

**MACROECONOMIC DETERMINANTS OF MONEY DEMAND IN MALAYSIA:
THE ROLE OF SHADOW ECONOMY – AN APPLICATION OF ARDL**

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ABSTRACT

This study investigates the macroeconomic determinants of money demand (M2) in Malaysia over the period 1980 to 2023. Using the Autoregressive Distributed Lag (ARDL) approach, the analysis explores the relationship between money demand and key economic variables, including Gross Domestic Product (GDP), interest rates (IR), inflation (INF), and the shadow economy (SE). The study ensures stationarity through unit root tests and examines long-run relationships using cointegration tests. The results reveal significant dynamics in both the long-run and short-run, with inflation and the shadow economy identified as key drivers of money demand. These findings highlight the role of both the formal and informal sectors in influencing monetary policy.

Keywords: Money demand, inflation, shadow economy, ARDL model, Malaysia

ABSTRAK

Kajian ini mengkaji penentu makroekonomi terhadap permintaan wang (M2) di Malaysia dari tahun 1980 hingga 2023. Menggunakan pendekatan *Autoregressive Distributed Lag (ARDL)*, analisis ini meneroka hubungan antara permintaan wang dan pembolehubah ekonomi utama, termasuk Keluaran Dalam Negara Kasar (KDNK), kadar faