficient for the current value of M3 at time t, showing the direct impact of current money supply on CPI_t.

δ_i (for $i > 0$): The coefficients for the lagged values of M3 (e.g., $M3_{t-1}, M3_{t-2}$, etc.). Each δ_i quantifies the effect of the i^{th} lag of M3 on the current CPI_t, showing how past values of money supply influence current CPI.

ε_t : The error term, capturing the part of CPI_t that is not explained by the included variables and their lags. It accounts for random shocks or other external influences on CPI_t not captured by the model.

6.5.4. Long-run and Bounds Testing for Long-Run Relationships

Long-run test:

The long-run and bounds test was conducted to examine whether a long-term equilibrium relationship exists between the variables in the model

$\boldsymbol{H_0}$: $\beta_j = 0$ (No long-run effect)

$\boldsymbol{H_1}$: $\beta_j \neq 0$ (Significant long-run effect)

Where: β_j be the long-run coefficient be the long-run coefficient

Bounds Testing Approach:

The ARDL bounds testing approach is applied to assess the presence of a long-term equilibrium relationship among variables. If such a relationship is confirmed, it indicates that adjustments in monetary policy instruments exert a sustained influence on economic indicators, extending beyond short-term fluctuations.

The Bounds test establishes the upper and lower boundaries of the crucial values. The absence of cointegration is accepted as a null hypothesis if the computed F-statistic is less than the lower critical value. Cointegration of the variables under study is shown by the rejection of the null hypothesis if the estimated F-statistic is greater than the upper critical value. (Pesaran et al, 2001).

The test includes the following hypotheses:

$\boldsymbol{H_o}$: $\beta_1 = \beta_2 = \cdots = \beta_n = 0$ (No long-run relationship)

$\boldsymbol{H_1}$: At least one $\beta_i \neq 0$ (There is a long-run relationship)

Where β_i represent the coefficients of the independent variables in the long-run equation.

6.5.5. Granger Causality Test

In statistics, the Granger Causality Test (GCT) determines whether two sets of time series data are predictive of each other. In order to establish a direct causal link, the GCT utilizes the "precedence of interdependence" test. To rephrase, it's useful for looking for long-term trends in which one variable significantly affects another. The test is widely employed in economic and social sciences research to examine causality and relationships between variables (Beyzatlar MA, Karacal M, Yetkiner H., 2014).

The notion of "Granger-causality" denotes a predictive association, whereby historical values of one variable (x) might assist in forecasting future values of another variable (y). This doesn't necessarily mean x causes y, but that there's a statistical relationship that can be used for prediction (Granger CWJ., 1969).

The Granger Causality Test was employed to examine whether past values of the independent variables (discount rate, money supply M3, and required reserves ratio) can predict changes in the dependent variables (GDP, Real GDP, and ınflatıon rate). This test identifies causality, helping to determine if monetary policy instruments can effectively predict Türkiye's economic performance.

- Hypotheses of Granger Causality Test:

$\boldsymbol{H_0}$: Past values of the independent variable do not Granger-cause changes in the dependent variable.

$\boldsymbol{H_1}$: Past values of the independent variable do Granger-cause changes in the dependent variable.

6.6. Diagnostic Tests

A fitted autoregressive model must pass all diagnostic tests, indicating that the residuals are normally distributed, and that there is no serial autocorrelation or heteroskedasticity. Only then can the findings be trusted. (Gerlach, R., Carter, C., & Kohn, R., 1999).

6.6.1. Serial Correlation Testing:

- **Durbin-Watson Test:**

Autocorrelation, also known as serial correlation, may be detected in regression analysis using the Durbin-Watson Test, which is especially useful when dealing with time-series data. When regression model error terms show correlation, a traditional linear regression model assumption is violated, and autocorrelation results. (Uysal, M., & Günay, S., 2001).

This test checks for autocorrelation in residuals. The test statistics are:

$$\boldsymbol{H_o}: \rho = 0$$

$$\boldsymbol{H_1}: \rho \neq 0$$

Where ρ represents the autocorrelation coefficient(s) at the respective lags.

- **Breusch-Godfrey Test**:

When dealing with dynamic linear models that include delayed values of the dependent variable as regressors, the Breusch-Godfrey (BG) test may be used to identify higher-order autocorrelation in the residuals of the model. Coefficient estimates may be skewed or inconsistent if autocorrelation is present, as it goes against a fundamental premise of the conventional linear regression model. (asak, T., Rahman, M. M., & Majumder, A., 2012).

The test statistics are:

$$\boldsymbol{H_o}: \rho_1 = \rho_2 = \cdots = \rho_p = 0$$

$\boldsymbol{H_1}$: At least one $\rho_i \neq 0$ (for $i = 1,2, \ldots, p$)

Where ρ represents the autocorrelation coefficient(s) at the respective lags.

6.6.2. Heteroscedasticity Testing:

- **Studentized Breusch-Pagan Test:**

The standard BP test, a widely used method for detecting heteroscedasticity, is known to be sensitive to deviations from normality and the presence of outliers. This sensitivity stems from the test's reliance on squared residuals, which can be heavily influenced by extreme values. This

lack of robustness can lead to unreliable results, particularly in small samples or when the error term is not normally distributed (Koenker, R., 1981). The test statistics are:

$\boldsymbol{H_o}: \sigma_i^2 = \sigma^2$ (Constant variance for all observations)

$\boldsymbol{H_1}: \sigma_i^2 \neq \sigma^2$ (Variance changes across observations)

Where σ_i^2 represent the variance of the residuals for observation i

6.6.3. Normality Testing:

One way to find out whether a dataset is normally distributed is to utilize normality tests, which are statistical techniques. Since the validity of many parametric statistical procedures (such t-tests and ANOVA) depends on the assumption of normality, these tests are important. When data deviates significantly from a normal distribution, non-parametric methods are preferred (Demir, 2022).

- **Shapiro-Wilk Test:**

An important differentiator of the Shapiro-Wilk (SW) test is its use of regression analysis for normality assessment. Using the correlation between the actual data and the predicted values of conventional normal-order statistics, this method determines a test statistic (W). (Shapiro, S. S., & Wilk, M. B., 1965).

Checks if residuals follow a normal distribution.

$\boldsymbol{H_o}: \varepsilon \sim \text{Normal}(\mu, \sigma^2)$ (The residuals follow a normal distribution)

$\boldsymbol{H_1}: \varepsilon \nsim \text{Normal}(\mu, \sigma^2)$ (The residuals do not follow a normal distribution)

Where ε represent the residuals:

6.6.4. Stability Testing:

- **Recursive CUSUM Test:**

The test relies on recursive residuals, which are essentially standardized one-step prediction errors. These residuals are calculated by comparing the observed values of the dependent variable with the values predicted using recursively estimated coefficients. The idea is

that if the coefficients remain stable over time, these recursive residuals should have an average of zero. However, if a shift occurs, a disproportionate number of residuals will share the same sign, causing a deviation from the zero average (Farhani, 2012).

The CUSUM test quantifies these deviations using the cumulative sum (CUSUM) of the recursive residuals. This statistic is plotted against time, forming a CUSUM chart. The chart also includes a corridor defined by confidence bounds. If the CUSUM statistic breaches these bounds, it signals potential instability in the coefficients. A negative slope on the chart suggests that the predicted values consistently exceed the observed values, while a positive slope implies the opposite (Farhani, 2012).

- Assesses the stability of model parameters over time.

$\boldsymbol{H_0}$: The regression coefficients are stable over time (no structural change*).*

$\boldsymbol{H_1}$: The regression coefficients are not stable (vary) over time (there is a structural change).

6.6.5. Outliers Detection

When a time series contains data points that drastically differ from the predicted trends, these points are called outliers. These deviations can arise from various sources, including errors in data entry, sudden shocks, or gradual changes in the underlying trends or seasonality of the data (Fröhlich, M.).

- **Time series outliers test:**

$\boldsymbol{H_0}$: There are no outliers present in the time series; the data follows its expected pattern without anomalies.

$\boldsymbol{H_1}$: There are outliers present in the time series; the data contains points that deviate significantly from the expected pattern.

The outlier detection process involved analyzing residuals through several diagnostic methods, including **Residuals Plot, Standardized Residuals Plot, Cook's Distance, and the Time Series Outliers (TSO) test.**

6.7. Hypotheses

The study formulates the following key hypotheses to examine the connections between monetary policy indicators and Türkiye's economic performance:

1. **Hypothesis 1: There is a significant relationship between the independent variables (discount rate, money supply, and required reserves ratio) and GDP Current Prices.**

•Model:

$\boldsymbol{H_0}$: The discount rate, money supply, and required reserves ratio do not exert a significant influence on gross domestic product (GDP).

$\boldsymbol{H_1}$: The discount rate, money supply, and required reserves ratio have a meaningful impact on gross domestic product (GDP).

2. **Hypothesis 2: There exists a significant relationship between the independent variables (discount rate, money supply, and required reserves ratio) and Real GDP.**

•Model:

$\boldsymbol{H_0}$: The Discount Rate, Money Supply, and Required Reserves Ratio does not have a significant impact on the Real GDP.

$\boldsymbol{H_1}$: The Discount Rate, Money Supply, and Required Reserves Ratio have a significant impact on the Real GDP

3. **Hypothesis 3: The independent variables (discount rate, money supply, and required reserves ratio) have a significant impact on the inflation rate**

•Model:

$\boldsymbol{H_0}$: The Discount Rate, Money Supply, and Required Reserves Ratio do not have a significant impact on inflation.

$\boldsymbol{H_1}$ The Discount Rate, Money Supply, and Required Reserves Ratio have a significant impact on inflation.

6.8. Result Interpretation

For each dependent variable—GDP Current Prices, Real GDP, and CPI—the ARDL model shed light on the consequences in the short and long term. What follows is an analysis of the findings:

- **Short-Run Analysis**: Using the ARDL model, the short-term effects of the independent variables (discount rate, money supply, and required reserves ratio) on each dependent variable are analyzed. Immediate impacts indicate how changes in these monetary policy instruments influence economic indicators within a few quarters, capturing the short-term adjustments in Türkiye's economy.
- **Long-Run Analysis**: The bounds test results indicate whether there is a long-run equilibrium relationship for each model. If significant, it suggests that monetary policy instruments exert a lasting influence on economic indicators over. The process involved analyzing **Breakpoint Test**
  - **Breakpoint Test**

Structural Breaks: These represent significant shifts or changes in the underlying patterns of a time series, often caused by policy changes, economic shocks, or other external factors. Ignoring structural breaks can lead to inaccurate conclusions in time series analysis. standard unit root tests, like the Augmented Dickey-Fuller (ADF) test, might fail to detect stationarity in macroeconomic time series if they don't account for structural breaks. This is because structural breaks can create the appearance of non-stationarity even when the underlying series might be stationary around a shifting trend (Alabi, N. O., & Bada, O., 2023). By Breakpoint test, Structural breaks can be tested:

$\boldsymbol{H_0}$: There is no structural break in the time series; the model parameters remain constant over time.

$\boldsymbol{H_1}$: There is at least one structural break in the time series; the model parameters change at some point(s) over time.

6.9. Limitations and Considerations

This study focuses primarily on short-term dynamics due to the lack of strong long-run equilibrium relationships in some cases. However, further research may consider additional economic factors to provide a more comprehensive view of the long-term interactions within Türkiye's economy. Additionally, any structural changes in the Turkish economy over the study period, such as policy shifts or economic crises, could impact the stability and interpretation of these results.

7. DATA ANALYSIS

7.1. Introduction

In this chapter, we see the outcomes of the statistical study, which included exploratory and descriptive statistics on the variables, as well as regression analyses between the response and explanatory factors. All procedures were carried out using the R and Python computing languages. The significance level for this analysis is 0.05. An acronym for the research variables is as follows:

Table 2 Variables Abbreviations

Variable	***Abbreviation***	***Data source***
Discount Rate	DISC_RT	CBRT EVDS
Money Supply	M3	CBRT EVDS
Required Reserves Ratio	RR	CBRT
Gross Domestic Product	GDP	CBRT EVDS
Real Gross Domestic Product	R_GDP	CBRT EVDS
Inflation Rate	CPI	CBRT EVDS

Source: Author's own work based on original data analysis.

7.2. Descriptive and Exploratory analysis

The following table contains Descriptive statistics for all the study variables the dependent variables, independent variables.

Table 3 Descriptive statistics

Stat	*DISC_RT*	*M3*	*RR*	*GDP*	*R_GDP*	*CPI*
Mean	14.11	2296385000	8.07	1215608000	360879900	3.88

STD	8.85	3486601000	2.67	2015643000	111163200	4.63
Min	4.50	81584080	3.51	119544500	186597400	-0.37
25%	7.50	449705300	6.00	242973600	264774800	1.49
50%	11.78	955324600	7.61	492463500	345959300	2.64
75%	17.50	2193139000	10.55	1032344000	441118000	3.96
Max	50.00	16325990000	14.39	9949792000	608719500	28.29

Source: Author's own work based on original data analysis.

Table 3 descriptive statistics provide insights into the economic variables, with all monetary values reported in thousands Turkısh lira.

Starting with the Discount Rate, the average stands at 14.11%, with a standard deviation of 8.85%, indicating significant variability. The values range from 4.5% to a maximum of 50%, suggesting substantial shifts over time, likely tied to policy adjustments or economic responses.

For Money Supply, the mean is approximately 2.3 trillion (2,296,385,000 in thousands), with a high standard deviation of 3.5 trillion. The values vary widely, from 81.6 million to 16.3 trillion, suggesting fluctuations in liquidity influenced by changing monetary policies or external economic factors.

The Required Reserve has a mean of 8.07%, with a standard deviation of 2.67%, showing moderate variation. Its range, from 3.51% to 14.39%, points to a relatively steady policy approach compared to the other variables.

Moving to GDP in Current Prices, the mean is 1.2 trillion, with a standard deviation of approximately 2 trillion, showing high variability. The values span from 119.5 million to nearly 10 trillion, indicating dramatic changes over time, likely reflecting economic growth cycles and inflation effects.

Real GDP has a mean of 360.9 billion, with a standard deviation of 111.2 billion, suggesting more stability relative to GDP in current prices. Values range from 186.6 billion to 608.7 billion, reflecting real economic growth when adjusted for inflation.

Lastly, the Inflation Rate has a means of 3.88% and a standard deviation of 4.63%, with values ranging from -0.37% to 28.29%. This indicates periods of both deflation and inflation, likely influenced by various economic pressures.

These statistics offer a foundational understanding of each variable, shedding light on economic trends and policy impacts over time.

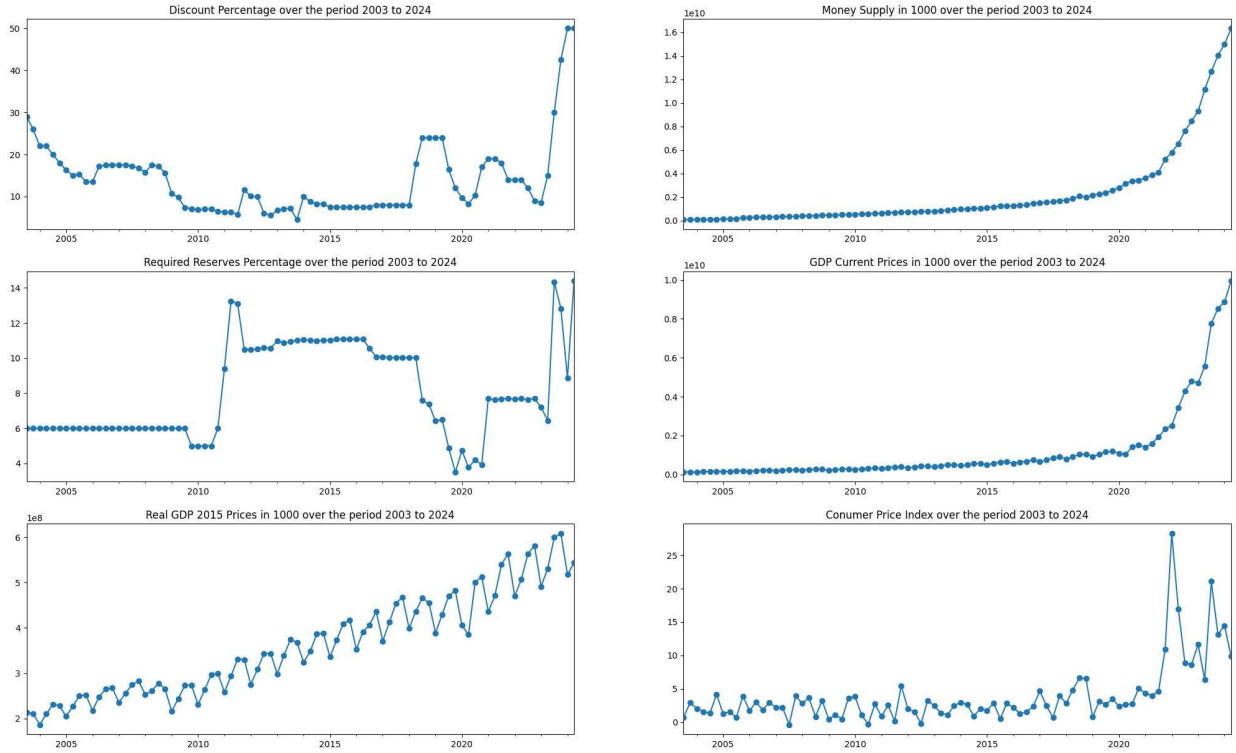

Figure 3 line chart for all the study variables

Source: Author's own work based on original data analysis.

Figure 3 the line charts display trends in key economic indicators over the period from 2003 to 2024. The Discount Rate and Required Reserves Ratio percentages show notable fluctuations, with the discount rate rising sharply in recent years and the required reserves ratio showing a spike around 2011, followed by a decline. Money Supply and GDP in Current Prices exhibit exponential growth, particularly in the most recent years, indicating significant economic expansion or inflationary pressures. Real GDP shows a steadier, more gradual increase, reflecting real economic growth without inflation. The Inflation Rate shows periods of volatility, with a sharp peak around 2020, likely to capture an inflationary period or economic shock.

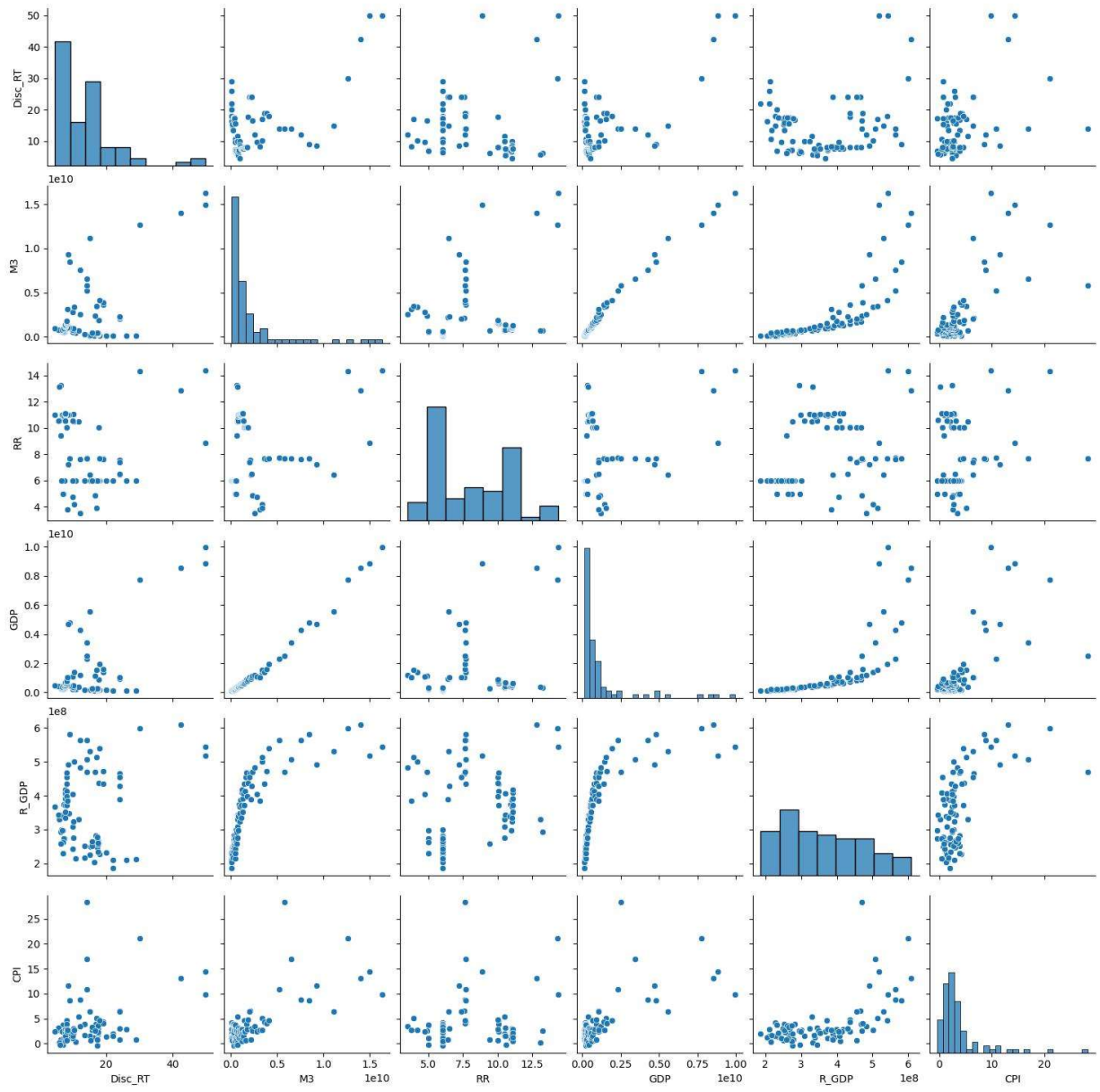

Figure 4 Scatter matrix for all the study variables

Source: Author's own work based on original data analysis.

Figure 4 The scatter matrix provides an overview of the relationships between key economic indicators, with particular attention to the dependent variables: Inflation Rate, GDP in Current Prices, and Real GDP. Visually, GDP in Current Prices and Real GDP show a strong positive correlation, with both increasing steadily alongside variables like Money Supply. This

suggests that increases in money supply may be associated with economic growth, as reflected in both nominal and real GDP.

For the Inflation Rate, the relationships with the other variables appear less distinct, with some scattered patterns indicating weak or nonlinear relationships. However, the pair plot suggests a possible positive association between Inflation Rate and Discount Rate, as well as with Money Supply, which might reflect inflationary pressures related to monetary expansion and interest rate adjustments. These insights provide a foundation for further analysis, especially in understanding how money supply and discount rates may impact inflation and economic growth.

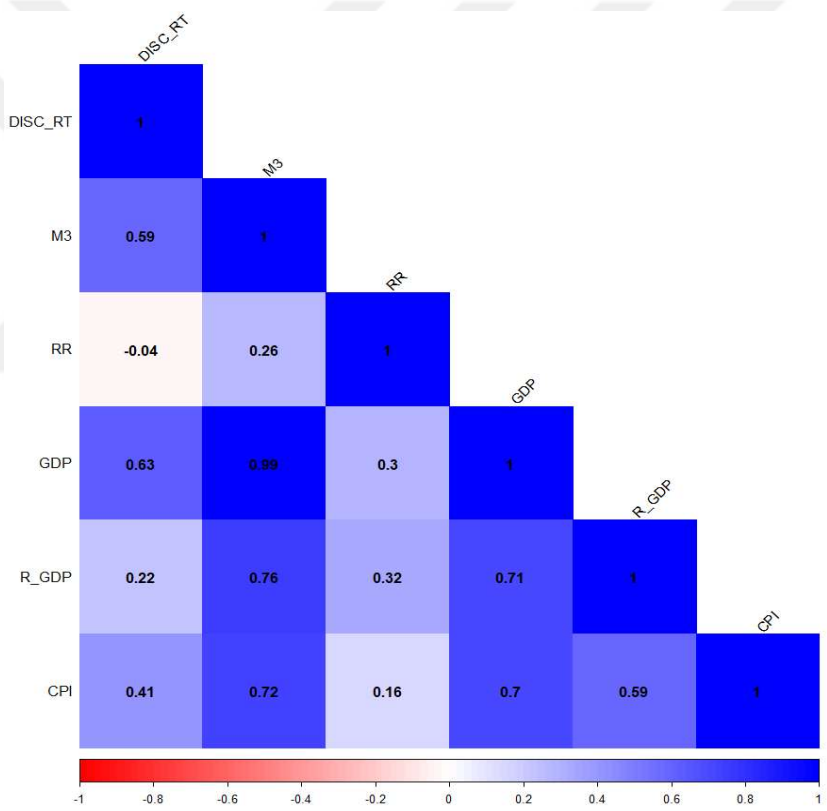

Figure 5 Correlation Heat map for the study variables

Source: Author's own work based on original data analysis.

Figure 5 the correlation heatmap provides insights into the relationships between the economic indicators, with a focus on the dependent variables: Inflation Rate, GDP in Current Prices, and Real GDP. There is a very strong positive correlation (0.99) between GDP in Current Prices and Real GDP, indicating that both measures of economic output move closely together, as

expected. This suggests that the nominal and real GDP figures are highly aligned, with real GDP adjusted for inflation.

The money supply (0.72) and GDP in current prices (0.70) are somewhat positively correlated with the inflation rate. According to this correlation, inflationary pressures, as measured by the inflation rate, tend to grow in tandem with increases in both the money supply and nominal GDP. A significant correlation of 0.59 between the discount rate and the money supply suggests that monetary policy actions to control inflation or encourage growth might include raising interest rates together with the money supply. These relationships point to the interdependence between monetary variables, GDP growth, and inflation..

7.3. Stationarity Test

Before starting the modelling for the variables, a necessary step must be taken to check the stationarity of the data since the data was collected from 2003 to 2024. ADF test was used to test stationarity. table 4 illustrates the results of ADF test

Table 4 ADF Stationarity test

Variable	Dickey Fuller	P value	Interpretation
DISC_RT	-1.299422	0.8632394	Non-Stationary
M3	2.058974	0.990000	Non-Stationary
RR	-1.969039	0.5885813	Non-Stationary
GDP	3.16755	0.990000	Non-Stationary
R_GDP	-1.691072	0.7025954	Non-Stationary
CPI	-2.034757	0.5616257	Non-Stationary

Source: Author's own work based on original data analysis.

Table 4 illustrating the results of ADF test after all the differences.

Table 5 ADF Stationarity test after all the differences

Variable	Dickey Fuller	P value	Interpretation
DISC_RT	-4.311418	0.010000	Stationary

M3	-6.239993	0.010000	Stationary
RR	-3.648379	0.03451569	Stationary
GDP	-6.790388	0.010000	Stationary
R_GDP	-3.579045	0.0405343	Stationary
CPI	-7.849635	0.010000	Stationary

Source: Author's own work based on original data analysis.

7.4. Variance Inflation Factor (VIF)

The correlation heatmap suggested potential multicollinearity among the independent variables due to the observed relationships, particularly between Money Supply and Discount Rate. The level of multicollinearity was evaluated by computing the Variance Inflation Factor (VIF) for each independent variable in a preliminary model that was created to delve further into this.

Table 6 VIF results for multicollinearity

Variable	VIF	Interpretation
DISC_RT	1.109618	No multicollinearity
M3	1.040578	No multicollinearity
RR	1.068607	No multicollinearity

Source: Author's own work based on original data analysis.

Table 6 displays the VIF results, showing that each variable—Discount Rate (VIF = 1.11), Money Supply (VIF = 1.04), and Required Reserves Ratio (VIF = 1.07)—has a VIF value well below the common threshold of 5. This indicates that multicollinearity is not a significant concern in this model, as all values suggest low multicollinearity among the independent variables. Consequently, each variable can be included in the model without the risk of inflating standard errors due to multicollinearity.

7.5. Hypothesis Analysis

This section of the study focuses on testing hypotheses related to monetary policy instruments and economic performance. The analysis aims to examine the impact of these

instruments on the economic performance of Türkiye. By employing various statistical methods, we will assess whether the key economic indicators significantly influence Türkiye's economic landscape. Through rigorous testing, this section seeks to uncover the extent to which these instruments drive growth.

First hypothesis: The Discount Rate, Money Supply, and Required Reserves Ratio have a significant impact on the Gross Domestic Product (GDP).

7.5.1. Modeling Approach: ARDL Model

This study employed the ARDL bounds testing approach to analyze the long- and short-run relationship between GDP and monetary policy indicators. The ARDL model effectively addresses concerns related to both spurious and genuine regressions in time series data. In this study, the optimal lag structure was determined using the AIC criterion, with a maximum of 10 lags specified in the auto ARDL process to identify the best model. The 10 lags were chosen as maximum since Increasing the number of lags beyond 10 could excessively reduce the degrees of freedom, potentially compromising the model's reliability and statistical power. This approach allows for a robust analysis while maintaining the validity of the result. This model, with GDP as the dependent variable and Discount Rate, Money Supply, and Required Reserves Ratio as predictors, yielded an optimal lag configuration. The empirical results for this ARDL model are presented in Table 7. The hypothesis for testing was modeled as follows:

H_0: The Discount Rate, Money Supply, and Required Reserves do not have a significant impact on the Gross Domestic Product (GDP).

H_1: The Discount Rate, Money Supply, and Required Reserves have a significant impact on the Gross Domestic Product (GDP).

Table 7 ARDL Model Results

Term	*Estimate*	*std. error*	*statistic*	*P value*
(Intercept)	12361630.00	8804738.	1.40397	0.1717
L(GDP, 1)	-1.59	0.19	-8.24769	0.00***
L(GDP, 2)	-2.10	0.40	-5.2346	0.00***
L(GDP, 3)	-1.86	0.75	-2.47567	0.0199*
L(GDP, 8)	4.31	1.63	2.64428	0.0135*
L(GDP, 9)	2.51	1.20	2.09471	0.0457*
L(GDP, 10)	1.24	0.57	2.17172	0.0388*

L(DISC_RT, 7)	17318640.00	8110343	2.13537	0.0420*
L(DISC_RT, 9)	18569620.00	6787490	2.73586	0.0109*
L(M3, 4)	-0.68	0.26	-2.62144	0.0142*
L(M3, 7)	-0.60	0.28	-2.13343	0.0421*
L(RR, 6)	-70060750.	23180850	-3.02235	0.0054**
L(RR, 10)	-39673030	18705120.	-2.12097	0.0433*

Source: Author's own work based on original data analysis.

*Only statistically significant variables (p < 0.05) are included in the table. * p < 0.05, ** p < 0.01, *** p < 0.001*

Table 8 Goodness of Fit Measures

R^2	Adj R^2	sigma	F-statistic	P value	df	Df residual	N
0.993	0.982	64364530	89.865	0.00001	43	27	71

Source: Author's own work based on original data analysis.

The ARDL model includes several lags of GDP, Discount Rate, Money Supply, and Required Reserves. Among these, certain lags have shown statistically significant relationships with the dependent variable, GDP.

$$\begin{aligned}\widehat{\mathrm{GDP}_t} = \; & 12361630.00 + (-1.59)\mathrm{L(GDP,1)} + (-2.10)\mathrm{L(GDP,2)} + (-1.86)\mathrm{L(GDP,3)} + (-1.63)\mathrm{L(GDP,4)} \\ & +0.66\ \mathrm{L(GDP,5)} + 2.19\ \mathrm{L(GDP,6)} + 3.12\ \mathrm{L(GDP,7)} + 4.31\ \mathrm{L(GDP,8)} + 2.51\ \mathrm{L(GDP,9)} \\ & +1.24\ \mathrm{L(GDP,10)} + (-5701821)\mathrm{DISC_{RT}} + 2608753\ \mathrm{L(DISC}\mathit{R}\mathrm{RT,1)} + 2104082\ \mathrm{L(DISC_{RT},2)} \\ & +(-37549.96)\mathrm{L(DISC}\mathit{R}\mathrm{RT,3)} + 7751673\ \mathrm{L(DISC_{RT},4)} + (-8314276)\mathrm{L(DISC}\mathit{RT}\mathrm{,5)} \\ & +(-8683387)\mathrm{L(DISC_{RT},6)} + 17318640\ \mathrm{L(DISC_{RT},7)} + (-10594710)\mathrm{L(DISC_{RT},8)} \\ & +18569620\ \mathrm{L(DISC_{RT},9)} + (-4324121)\mathrm{L(DISC_{RT},10)} + (-0.21)\mathrm{M3} \\ & +0.21\ \mathrm{L(M3,1)} + (-0.13)\mathrm{L(M3,2)} + 0.13\ \mathrm{L(M3,3)} + (-0.68)\mathrm{L(M3,4)} \\ & +(-0.76)\mathrm{L(M3,5)} + (-0.23)\mathrm{L(M3,6)} + (-0.60)\mathrm{L(M3,7)} + 0.75\ \mathrm{L(M3,8)} \\ & +0.49\ \mathrm{L(M3,9)} + (-0.23)\mathrm{L(M3,10)} + 9947158\mathrm{RR} + (-2707064)\mathrm{L(RR,1)} \\ & +6315159\ \mathrm{L(RR,2)} + 8776183\ \mathrm{L(RR,3)} + (-20912960)\mathrm{L(RR,4)} \\ & +32961250\ \mathrm{L(RR,5)} + (-70060750)\mathrm{L(RR,6)} + 57437170\ \mathrm{L(RR,7)} \\ & +(-47423590)\mathrm{L(RR,8)} + 36766370\ \mathrm{L(RR,9)} + (-39673030)\mathrm{L(RR,10)}\end{aligned}$$

1. **Lags of GDP**:

L(1) and L(2) have negative coefficients (-1.59 and -2.10, respectively) and are highly significant ($p < 0.001$). This suggests that GDP values from the previous two periods negatively impact the current GDP at current prices, possibly indicating an adjustment mechanism.

L(3) and L(8) also have significant negative coefficients (-1.86 and 4.31, respectively) with p-values of 0.0199 and 0.0135, indicating further lagged influences.

L(9) and L(10) are positively significant, with coefficients of 2.51 and 1.24, respectively, and p-values of 0.0457 and 0.0388. This suggests that GDP values from nine and ten periods ago positively influence the current GDP.

2. **Lags of Discount Rate**:

L(7) and L(9) of the Discount Rate are significant, with coefficients of 17,318,640 (p = 0.0420) and 18,569,620 (p = 0.0109), respectively. These positive values suggest that higher discount rates from seven and nine periods ago are associated with an increase in the current GDP, potentially reflecting delayed economic adjustments to monetary policy.

3. **Lags of Money Supply**:

L(4) and L(7) of Money Supply are also significant, with coefficients of -0.68 (p = 0.0142) and -0.60 (p = 0.0421), respectively. These negative coefficients suggest that an increase in money supply four and seven periods ago may lead to a decrease in current GDP, possibly reflecting inflationary pressures reducing real economic output.

4. **Lags of Required Reserves**:

L(6) and L(10) of Required Reserves Ratio are significant, with coefficients of -70,060,750 (p = 0.0054) and -39,673,030 (p = 0.0433), respectively. This indicates that higher required reserves ratio from six and ten periods ago are associated with lower current GDP, which might reflect restrictive monetary policy effects from higher reserves requirements.

Several other lags of Discount Rate, Money Supply, Required Reserves, and GDP are statistically insignificant, with p-values well above conventional significance levels (e.g., 0.05). This lack of significance suggests that these specific lagged values do not have a strong or direct influence on the current GDP at current prices. These variables do not contribute substantially to explaining variations in GDP and can be seen as noise within the model rather than as drivers of economic performance.

The model has substantial explanatory power, shown by an R-squared (R^2) of 0.993 and an Adjusted R-squared (Adj R^2) of 0.982. This means that approximately 99.3% of the variance in

GDP is explained by the model, with the adjusted R-squared value accounting for the number of predictors, showing that 98.2% of the variance is explained even when adjusting for the complexity of the model. The standard error of the regression (sigma) is 64,364,530, suggesting that while the model fits the data very well, there is still some residual variability. The model's F-statistic of 89.865 and a p-value of 0.00001 further validate its overall significance, demonstrating that the predictors collectively explain a substantial portion of GDP variation.

In summary, the model demonstrates strong goodness of fit, with significant predictors indicating meaningful relationships between lagged economic indicators and the current GDP in Türkiye.

- **Long-Run and Bounds test**

Long-Run test

A long-term equilibrium connection between the model's variables was examined using the long-run and boundstest. Table *9* shows the outcomes of the long run test:

Table 9 Long Run Test

Term	*Estimate*	*Std. Error*	*t value*	$Pr(>\|t\|)$
(Intercept)	-2113183	3895995	-0.5423989	0.5919929
Discount Rate	-1828604	3412504	-0.5358541	0.5964466
Money Supply M3	0.2144	0.3687	0.5814521	0.5657589
Required Reserves Ratio	4884657	11403730	0.4283387	0.6718023

Source: Author's own work based on original data analysis.

Long-Run Coefficients:

• The estimated intercept is -2,113,183, and the p-value is 0.592, thus, it isn't statistically significant.

• The discount rate is similarly not statistically significant, as its negative coefficient of -1,828,604 is accompanied by a p-value of 0.596. Therefore, changes in the discount rate do not significantly affect GDP at current prices over the long term.

• There is no statistically significant relationship between the money supply and GDP at present prices over the long run (0.2144, 0.566).

• The needed reserves ratio is estimated to be 4,884,657, which is positive but not statistically significant (p = 0.672). Therefore, adjustments to the needed reserves ratio do not have a long-term impact on GDP.

Table 10 F Bounds Test

	Statistic	*Lower-bound*	*Upper-bound*	*alpha*	*P value*
F	0.9832	3.224392	4.354236	0.05	0.8942091

Source: Author's own work based on original data analysis.

Bounds test:

The F-statistic for the bounds test is 0.9832, which is significantly lower than the critical lower bound of 3.224 at the 5% significance level. Additionally, the p-value of 0.894 further confirms the absence of any long-term equilibrium relationship among the model's variables.

In summary, there is no statistically significant long-run link between GDP and the independent variables (Discount Rate, Money Supply, and Required Reserves), according to both the bounds test findings and the long-run coefficients. Based on this model, it seems that these monetary policy factors do not have a lasting effect on GDP in Türkiye.

Given the lack of a significant long-run relationship, as indicated by the bounds test, the analysis will focus on the diagnostics and short-term dynamics of the ARDL model to better understand the immediate impacts and interactions among the variables.

- **Serial Correlation tests**

Table 11 serial correlation tests

Test	*Test statistic*	*P value*
Durbin-Watson	1.8927	0.4495
Breusch-Godfrey	0.18727	0.6652

Source: Author's own work based on original data analysis.

The Durbin-Watson test reports a test statistic of 1.8927 with a p-value of 0.4495, indicating no substantial evidence of serial correlation in the residuals. This implies that the model's residuals are uncorrelated, reinforcing the reliability of the parameter estimates.

Similarly, the Breusch-Godfrey test corroborates this finding, yielding a test statistic of 0.18727 and a p-value of 0.6652, further confirming the absence of significant serial correlation in the residuals.

- **Heteroscedasticity test**

Table 12 Heteroscedasticity tests

Test	*Test statistic*	*Df*	*P value*
studentized Breusch-Pagan	32.615	43	0.8753

Source: Author's own work based on original data analysis.

The studentized Breusch-Pagan test yields a test statistic of 32.615 with 43 degrees of freedom and a p-value of 0.8753. This high p-value suggests no evidence of heteroscedasticity, meaning that the variance of the residuals is constant, an important assumption for reliable inference in regression models.

- **Normality test**

Table 13 Normality tests

Test	*Test statistic*	*P value*
Shapiro-Wilk	0.98086	0.3515

Source: Author's own work based on original data analysis.

The Shapiro-Wilk test gives test statistics of 0.98086 with a p-value of 0.3515. This indicates that the residuals are normally distributed, meeting the normality assumption necessary for valid hypothesis testing in regression analysis.

- **Recursive CUSUM test**

Figure 6 illustrates that the cumulative sum of residuals remains within the confidence bands over time, implying that the model exhibits stability throughout the sample period. This suggests that the ARDL model does not suffer from structural breaks or instability in its parameters over time thus we accept the null hypothesis the regression coefficients are stable over time.

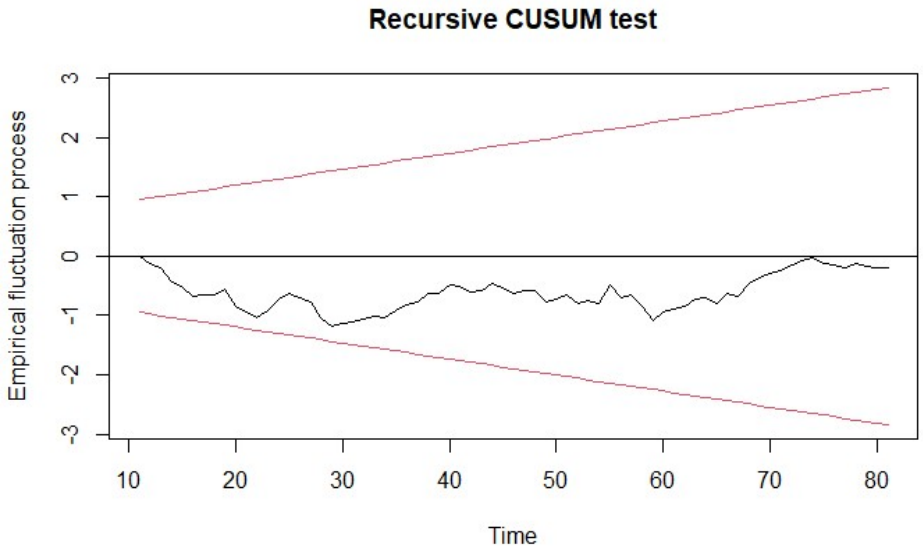

Figure 6 Recursive *CUSUM*

Source: Author's own work based on original data analysis.

- **Outliers Detection**

Table 14 time series outliers test

Test	$\boldsymbol{sigma^2}$	$\boldsymbol{log\ likelihood}$	***AIC***	***AICc***	***BIC***	***result***
Time series outliers	1.575e+15	-1343.01	2688.01	2688.07	2690.28	No outliers were detected

Source: Author's own work based on original data analysis.

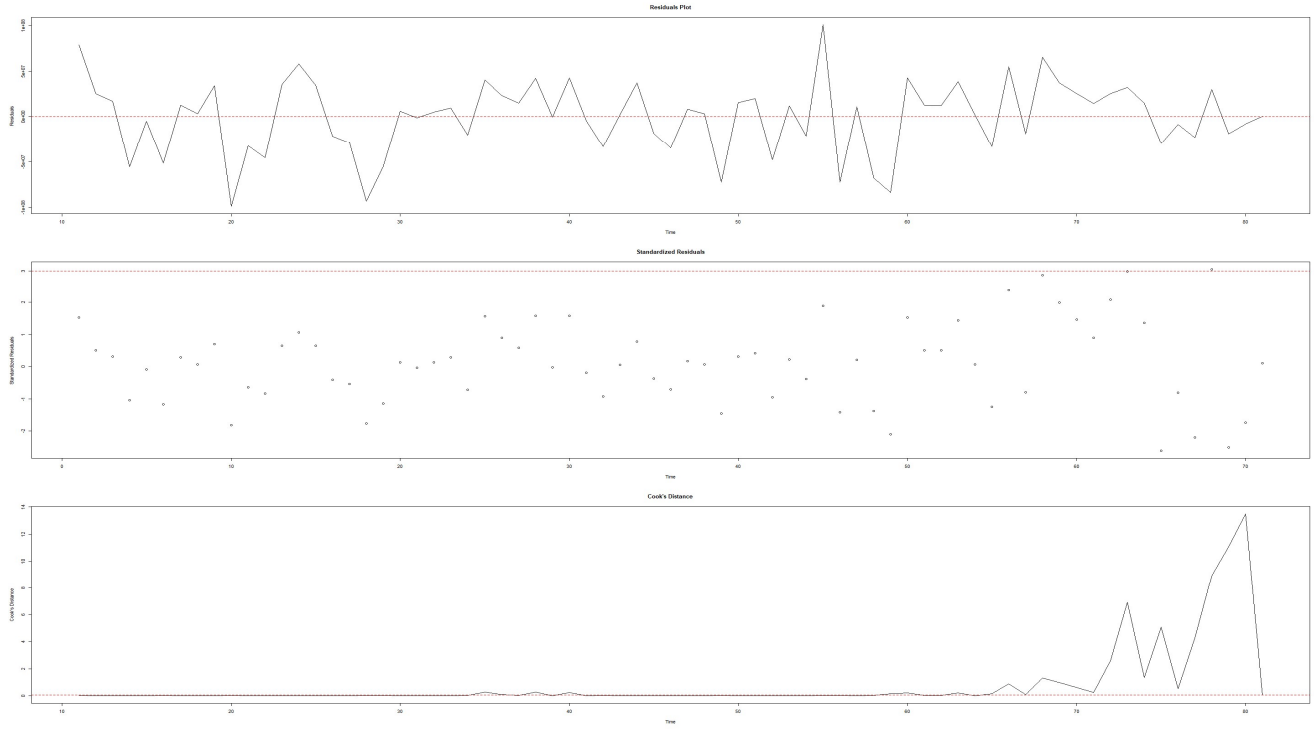

Figure 7 outliers Detection plots

Source: Author's own work based on original data analysis.

The outlier detection process involved analyzing residuals through several diagnostic methods, including Residuals Plot, Standardized Residuals Plot, Cook's Distance, and the Time Series Outliers (TSO) test.

1. Residuals Plot: The residuals plot reveals no clear patterns or unusual fluctuations, suggesting that the residuals are randomly distributed and do not indicate the presence of outliers in the model.
2. Standardized Residuals Plot: This plot also shows that the residuals fall within expected bounds, with no points crossing the red threshold line, further supporting the absence of extreme outliers or influential data points.
3. Cook's Distance: The Cook's distance analysis indicates that most observations have minimal influence on the model, with values well below the threshold. Only a few points at the end of the series show a slight increase, but they remain within acceptable limits, suggesting no data points exert undue influence on the model.

4. Time Series Outliers (TSO) Test: The TSO test results, summarized in the table, report no detected outliers, with a log-likelihood of -1343.01 and an AIC of 2688.01. This indicates that the model is free from significant time series outliers, affirming the robustness of the fit lead to accept the null hypothesis.

In conclusion, all four outlier detection techniques confirm that the data is devoid of influential outliers, ensuring the consistency and robustness of the model's results. These conclusions reinforce confidence in the model's reliability and the insights derived from the analysis.

The diagnostic tests confirm that the ARDL model is well-specified. There is no evidence of serial correlation, heteroscedasticity, or significant deviations from normality, and the model demonstrates stability over time. These findings support the reliability of the ARDL model's short-term results, as it provides a sound basis for interpreting the short-term impacts of Discount Rate, Money Supply, and Required Reserves Ratio on GDP Current price, even in the absence of a long-term equilibrium relationship.

- **Granger Causality Test**

Granger causality tests were performed to assess whether past values of key monetary policy instruments—the Discount Rate, Money Supply (M3), and Required Reserves—possess predictive ability for GDP fluctuations at current prices.

Table 15 Granger Causality Test

variable	Models	F-stat	P value
DISC_RT	Model 1: GDP ~ L(GDP, 1:10) + L(DISC_RT, 1:10) Model 2: GDP ~ L(GDP, 1:10)	0.8502	0.584
M3	Model 1: GDP ~ L(GDP, 1:10) + L(M3, 1:10) Model 2: GDP ~ L(GDP, 1:10)	10.734	0.0000
RR	Model 1: GDP ~ L(GDP, 1:10) + L(RR, 1:10) Model 2: GDP ~ L(GDP, 1:10)	3.0836	0.00398

Source: Author's own work based on original data analysis.

To find out whether certain economic indicators' lagged values may foretell changes in GDP, the Granger causality analysis was run. The premise that the dependent variable is not Granger-caused by the studied variable's lagged values is the null hypothesis for these tests. Here are the ways the findings are interpreted:

H0: The lagged values of the Discount Rate do not Granger-cause GDP.

H1 : The lagged values of the Discount Rate do Granger-cause GDP.

For the Granger causality test involving the Discount Rate, The Model (which includes lagged values of both GDP and the Discount Rate) yielded an F-statistic of 0.8502 with a p-value of 0.584. Since this p-value exceeds 0.05, we fail to reject the null hypothesis, suggesting that the Discount Rate does not Granger-cause GDP. Therefore, past values of the Discount Rate lack significant predictive power for current GDP levels.

H0: The lagged values of the Money Supply do not Granger-cause GDP.

H1 : The lagged values of the Money Supply do Granger-cause GDP.

The test using Money Supply produced a markedly noteworthy outcome. Model 1, including both GDP and delays of M3, exhibited an F-statistic of 10.734 and a p-value of 1.978e-09, significantly below 0.001. This notable outcome compels us to reject the null hypothesis, indicating that Money Supply (M3) Granger-causes GDP. Therefore, past values of M3 are strong predictors of changes in GDP.

H0: The lagged values of the Required Reserves Ratio do not Granger-cause GDP.

H1 : The lagged values of the Required Reserves Ratio do Granger-cause GDP.

The test involving Required Reserves Ratio also showed a significant relationship. Model 1, incorporating both GDP and lags of Required Reserves Ratio, produced an F-statistic of 3.0836 with a p-value of 0.003977, which is below the 0.01 threshold. This result allows us to reject the null hypothesis, suggesting that Required Reserves Ratio Granger-cause GDP. Hence, the past values of Required Reserves Ratio contribute meaningfully to the prediction of current GDP levels.

Overall, these tests reveal that while Discount Rate does not Granger-cause changes in GDP, both Money Supply and Required Reserves Ratio show significant predictive relationships with GDP.

The results support the study hypothesis in the short run. Specific lagged values of Discount Rate, Money Supply, and Required Reserves Ratio showed significant associations with GDP in Türkiye, Indicating that these monetary policy instruments may exert short-term influences on economic output. The Granger causality tests revealed that Money Supply and Required Reserves Ratio significantly Granger-cause GDP, affirming their predictive power for short-term fluctuations. However, the Discount Rate did not show a Granger-causal relationship, implying that while it may influence GDP in other ways, it does not provide predictive power in this context.

Second Hypothesis **the Discount Rate, Money Supply, and Required Reserves Ratio have a significant impact on the Real Gross Domestic Product (GDP).**

7.5.2. Modeling Approach: ARDL Model

This research used the ARDL bounds testing methodology to examine the long-term and short-term link between GDP and monetary policy variables. The ARDL model proficiently addresses issues associated with both spurious and authentic regressions in time series data. In this study, the optimal lag structure was determined using the AIC criterion, with a maximum of 10 lags specified in the auto ARDL process to identify the best model. The 10 lags were chosen as maximum since Increasing the number of lags beyond 10 could excessively reduce the degrees of freedom, potentially compromising the model's reliability and statistical power. This approach allows for a robust analysis while maintaining the validity of the result. This model was, with **Real GDP** as the dependent variable and **Discount Rate**, **Money Supply**, and **Required Reserves Ratio** as predictors, yielded an optimal lag configuration. The empirical results for this ARDL model are presented in Table 16

H_0: The Discount Rate, Money Supply, and Required Reserves does not have a significant impact on the Real GDP .

H_1: The Discount Rate, Money Supply, and Required Reserves have a significant impact on the Real GDP

Table 16 ARDL Model for Real GDP

Term	*Estimate*	*std. error*	*statistic*	*P value*
(Intercept)	6158887.00	3555098	1.7324	0.0923
L(R_GDP, 3)	-0.65880	0.20020	-3.2912	0.0023**
L(R_GDP, 6)	-0.56110	0.22190	-2.5288	0.0163*
DISC_RT	2741656.00	846821.20	3.2376	0.0027**
L(DISC_RT, 3)	1625004.00	752017.10	2.1609	0.0378*
L(DISC_RT, 7)	-3097098.00	741556	-4.1765	0.0002***
L(M3, 2)	0.06663	0.02899	2.2986	0.0278*
L(M3, 8)	-0.11150	0.04350	-2.5640	0.0149*
L(M3, 9)	-0.13290	0.04125	-3.2205	0.0028**
L(RR, 5)	7645653.00	2362783	3.2359	0.0027**
L(RR, 6)	-6317758.00	2225709	-2.8385	0.0076**

Source: Author's own work based on original data analysis.

*Only statistically significant variables (p < 0.05) are included in the table. * p < 0.05, ** p < 0.01, *** p < 0.001*

Table 17 Goodness of fit measures

R^2	*Adj* R^2	*sigma*	*Statistic*	*P value*	*df*	*Df residual*	*n*
0.971	0.94	10343412	31.48	0.00000	36	34	71

Source: Author's own work based on original data analysis.

The ARDL framework, where Real GDP serves as the dependent variable, incorporates multiple lags of Real GDP, Discount Rate, Money Supply, and Required Reserves. Here are the significant results:

$$\widehat{R_{GDP_t}} = 6158887.00 + (-0.13700)\mathrm{L}(\mathrm{R_{GDP}}, 1) + 0.14230\ \mathrm{L}(\mathrm{R_{GDP}}, 2) + (-0.65880)\mathrm{L}(\mathrm{R_{GDP}}, 3) + 0.35720\ \mathrm{L}(\mathrm{R_{GDP}}, 4) + (-0.18790)\mathrm{L}(\mathrm{R_{GDP}}, 5) + (-0.56110)\mathrm{L}(\mathrm{R_{GDP}}, 6) + 0.26810\ \mathrm{L}(\mathrm{R_{GDP}}, 7) + 0.25780\ \mathrm{L}(\mathrm{R_{GDP}}, 8) + 2741656.00 Disc_{RT} + (-1722566.00)\mathrm{L}(\mathrm{DISC}RRT, 1)$$

+ (-864733.90)L(DISC_RT, 2) + 1625004.00L(DISC_RT, 3) + (-987937.30)L(DISC_RT, 4) + 1284517.00L(DISC_RT, 5) + 118929.80L(DISC_RT, 6) + (-3097098.00)L(DISC_RT, 7) + (-919223.30)L(DISC_RT, 8) + 1681903.00L(DISC_RT, 9) + (-794332.60)L(DISC_RT, 10)

$$+(-0.00475)\mathrm{M3} + (-0.01921)\mathrm{L}(\mathrm{M3},1) + 0.06663\ \mathrm{L}(\mathrm{M3},2) + 0.03069\ \mathrm{L}(\mathrm{M3},3) + 0.02655\ \mathrm{L}(\mathrm{M3},4) + (-0.02977)\mathrm{L}(\mathrm{M3},5) + 0.02217\ \mathrm{L}(\mathrm{M3},6) + 0.03995\ \mathrm{L}(\mathrm{M3},7) + (-0.11150)\mathrm{L}(\mathrm{M3},8) + (-0.13290)\mathrm{L}(\mathrm{M3},9) + 2009080.00\mathrm{RR} + 1857811.00\ \mathrm{L}(\mathrm{RR}, 1) + (-3252525.00)\mathrm{L}(\mathrm{RR}, 2) + 3277759.00\ \mathrm{L}(\mathrm{RR}, 3) + (-4698114.00)\mathrm{L}(\mathrm{RR}, 4) + 7645653.00\ \mathrm{L}(\mathrm{RR}, 5) + (-6317758.00)\mathrm{L}(\mathrm{RR}, 6)$$

1. **Lags of Real GDP:**

L(3) and L(6) of Real GDP have significant negative coefficients (-0.6588 with p = 0.0023 and -0.5611 with p = 0.0163, respectively). This suggests that Real GDP from three and six periods ago negatively influences the current Real GDP, indicating possible cycles in economic growth where previous values exert a dampening effect.

2. **Discount Rate**:

The current Discount Rate is significant, with a positive coefficient of 2,741,656 and a p-value of 0.0027, suggesting that an increase in the discount rate has an immediate positive impact on Real GDP, which may reflect short-term stimulative effects of higher interest rates.

L(3) and **L(7)** of the Discount Rate are also significant, with coefficients of 1,625,004 (p = 0.0378) and -3,097,098 (p < 0.001), respectively. This indicates that an increase in the discount rate three periods ago has a positive impact on Real GDP, while an increase from seven periods ago has a negative impact, reflecting delayed and potentially contrasting effects on economic growth.

3. **Lags of Money Supply**:

An rise in the money supply two periods ago has a positive influence on current Real GDP, perhaps via increasing economic activity, according to L(2) of Money Supply, which is statistically significant with a positive coefficient of 0.06663 and a p-value of 0.0278.L(8) and L(9) of Money Supply are significant with negative coefficients (-0.1115, p = 0.0149 and -0.13, p = 0.0028, respectively). This indicates that increases in money supply from eight and nine periods ago may have a contractionary effect on Real GDP, possibly due to inflationary pressures that reduce real output over time.

4. **Lags of Required Reserves**:

L(5) and L(6) of Required Reserves Ratio are significant, with coefficients of 7,645,653 (p = 0.0027) and -6,317,758 (p = 0.0076), respectively. This suggests that higher required reserves Ratio from five periods ago have a positive impact on Real GDP, possibly reflecting delayed economic stability effects, while higher reserves from six periods ago have a negative impact, potentially indicating restrictive policy effects.

The remaining lags of Real GDP, Discount Rate, Money Supply, and Required Reserves Ratio exhibit p-values above the 0.05 threshold, indicating they do not have a statistically significant effect on current Real GDP. These insignificant variables do not contribute substantially to explaining the variation in Real GDP and can be considered less influential in this model.

The model has a robust goodness of fit, with an R-squared (R^2) of 0.971 and an Adjusted R-squared (Adj R^2) of 0.94. This indicates that 97.1% of the variation in Real GDP is elucidated by the model, while 94% is elucidated when considering the number of predictors. The standard error of the regression (sigma) is 10,343,412, indicating a substantial degree of residual variability. The model's F-statistic of 31.48, accompanied by a p-value of 0.00000, further substantiates its overall importance, indicating that the predictors together account for a considerable percentage of the variance in Real GDP.

- **Long-Run and Bounds test**

Long-Run test

The long-run and bounds test was conducted to examine whether a long-term equilibrium relationship exists between the variables in the model. The results, as shown in Table 18, reveal the long run test:

Table 18 Long Run Test

Term	*Estimate*	*Std. Error*	*t value*	$Pr(>\|t\|)$
(Intercept)	4053441.0	940186.9	4.311315	0.000132
Discount Rate	-614628.9	2445130	-0.25137	0.803042
Money Supply M3	-0.0738	0.0802	-0.92038	0.363857
Required Reserves Ratio	343490.2	3613960	0.095045	0.924837

Source: Author's own work based on original data analysis.

Long-Run Coefficients:

The Intercept is statistically significant (Estimate = 4,053,441, p = 0.0001), However, this merely represents a baseline Real GDP level that is independent of monetary policy instruments.

The coefficients for Discount Rate (-614,628.9, p = 0.803), Money Supply (-0.0738, p = 0.364), and Required Reserves Ratio (343,490.2, p = 0.925) are all statistically insignificant. This suggests that, in the long run, changes in these variables do not have a meaningful impact on Real GDP .

Table 19 F Bounds Test

	Statistic	*Lower-bound*	*Upper-bound*	*alpha*	*P value*
F	-1.715824	-2.865049	-3.771319	0.05	0.7290768

Source: Author's own work based on original data analysis.

Bounds test:

Bounds testing yielded an F-statistic of -1.716, which is less than the lower limit of -2.865 at the 5% level of significance. Further proof that there is no statistical evidence for a long-run association among the variables is shown by the p-value of 0.729.

It seems from the data that the Discount Rate, Money Supply, Required Reserves, and Real GDP do not have a substantial connection in the long term. Therefore, the ARDL model shows that these monetary policy variables may impact Real GDP in the near term, but they do not have any long-term impact. Consequently, the focus should remain on the short-term dynamics captured by the ARDL model rather than on long-run impacts, as the data does not support a sustained relationship over time. This conclusion aligns with the findings from the first model, suggesting that the effects of monetary policy on economic output in Türkiye are primarily short-term rather than enduring.

Since the bounds test indicates no significant long-term relationship, the analysis will emphasize diagnostics and short-term dynamics of the ARDL model to enhance understanding of immediate effects and variable interactions.

- **Serial Correlation tests**

Table 20 serial correlation tests

Test	*Test statistic*	*P value*
Durbin-Watson	1.75	0.1952
Breusch-Godfrey	3.1793	0.07457

Source: Author's own work based on original data analysis.

The Durbin-Watson test reports a statistic of 1.75 with a p-value of 0.1952, suggesting no significant evidence of serial correlation in the residuals. This indicates that the residuals are reasonably independent across time, supporting the reliability of the model's estimates.

The Breusch-Godfrey test yields a test statistic of 3.1793 with a p-value of 0.07457, which is slightly above the conventional 0.05 threshold. Although close, this result indicates no strong evidence of serial correlation in the residuals.

- **Heteroscedasticity test**

Table 21 Heteroscedasticity tests

Test	*Test statistic*	*df*	*P value*
studentized Breusch-Pagan	20.898	36	0.979

Source: Author's own work based on original data analysis.

The studentized Breusch-Pagan test yields a test statistic of 20.898, with 36 degrees of freedom and a p-value of 0.979. The elevated p-value indicates a lack of evidence for heteroscedasticity, signifying that the residuals maintain a constant variance, which is crucial for obtaining unbiased and reliable parameter estimations.

- **Normality test**

Table 22 Normality tests

Test	*Test statistic*	*P value*
Shapiro-Wilk	0.96864	0.07261

Source: Author's own work based on original data analysis.

The Shapiro-Wilk test yields a test statistic of 0.96864 with a p-value of 0.07261. This outcome indicates that the residuals exhibit an approximately normal distribution, satisfying the normality assumption required for valid hypothesis testing in regression analysis.

- **Recursive CUSUM test**

The Recursive CUSUM test plot illustrates that the cumulative sum of residuals remains within the confidence bands over time, signifying model stability. This suggests that the ARDL model does not experience structural breaks or parameter instability, reinforcing its robustness. Consequently, the null hypothesis is supported, confirming that the regression coefficients remain stable over time.

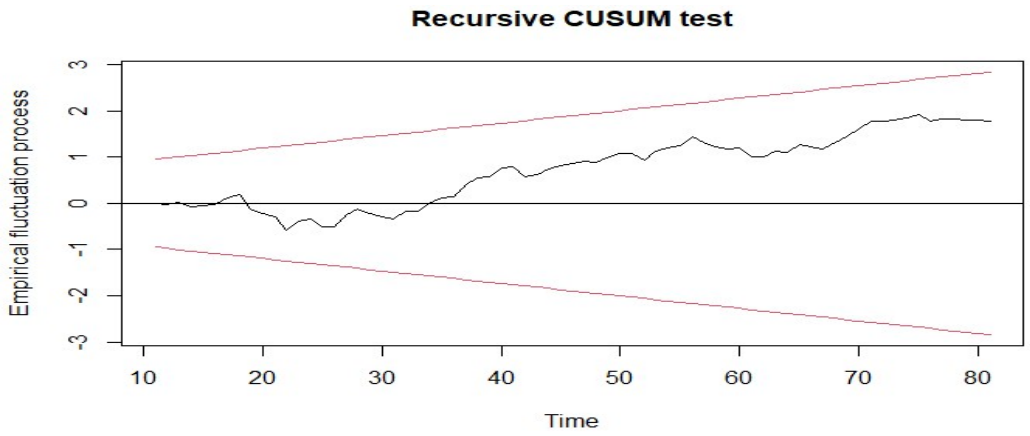

Figure 8 Recursive CUSUM Test

Source: Author's own work based on original data analysis.

- **Outliers Detection**

Null Hypothesis (H_0): There are no outliers present in the time series; the data follows its expected pattern without anomalies.

Alternative Hypothesis (H_1): There are outliers present in the time series; the data contains points that deviate significantly from the expected pattern.

Table 23 Time Series outliers detection test

Test	$\boldsymbol{sigma^2}$	***log likelihood***	***AIC***	***AICc***	***BIC***	***result***
Time series outliers	4.194e+13	-1213.78	2431.56	2431.74	2436.09	No outliers were detected

Source: Author's own work based on original data analysis.

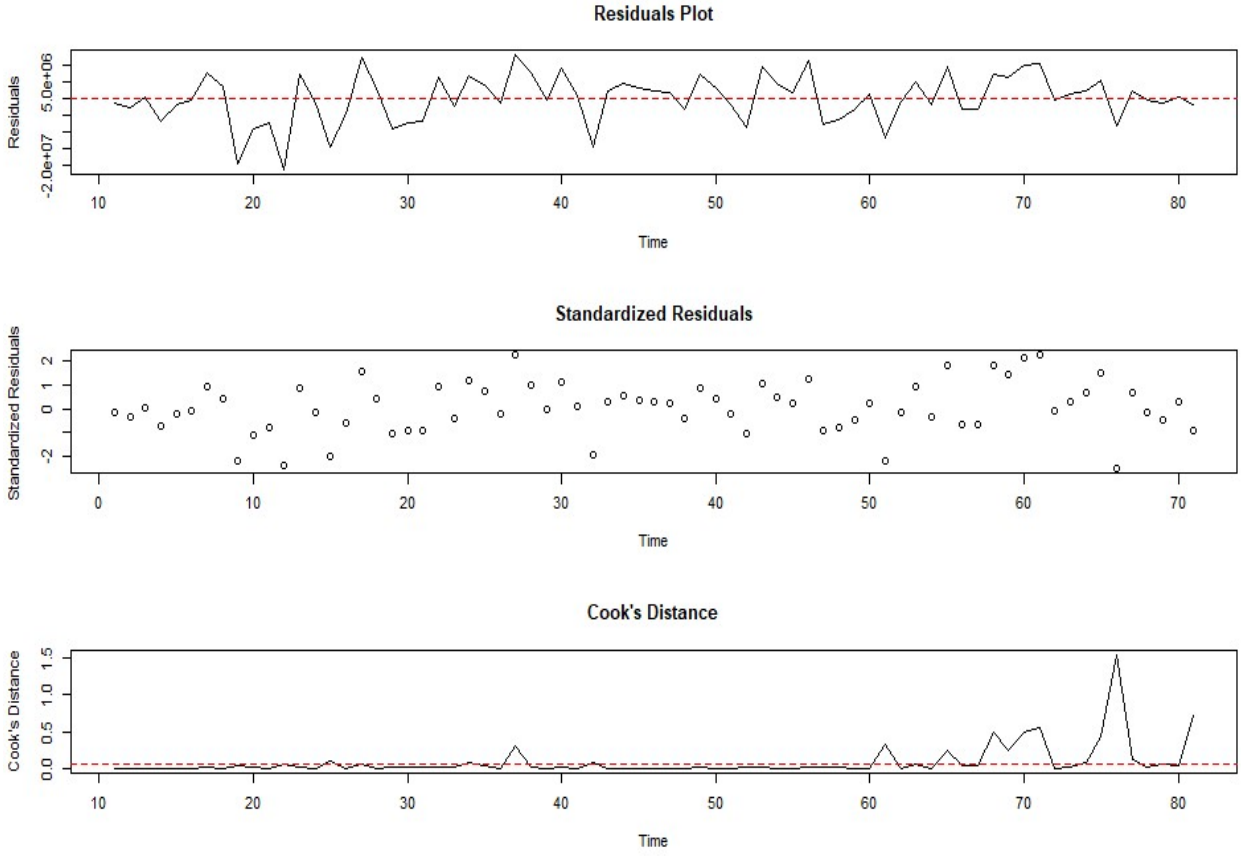

Figure 9 outlier Detection Plots

Source: Author's own work based on original data analysis.

The outlier diagnostics for the ARDL model applied to Real GDP were performed using multiple methods, including the Residuals Plot, Standardized Residuals Plot, Cook's Distance, and the Time Series Outliers (TSO) test.

1. **Time Series Outliers (TSO) Test**:

The TSO test reports a log-likelihood of -1213.78 and an AIC of 2431.56. No outliers were detected, confirming the stability and reliability of the model, affirming the robustness of the fit leads to accept the null hypothesis.

2. **Residuals Plot**:

The residuals plot shows no clear patterns or trends, indicating that the residuals are

randomly distributed around zero. This randomness suggests that the model is well-fitted without systematic biases.

3. **Standardized Residuals Plot**:

The standardized residuals also appear well within the bounds, with no values exceeding the typical threshold. This further supports the absence of extreme outliers or influential points that could disproportionately impact on the model's estimates.

4. **Cook's Distance**:

The graph of Cook's Distance illustrates that most observations have minimal influence, with values remaining below the threshold. A few points towards the end of the series show slightly elevated Cook's Distance values, but they remain within acceptable limits, suggesting no observations with an unduly high impact on the model.

In summary, all outlier detection methods indicate that the model is free from influential outliers, further validating the robustness and stability of the ARDL model's results. This absence of significant outliers supports the reliability of the model's insights into the short-term dynamics between Discount Rate, Money Supply, Required Reserves, and Real GDP.

The diagnostic tests confirm that the ARDL model is well-specified. There is no evidence of serial correlation, heteroscedasticity, or significant deviations from normality, and the model demonstrates stability over time. Although there is no long-term equilibrium link between the Discount Rate, Money Supply, and Required Reserves Ratio and Real GDP, these results provide credence to the ARDL model's short-term predictions.

- **Granger Causality Test**

To evaluate the predictive influence of past values of key monetary policy instruments (Discount Rate, Money Supply M3, and Required Reserves) on Real GDP fluctuations, Granger causality tests were applied.

Table 24 Granger Causality Test

variable	Models	F-stat	P value
DISC_RT	Model 1: R_GDP ~ L(R_GDP, 1:10) + L(DISC_RT, 1:10) Model 2: R_GDP ~ L(R_GDP, 1:10)	2.7078	0.0098
M3	Model 1: R_GDP ~ L(R_GDP, 1:10) + L(M3, 1:10) Model 2: R_GDP ~ L(R_GDP, 1:10)	1.3297	0.241
RR	Model 1: R_GDP ~ L(R_GDP, 1:10) + L(RR, 1:10) Model 2: R_GDP ~ L(R_GDP, 1:10)	1.806	0.0839

Source: Author's own work based on original data analysis.

The Granger causality tests were applied to assess whether lagged values of key monetary policy instruments could predict changes in Real GDP.

H0: The lagged values of the Discount Rate do not Granger-cause Real GDP.

H1 : The lagged values of the Discount Rate do Granger-cause Real GDP.

The findings for the Discount Rate demonstrated a substantial correlation. Model 1 included lags of Real GDP. The Discount Rate yielded an F-statistic of 2.7078 and a p-value of 0.009771, which is below the 0.01 significance threshold. This enables us to exclude the null hypothesis and indicates that the Discount Rate Granger-causes Real GDP. In other terms, historical values of the Discount Rate provide considerable forecasting capability for short-term fluctuations in Real GDP.

H0: The lagged values of the Money Supply do not Granger-cause Real GDP.

H1 : The lagged values of the Money Supply do Granger-cause Real GDP.

The examination of Money Supply (M3) produced varying outcomes. In the Model, which included delays of Real GDP and M3, the F-statistic was 1.3297 with a p-value of 0.241, above the 0.05 significance criterion. This signifies that we do not reject the null hypothesis, suggesting that Money Supply (M3) does not demonstrate Granger causation with Real GDP. Consequently,

historical values of M3 lack substantial forecasting capability for short-term variations in Real GDP.

H0: The lagged values of the Required Reserves Ratio do not Granger-cause Real GDP.

H1 : The lagged values of the Required Reserves Ratio do Granger-cause Real GDP.

The experiment concerning the Required Reserves Ratio had inconclusive results. The F-statistic was 1.8054, with a p-value of 0.08388, beyond 0.05. This signifies that we do not reject the null hypothesis, implying that the Required Reserves Ratio does not Granger-cause Real GDP.

In summary, the results show that while the Discount Rate has a significant short-term predictive relationship with Real GDP, Money Supply (M3) and Required Reserves Ratio not significant. These findings imply that certain monetary policy variables may influence Real GDP in the short run, but their long-term impact might not be significant.

Third hypothesis the Discount Rate, Money Supply, and Required Reserves Ratio have a significant impact on the Inflation Rate.

7.5.3. Modeling Approach: ARDL Model

This study employed the ARDL bounds testing approach to analyze the long- and short-run relationship between GDP and monetary policy indicators. The ARDL model effectively addresses concerns related to both spurious and genuine regressions in time series data. In this study, the optimal lag structure was determined using the AIC criterion, with a maximum of 10 lags specified in the auto ARDL process to identify the best model. The 10 lags were chosen as maximum since Increasing the number of lags beyond 10 could excessively reduce the degrees of freedom, potentially compromising the model's reliability and statistical power. This approach allows for a robust analysis while maintaining the validity of the result. This model had, with Inflation Rateas the dependent variable and Discount Rate, Money Supply, and Required Reserves Ratio as predictors, yielded an optimal lag configuration. The empirical results for this ARDL model are presented in Table 25

H_0: The Discount Rate, Money Supply, and Required Reserves does not have a significant impact on Inflation Rate.

H_1: The Discount Rate, Money Supply, and Required Reserves have a significant impact on Inflation Rate.

The ARDL model excluded the Required Reserves Ratio and all its lags since all of them were significant and the optimal doesn't require the existence of the Required Reserves.

Table 25 ARDL model for Consumer Price Index

term	*estimate*	*std. error*	*statistic*	*P value*
(Intercept)	1.88×10^{-1}	2.16×10^{-1}	0.8693	0.3882
L(CPI, 1)	-3.49×10^{-1}	1.17×10^{-1}	-2.9889	0.0041**
L(CPI, 2)	-4.70×10^{-1}	1.21×10^{-1}	-3.8977	0.0003***
L(CPI, 3)	-4.01×10^{-1}	1.12×10^{-1}	-3.5824	0.0007***
L(CPI, 4)	4.01×10^{-1}	1.16×10^{-1}	3.4612	0.0010**
DISC_RT	3.32×10^{-1}	8.70×10^{-2}	3.8215	0.0003***
M3	3.76×10^{-9}	1.76×10^{-9}	2.1402	0.0366*
L(M3, 1)	6.00×10^{-9}	2.39×10^{-9}	2.5085	0.0149*
L(M3, 2)	1.74×10^{-9}	1.97×10^{-9}	8.8611	0.0000***
L(M3, 5)	-6.80×10^{-9}	3.17×10^{-9}	-2.1459	0.0361*
L(M3, 6)	-2.02×10^{-8}	3.29×10^{-9}	-6.1529	0.0000***
L(M3, 7)	-1.98×10^{-8}	4.52×10^{-9}	-4.3799	0.0001***

Source: Author's own work based on original data analysis.

*Only statistically significant variables ($p < 0.05$) are included in the table. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

Table 26 Goodness of fit Measures

R^2	*Adj* R^2	*Sigma*	*statistic*	*P value*	*df*	*Df residual*	*n*
0.856	0.821	1.66	24.656	0.00000	14	58	73

Source: Author's own work based on original data analysis.

The ARDL model examines the short-term effects of Discount Rate, lags of Money Supply on lags of Inflation Rate . Here are the key findings:

$$\begin{aligned}\widehat{CPI}_t = \; & 1.88 \times 10^{-1} + (-3.49 \times 10^{-1})\text{L(CPI, 1)} + (-4.70 \times 10^{-1})\text{L(CPI, 2)} \\ & +(-4.01 \times 10^{-1})\text{L(CPI, 3)} + (4.01 \times 10^{-1})\text{ L(CPI, 4)} + (3.32 \times 10^{-1})\text{DISC}_{\text{RT}} \\ & +(3.76 \times 10^{-9})\text{M3} + (6.00 \times 10^{-9})\text{ L(M3,1)} + (1.74 \times 10^{-9})\text{ L(M3,2)} + (4.29 \times 10^{-9})\text{ L(M3,3)} \\ & +(-4.13 \times 10^{-11})\text{ L(M3,4)} + (-6.80 \times 10^{-9})\text{ L(M3,5)} + (-2.02 \times 10^{-8})\text{ L(M3,6)} \\ & +(-1.98 \times 10^{-8})\text{ L(M3,7)} + (-8.35 \times 10^{-9})\text{ L(M3,8)}\end{aligned}$$

ε_t (for t = 1, 2, 3, …, T): This is the stochastic error term for the ECM model, representing random disturbances that are not explained by the model variables.

Lags of Inflation Rate:

L(1), L(2), and L(3) of CPI have significant negative coefficients (-0.35, -0.47, and -0.40, respectively) with p-values of 0.0041, 0.0003, and 0.0007. This indicates a significant negative impact of previous CPI values on the current CPI, suggesting an adjustment process where past CPI values contribute to moderating current inflation levels. This could imply that inflationary pressures are being countered by historical data.

L(4) of CPI has a significant positive coefficient (0.40) with a p-value of 0.0010. This suggests that CPI from four periods ago has a delayed positive effect on current CPI, possibly reflecting inflationary cycles where past price changes contribute to a current rise in the CPI after a certain period.

Discount Rate:

The present Discount Rate has a substantial positive correlation (0.33) with a p-value of 0.0003, signifying that an elevated discount rate correlates with a rise in the Consumer Price Index (CPI). This study may indicate that elevated interest rates contribute to inflation, maybe by transferring greater borrowing costs to consumers or firms.

Money Supply:

The present Money Supply (M3) has a little but statistically significant positive impact on the Consumer Price Index (CPI), with a p-value of 0.0366. This indicates that an increase in the money supply, even when calibrated to thousands, correlates with a modest rise in the inflation rate, aligning with economic theories that connect an expanding money supply to inflationary pressure.

L(1) and L(2) of M3 also have significant positive coefficients with p-values of 0.0149 and 0.0000, respectively. These results support the notion that fluctuations in the money supply

exert a lagged effect, contributing to CPI increases over the following periods. This suggests that monetary policy adjustments take time to fully manifest in the economy, affecting prices gradually.

L(5), L(6), and L(7) of M3 have significant negative coefficients with p-values of 0.0361, 0.0000, and 0.0001, respectively. This indicates that increases in money supply five, six, and seven periods ago lead to a reduction in CPI. This could represent a delayed deflationary effect as the economy absorbs and adjusts to prior expansions in money supply, reducing inflation after the initial inflationary pressures subside.

The Intercept and L(3), L(4), and L(8) of Money Supply possess p-values beyond 0.05, indicating their lack of a statistically significant effect on CPI within this model. These insignificant variables suggest that some periods' money supply changes do not directly contribute to fluctuations in the CPI, possibly due to varying lags in monetary transmission effects.

- The model has a robust fit, with an R-squared (R^2) value of 0.856 and an Adjusted R-squared (Adj R^2) value of 0.821. Approximately 85.6% of the variation in CPI is explained by the model, and 82.1% when corrected for the number of variables. The standard error of the regression (sigma) is 1.66, signifying the average divergence of the observed CPI values from the predicted values of the model. The model's F-statistic is 24.656 with a p-value of 0.00000, indicating that the predictors jointly account for a substantial fraction of the variance in CPI.
- **Long-Run and Bounds test**

Long-Run test

A long-term equilibrium connection between the model's variables was examined using the long-run and bounds test. The results of the long run test are shown in Table 27:

Table 27 Long Run Test

Term	*Estimate*	*Std. Error*	*t value*	$Pr(>\|t\|)$
(Intercept)	0.1031	0.1190	0.8657	0.3902
Discount Rate	0.1826	0.0624	2.9281	0.00487
Money Supply M3	0.0000	0.0000	-2.6714	0.00979

Source: Author's own work based on original data analysis.

The long-run estimation and bounds test results for the third model provide evidence of a significant long-term relationship between Inflation Rate and the independent variables Discount Rate, and Money Supply.

The results show that the discount rate is positively related to inflation, with a coefficient of 0.1826 and a p-value of 0.00487, which is statistically significant. Elevated interest rates contribute to inflationary pressures by raising borrowing costs, which can ultimately be transferred to consumer prices because they make borrowing money more expensive, which is passed on to consumers in the form of higher prices.

The Money Supply has a notable, though minimal, negative coefficient, with an estimated effect of 0.0000 (presumably a negligible value) and a p-value of 0.00979. This indicates that an augmentation in the money supply may have a marginal deflationary influence on the Inflation Rate over the long run. This outcome may suggest that, over time, an augmented money supply ultimately stabilizes prices via enhanced production capacity or economic adjustments.

Bounds test:

Table 28 F Bounds Test

	Statistic	*Lower-bound*	*Upper-bound*	*alpha*	*P value*
F	14.8701	3.790645	4.806771	0.05	0.0000

Source: Author's own work based on original data analysis.

The F-bound test findings indicate an F-statistic of 14.8701, which substantially above the upper limit critical value of 4.806771 at the 5% significance level. The p-value of 0.0000 indicates a substantial strong long-term association among the variables analyzed. The results indicate that the Discount Rate and Money Supply together have a persistent effect on the Inflation Rate, underscoring the existence of a long-term equilibrium relationship.

Assuming the limits test has shown the existence of a statistically significant long-run connection, the next step is to diagnose and evaluate the ARDL model to ensure its assumptions and robustness. After that, we will use the Error Correction Term (ECT) model to delve further into the dynamics in the short run and the pace of adjustment to the long run equilibrium, illuminating all the interplay between the variables.

- **Serial Correlation tests**

Table 29 serial correlation tests

Test	*Test statistic*	*P value*
Durbin-Watson	2.1894	0.7849
Breusch-Godfrey	2.2944	0.1298

Source: Author's own work based on original data analysis.

The Durbin-Watson test yields a statistic of 2.1894 with a p-value of 0.7849, indicating no significant evidence of serial correlation in the residuals. This suggests that the residuals are independent across observations, which supports the validity of the model's estimates.

The Breusch-Godfrey test reports a test statistic of 2.2944 with a p-value of 0.1298, further indicating no significant serial correlation in the residuals.

- **Heteroscedasticity test**

Table 30 Heteroscedasticity tests

Test	*Test statistic*	*df*	*P value*
studentized Breusch-Pagan	11.721	14	0.6287

Source: Author's own work based on original data analysis.

The studentized Breusch-Pagan test results in a test statistic of 11.721 with 14 degrees of freedom and a p-value of 0.6287. This high p-value indicates no evidence of heteroscedasticity, suggesting that the residuals have constant variance, which is essential for reliable and unbiased parameter estimates.

- **Normality test**

Table 31 Normality tests

Test	*Test statistic*	*P value*
Shapiro-Wilk	0.97786	0.227

Source: Author's own work based on original data analysis.

The Shapiro-Wilk test yields a test statistic of 0.97786 with a p-value of 0.227, suggesting that the residuals exhibit an approximate normal distribution. This finding supports the assumption of normality, which is essential for ensuring the validity of hypothesis testing within the ARDL model.

- **Recursive CUSUM test**

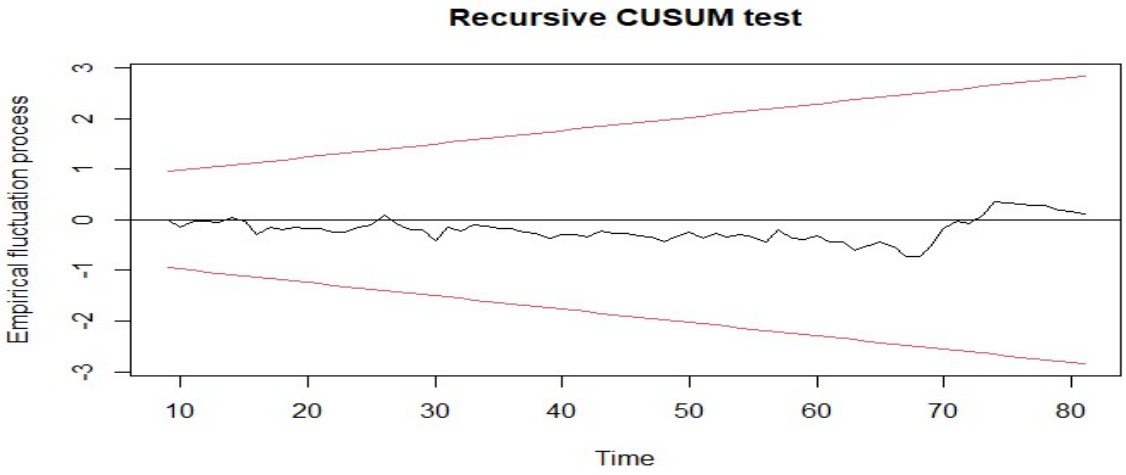

Figure 10 Recursive CUSUM test

Source: Author's own work based on original data analysis.

The Recursive CUSUM test plot shows that the cumulative sum of the residuals remains well within the confidence bands over time, indicating that the model maintains stability throughout the entire sample period. This stability suggests no structural breaks or parameter instability, further supporting the reliability of the model thus we accept the null hypothesis that the regression coefficients are stable over time.

- **Outliers Detection**

Table 32 Time Series outliers detection test

Test	$\boldsymbol{sigma^2}$	$\boldsymbol{log\ likelihood}$	***AIC***	***AICc***	***BIC***	***result***
Time series outliers	1.697	-121.94	249.89	250.24	256.76	No outliers were detected

Source: Author's own work based on original data analysis.

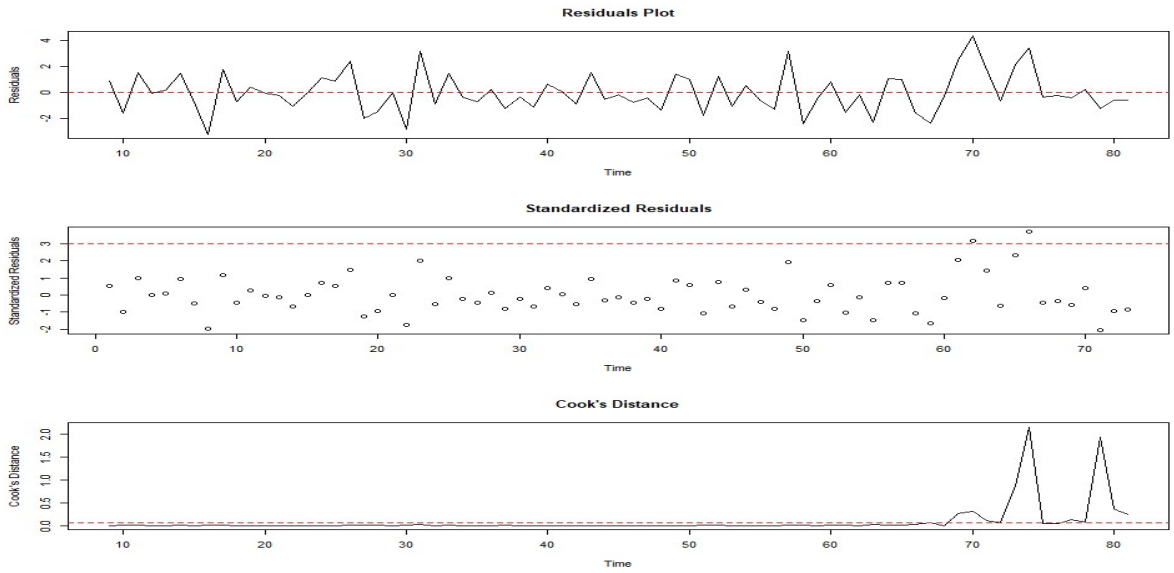

Figure 11 Outliers Detection plots

Source: Author's own work based on original data analysis.

The outlier diagnostics for the ARDL model with the Inflation Rate as the dependent variable provide further confirmation of the model's stability and reliability. Multiple methods were employed to detect outliers, including Residuals Plot, Standardized Residuals Plot, Cook's Distance, and a Time Series Outliers (TSO) Test.

1. Residuals Plot: The residuals plot shows no clear patterns or trends, indicating that the residuals are randomly distributed around zero. This randomness suggests that the model captures the underlying relationship without any systematic bias or trend.
2. Standardized Residuals Plot The standardized residuals are mostly within expected bounds, with only a few points approaching but not crossing the critical threshold. This indicates that the residuals are well-behaved, with no extreme outliers, reinforcing the model's robustness.
3. Cook's Distance: The graph of Cook's Distance shows that most observations have minimal influence on the model, with values remaining well below the threshold. There are slight increases towards the end of the series, but these remain within acceptable limits, suggesting that no data points have an undue influence on the model's estimates.
4. **Time Series Outliers (TSO) Test** The TSO test reports a log-likelihood of -121.94 and an AIC of 249.89. No outliers were detected, confirming the stability and reliability of the model in

capturing the relationship without significant anomalies or influential points, affirming the robustness of the fit leads to accepting the null hypothesis

The ARDL model for Inflation Rate is found to meet all critical assumptions, according to the diagnostic tests. Throughout the time series, the model remains stable, and no signs of serial correlation, heteroscedasticity, or major departures from normality are identified. The absence of significant outliers, as shown by outlier diagnostics, lends credence to the reliability and validity of the model's conclusions. This study's findings provide the groundwork for further research into the relationship between the money supply, required reserves ratio, discount rate, and inflation rate, as well as its short- and long-term impacts.

7.5.4. Long-Run Model

With these assumptions validated, we can confidently proceed to incorporate the Error Correction Term (ECT) model to assess the speed of adjustment toward the long-term equilibrium. This analysis will allow us to capture both the immediate impacts of the variables and the rate at which any deviations from the long-run relationship are corrected over time.

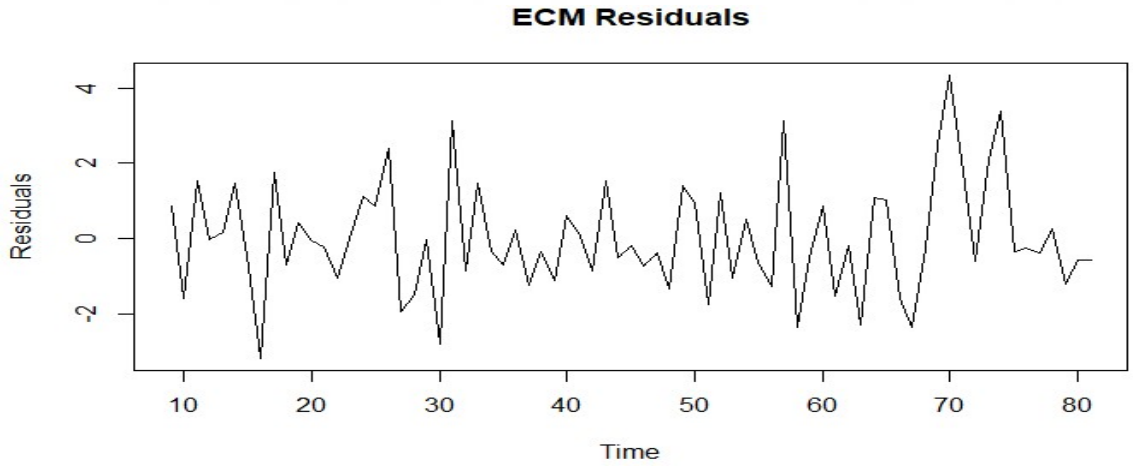

Figure 12 ECM Residuals

Source: Author's own work based on original data analysis.

$$\begin{aligned}\mathrm{CPI}_t = \; & \alpha + \beta_1\,\mathrm{L(CPI,1)} + \gamma \mathrm{DISC_{RT}} + \delta_1\,\mathrm{L(M3,1)} + \theta_1\,\mathrm{d}\big(\,\mathrm{L(CPI,1)}\big) + \theta_2\,\mathrm{d}\big(\,\mathrm{L(CPI,2)}\big) \\ & + \theta_3\,\mathrm{d}\big(\,\mathrm{L(CPI,3)}\big) + \mu_1\,\mathrm{d(M3)} + \mu_2\,\mathrm{d}\big(\,\mathrm{L(M3,1)}\big) + \mu_3\,\mathrm{d}\big(\,\mathrm{L(M3,2)}\big) + \mu_4\,\mathrm{d}\big(\,\mathrm{L(M3,3)}\big) \\ & + \mu_5\,\mathrm{d}\big(\,\mathrm{L(M3,4)}\big) + \mu_6\,\mathrm{d}\big(\,\mathrm{L(M3,5)}\big) + \mu_7\,\mathrm{d}\big(\,\mathrm{L(M3,6)}\big) + \mu_8\,\mathrm{d}\big(\,\mathrm{L(M3,7)}\big) + \phi\ \mathrm{lagged\_ect} + \varepsilon_t\end{aligned}$$

α: This is the intercept term, representing the constant in the regression model. It captures the baseline value of CPI when all other variables are zero.

β: The coefficient for the lagged value of CPI (L(CPI, 1)). It represents the long-term effect of the first lag of CPI on the current CPI.

γ: The coefficient for the contemporaneous value of DISC_RT (Discount Rate). It indicates the immediate impact of the discount rate on CPI.

δ_1 : The coefficient for the first lagged value of M3 (L(M3, 1)). It represents the effect of the first lag of the money supply on the current CPI in the long term.

θ_i(for i = 1, 2, 3): These are the coefficients for the differenced lagged values of CPI. θ_1 represents the effect of the first differenced lag (d(L(CPI, 1))), θ_2 represents the effect of the second differenced lag (d(L(CPI, 2))), and θ_3 represents the effect of the third differenced lag (d(L(CPI, 3))). These capture the short-term dynamics of past changes in CPI on the current CPI.

μ_i (for i = 1, 2, 3, …, 7): These are the coefficients for the differenced values of M3 and its lags. μ_1 represents the effect of the change in M3 (d(M3)), and μ_2 to μ_8 represent the effects of the differenced lags of M3 (e.g., d(L(M3, 1)), d(L(M3, 2)), etc.). These coefficients capture the short-term impacts of changes in the money supply on the current CPI.

ϕ : The coefficient for the lagged error correction term (lagged_ect). It measures the speed of adjustment toward long-term equilibrium after a short-term disturbance. A significant ϕ indicates that deviations from the long-term relationship are corrected over time.

ε_t (for t = 1, 2, 3, …, T): This is the stochastic error term for the ECM model, representing random disturbances that are not explained by the model variables.

Table 33 ECM Regression

Term	***estimate***	***std.error***	***statistic***	***P value***
(Intercept)	1.83×10^{-1}	2.16×10^{-1}	0.8503	0.3987
L(CPI, 1)	-1.97	3.95×10^{-1}	-4.9963	0.0000***
DISC_RT	2.87×10^{-1}	9.73×10^{-2}	2.9497	0.0046**
d(L(CPI, 3))	-3.87×10^{-1}	1.17×10^{-1}	-3.3218	0.0016**
d(M3)	4.35×10^{-9}	1.84×10^{-9}	2.3583	0.0218*

d(L(M3, 1))	3.37×10^{-8}	8.97×10^{-9}	3.7539	0.0004***
d(L(M3, 2))	5.14×10^{-8}	9.64×10^{-9}	5.3321	0.0000***
d(L(M3, 3))	5.65×10^{-8}	9.38×10^{-9}	6.0283	0.0000***
d(L(M3, 4))	5.75×10^{-8}	9.67×10^{-9}	5.9412	0.0000***
d(L(M3, 5))	5.13×10^{-8}	1.03×10^{-8}	4.9670	0.0000***
d(L(M3, 6))	2.99×10^{-8}	8.67×10^{-9}	3.4414	0.0011**
d(L(M3, 7))	8.95×10^{-9}	4.47×10^{-9}	2.0029	0.0500*

Source: Author's own work based on original data analysis.

*Only statistically significant variables ($p < 0.05$) are included in the table. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*

Table 34 ECM Goodness of fit

R^2	*Adj* R^2	*sigma*	*statistic*	*P value*	*df*	*Df residual*	*n*
0.945	0.930	1.66	64.9	0.0000	15	57	73

Source: Author's own work based on original data analysis.

The Error Correction Term (ECT), labeled as lagged_ect, has an estimate of 0.54 with a p-value of 0.3029, indicating it is not statistically significant. This suggests that deviations from the long-term equilibrium do not significantly influence the speed of adjustment in the short term. The lack of significance in the ECT implies that the model's adjustment toward the long-run equilibrium may be minimal or slow, with short-term dynamics primarily driving the relationship between **CPI** and the independent variables in the short run.

$$\widehat{CPI}_t = 1.83 \times 10^{-1} - 1.97e^{0}\ \mathrm{L(\ CPI,\ 1)}\ + 2.87 \times 10^{-1}\ \mathrm{DISC\_RT}\ - 1.60 \times 10^{-8}\ \mathrm{L(M3,1)} + 5.69 \times 10^{-1}\ \mathrm{d(\ L(\ CPI,\ 1)\ )} + 6.74 \times 10^{-2}\ \mathrm{d(\ L(\ CPI,\ 2)\ )} - 3.87 \times 10^{-1}\ \mathrm{d(\ L(\ CPI,\ 3)\ )} + 4.35 \times 10^{-9}\ \mathrm{d(M3)} + 3.37 \times 10^{-8}\ \mathrm{d(\ L(M3,1))} + 5.14 \times 10^{-8}\ \mathrm{d(\ L(M3,2))} + 5.65 \times 10^{-8}\ \mathrm{d(\ L(M3,3))} + 5.75 \times 10^{-8}\ \mathrm{d(\ L(M3,4))} + 5.13 \times 10^{-8}\ \mathrm{d(\ L(M3,5))} + 2.99 \times 10^{-8}\ \mathrm{d(\ L(M3,6))} + 8.95 \times 10^{-9}\ \mathrm{d(\ L(M3,7))} + 5.44 \times 10^{-1}\ \mathrm{lagged\_ect}$$

1. **Lags of Inflation Rate**:

L(CPI, 1) has a significant negative coefficient of -1.97 ($p < 0.0001$), indicating a strong negative effect of the previous period's CPI on the current CPI. This negative relationship suggests a corrective adjustment where high CPI values in the previous period tend to be followed by a reduction in the current period.

d(L(CPI, 3)) has a significant negative coefficient of -0.39 ($p = 0.0016$), indicating that the CPI from three periods ago also negatively influences the current CPI in the short term. This further supports the corrective nature of CPI adjustments, with past values playing a stabilizing role.

2. **Discount Rate**:

The current Discount Rate has a significant positive coefficient of 0.29 (p = 0.0046), suggesting that increases in the discount rate are associated with a rise in CPI in the short term. This aligns with the idea that higher interest rates might lead to inflationary pressures by increasing borrowing costs that are then passed on in prices.

3. **Changes in Money Supply**:

d(M3) and several of its lags are highly significant:

d(M3) has a positive coefficient (p = 0.0218), indicating that an increase in money supply has an immediate inflationary impact on CPI.

d(L(M3, 1)), d(L(M3, 2)), d(L(M3, 3)), d(L(M3, 4)), d(L(M3, 5)), d(L(M3, 6)), and d(L(M3, 7)) are all significant, with p-values below 0.05, showing that changes in money supply continue to impact CPI for up to seven periods. The positive coefficients across these lags indicate persistent short-term inflationary pressures following increases in money supply, aligning with the expectation that an expanded money supply can lead to rising prices.

The following variables were found to be statistically insignificant:

Intercept (p = 0.3987): The baseline effect, independent of the predictors, is not significant, suggesting it has minimal impact on CPI.

L(M3, 1) (p = 0.1321): The first lag of money supply was not significant, possibly due to the stronger influence of the current value and later lags.

d(L(CPI, 1)) (p = 0.0586) and d(L(CPI, 2)) (p = 0.7494): The first and second differences in lagged CPI values do not significantly impact the current CPI, indicating that only certain lags of CPI play a role in short-term adjustments.

To ensure the robustness of these findings, diagnostic tests will be conducted to validate the model's assumptions, including tests for serial correlation, heteroscedasticity, normality of

residuals, and model stability. These diagnostics will provide additional confirmation that the model accurately captures the short-term dynamics influencing CPI.

- **Serial Correlation tests**

Table 35 serial correlation tests

Test	*Test statistic*	*P value*
Durbin-Watson	2.5315	0.7649
Breusch-Godfrey	1.3647	0.2427

Source: Author's own work based on original data analysis.

There is no significant evidence of serial correlation in the residuals, as shown by the Durbin-Watson test, which produces a statistic of 2.5315 with a p-value of 0.7649. This provides further evidence that the ECM's estimations are reliable and implies that the residuals are independent across observations.

The Breusch-Godfrey test reports a test statistic of 1.3647 with a p-value of 0.2427, further supporting the absence of serial correlation.

- **Heteroscedasticity test**

Table 36 Heteroscedasticity tests

Test	*Test statistic*	*df*	*P value*
studentized Breusch-Pagan	11.841	15	0. 6911

Source: Author's own work based on original data analysis.

The studentized Breusch-Pagan test yields a test statistic of 11.841, accompanied with 15 degrees of freedom and a p-value of 0.6911. The elevated p-value signifies a lack of evidence for heteroscedasticity, implying that the residuals exhibit constant variance, which is crucial for obtaining unbiased parameter values.

- **Normality test**

Table 37 Normality tests

Test	*Test statistic*	*P value*
Shapiro-Wilk	0.97916	0.2687

Source: Author's own work based on original data analysis.

The Shapiro-Wilk test yields a test statistic of 0.97916 and a p-value of 0.2687, suggesting that the residuals are almost normally distributed. This corroborates the assumption of normalcy, essential for accurate inference in the ECM.

- **Recursive CUSUM test**

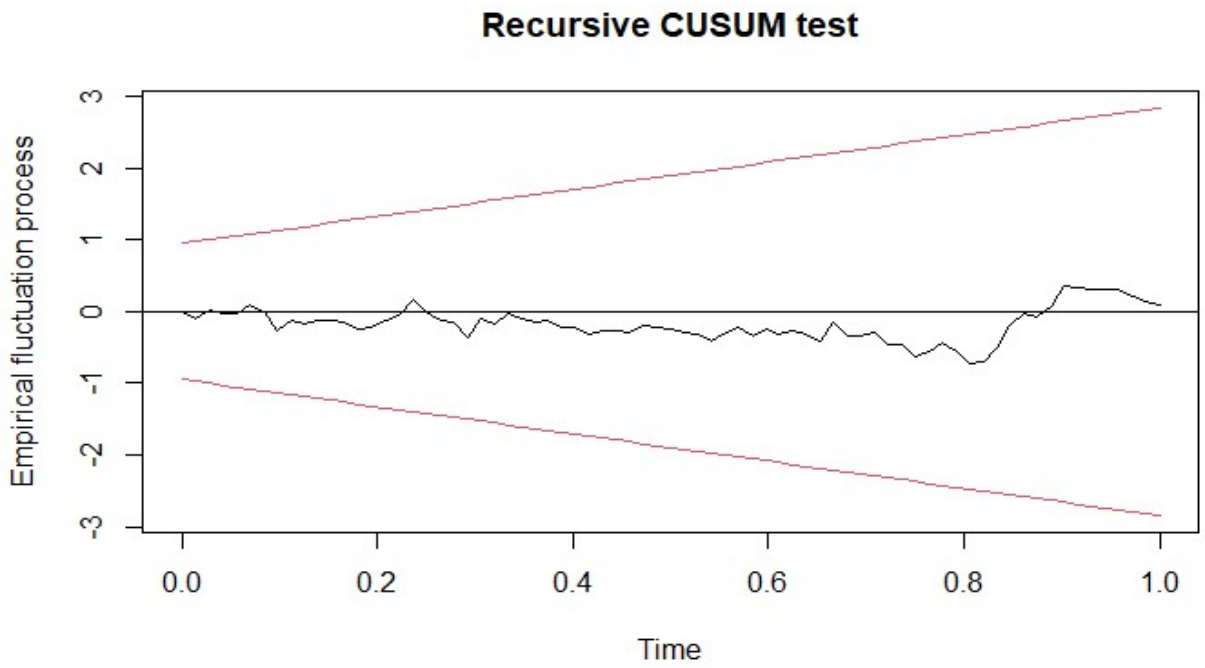

Figure 13 Recursive CUSUM test

Source: Author's own work based on original data analysis.

The Recursive CUSUM test plot demonstrates that the cumulative sum of the residuals stays within the confidence bands, indicating that the model maintains stability throughout sample time. This stability indicates that the ECM remains resilient over time, exhibiting no substantial structural changes; hence, we accept the null hypothesis that the regression coefficients are constant over time.

- **Breakpoint Test**

H_0: There is no structural break in the time series; the model parameters remain constant over time.

H_1: There is at least one structural break in the time series; the model parameters change at some point(s) over time.

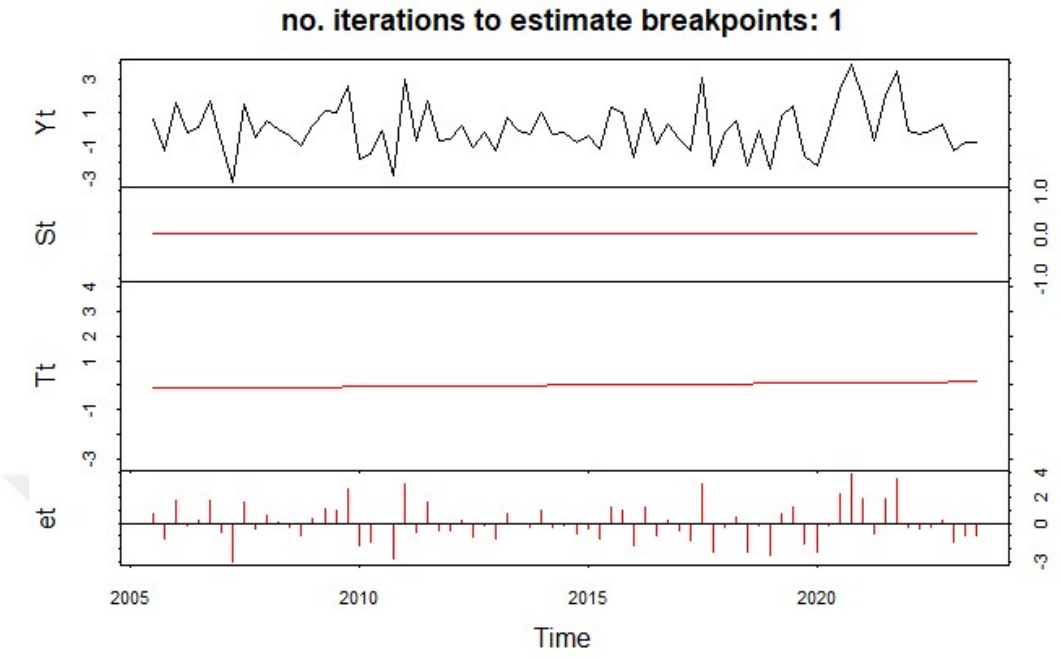

Figure 14 Breakpoint Test

Source: Author's own work based on original data analysis.

The Breakpoint Test indicates only one detected breakpoint, and the residual fluctuations (et) remain largely stable across time, showing no significant structural breaks, we reject the null hypothesis. This further supports the ECM's stability.

These diagnostic tests confirm that the ECM satisfies key assumptions. There is no evidence of serial correlation, heteroscedasticity, or deviations from normality, and the model remains stable throughout the period. These results validate the robustness of the ECM, providing a solid foundation for interpreting the short-term dynamics and speed of adjustment toward the long-term equilibrium for Inflation Rate in response to Discount Rate, Money Supply, and Required Reserves.

- **Granger Causality Test**

The study used Granger causality tests to see whether the Discount Rate, Money Supply M3, and Required Reserves—three important monetary policy variables—can predict future changes in the inflation rate.

Table 38 Granger Causality Test

Variable	Models	F-stat	P value
DISC_RT	Model 1: CPI ~ L(CPI, 1:10) + L(DISC_RT, 1:10) Model 2: CPI ~ L(CPI, 1:10)	1.6334	0.1243
M3	Model 1: CPI ~ L(CPI, 1:10) + L(M3, 1:10) Model 2: CPI ~ L(CPI, 1:10)	17.103	0.0000

Source: Author's own work based on original data analysis.

We used Granger causality tests to see whether important monetary policy variables' lagged values might foretell how the inflation rate would change.

H0: The lagged values of the Discount Rate do not Granger-cause Inflation Rate.

H1 : The lagged values of the Discount Rate do Granger-cause Inflation Rate.

The outcome analyzes the correlation between the Inflation Rate and the Discount Rate. Model 1, including lags of both the Inflation Rate and the Discount Rate, was juxtaposed with Model 2, which only contained lags of the Inflation Rate. The F-statistic was 1.6334, accompanied by a p-value of 0.1243, above the 0.05 significance threshold. This outcome indicates that we do not reject the null hypothesis, suggesting that the Discount Rate does not Granger-cause the Inflation Rate. In other terms, past values of the Discount Rate lack substantial forecasting capability about fluctuations in the Inflation Rate.

H0: The lagged values of the Money Supply do not Granger-cause Inflation Rate.

H1 : The lagged values of the Money Supply do Granger-cause Inflation Rate.

The second Granger causality test indicated a substantial correlation between the Inflation Rate and Money Supply. Model 1, including delays of both the Inflation Rate and Money Supply, was contrasted with Model 2, which contained solely lags of the Inflation Rate. The F-statistic was 17.103, accompanied by a p-value of 6.496e-13, indicating substantial significance at the 0.001 level. This enables us to exclude the null hypothesis and indicates that the Money Supply Granger-causes the Inflation Rate. This suggests that past values of Money Supply possess substantial predictive capability about fluctuations in Inflation Rate, indicating that changes in the money supply may profoundly influence inflation as quantified by the Inflation Rate.

The Granger causality tests indicate that while the Discount Rate does not have significant predictive power for changes in the Inflation Rate, Money Supply (M3) does. The results show that past values of Money Supply (M3) have a strong and significant effect on predicting changes in Inflation Rate, suggesting its important role in influencing inflation, whereas the Discount Rate does not show such an impact.

8. RESULTS AND DISCUSSION

8.1. According to Descriptive analysis, the monetary policy instruments studied show significant fluctuations over time. The discount rate experiences large changes, the money supply exhibits wide variations, while the required reserve ratio shows relative stability. These variables play a role in influencing economic growth. The economic growth indicators show significant changes in GDP at current prices, while the real GDP appears more stable. The inflation rate experiences noticeable fluctuations.

8.2. Results For the First hypothesis: The Discount Rate, Money Supply, and Required Reserves have a significant impact on the Gross Domestic Product (GDP):

8.2.1. Based on the results, in the short run:

The results do not support the null hypothesis (H_0) and support the alternative hypothesis (H_1), which states that the Discount Rate, Money Supply, and Required Reserves have a significant impact on the Gross Domestic Product (GDP). The lagged values of these variables demonstrate significant effects on Türkiye's GDP, with the model explaining approximately (Adjusted) 98.2% of the variation in GDP. Furthermore, Granger causality tests show that Money Supply and Required Reserves can predict short-term economic fluctuations, highlighting their substantial role in influencing the economy in the short term. The Discount Rate did not show a Granger-causal relationship, implying that while it influences GDP, it does not provide predictive power in this context.

8.2.2. Based on the results, in the long run:

The results support the null hypothesis (H_0), which states that the Discount Rate, Money Supply, and Required Reserves have no significant impact on the Gross Domestic Product (GDP)

8.3. Results For the Second hypothesis: the Discount Rate, Money Supply, and Required Reserves have a significant impact on the Real Gross Domestic Product (GDP).

8.3.1. Based on the results, in the short runt:

The results do not support the null hypothesis (H_0) and support the alternative hypothesis (H_1), which states that the Discount Rate, Money Supply, and Required Reserves have a significant impact on the Real Gross Domestic Product (GDP), The findings suggest that Discount Rate, Money Supply, and Required Reserves do have significant short-term impacts on Real GDP supporting study hypothesis. The lagged values of these variables demonstrate significant effects on Türkiye's Real GDP, with the model explaining approximately (Adjusted) 94% of the variance in Real GDP. The Granger causality tests revealed that the Discount Rate has strong predictive power for short-term changes in Real GDP, indicating a significant short-term relationship. Required Reserves demonstrated a borderline effect, suggesting limited but potential predictive power, while Money Supply (M3) did not show a significant Granger-causal relationship with Real GDP, implying that it may not be a strong predictor for short-term fluctuations.

8.3.2. Based on the results, in the long run:

The results support the null hypothesis (H_0), which states that the Discount Rate, Money Supply, and Required Reserves have a no significant impact on the Real Gross Domestic Product (GDP).

8.4. Results For the Third hypothesis: the Discount Rate, Money Supply, and Required Reserves have a significant impact on Inflation**.**

8.4.1. Based on the results, in the short run:

The results do not support the null hypothesis (H_0) and support the alternative hypothesis (H_1), which states that Discount Rate, Money Supply, and Required Reserves have a significant impact on the Inflation. The results strongly support the study hypothesis, indicating that Discount Rate and Money Supply significantly impact CPI, particularly in the short term. The lagged values of these variables demonstrate significant effects on Türkiye's Inflation, with the model explaining approximately (Adjusted) 82.1% of the variance in Inflation. The Granger causality tests confirm

that while the Discount Rate does not show significant predictive power for CPI, Money Supply (M3) has a strong and significant effect on predicting changes in CPI, highlighting its influential role in inflation.

8.4.2. Based on the results, in the long run:

The results indicate that changes in Discount Rate and Money Supply significantly influence the Inflation Rate in the short term, with certain lags of CPI playing a role in short-term stabilization. The lack of significance in the Error Correction Term (ECT) suggests minimal adjustment toward long-term equilibrium, thus there is a weak long-term relationship between the discount rate and the money supply with inflation. with a causal relationship between money and inflation according to Grange's test .implying that short-term effects primarily drive CPI in response to monetary policy variables. These findings underscore the importance of monetary factors, particularly changes in money supply, in shaping short-term inflationary dynamics in Türkiye.

8.4.3. Effects of monetary policy on economic output in Türkiye are primarily short-term rather than enduring.

8.5. Bridging a Recent Research Gap:

This study addresses a clear research gap in the Turkish economic literature, where the relationship between monetary policy instruments and both nominal and real economic growth indicators has not been systematically examined within the highly volatile context of the past decade. It stands as one of the most recent analyses of this topic, covering developments up to mid-2024. The study traces the impact of monetary policy instruments on both real and nominal GDP and inflation dynamics, employing ARDL models and Granger causality tests to reveal the temporal interconnections between the variables. In doing so, it offers a deep analytical framework for a monetary and economic context that has remained insufficiently explored in prior research, especially in light of the structural challenges and economic fluctuations that have shaped Turkey's recent trajectory.

9. RECOMMENDATIONS

9.1. Review of the Impact of Money Supply on Inflation

Given the strong short-term effect of the money supply on inflation, it is recommended to reassess policies related to expanding or contracting the money supply to ensure price stability without negatively impacting economic growth.

9.2. Strengthen Discount Rate Management Mechanisms

Considering the short-term impact of the discount rate on GDP, it is recommended to improve mechanisms for setting and adjusting the discount rate to ensure effective and precise responses to changing economic needs.

9.3. Strategic Use of Required Reserve Ratios

Given the limited impact of required reserve ratios, it is recommended to evaluate the best ways to utilize this tool as part of the monetary policy mix to support banking sector stability and overall macroeconomic balance.

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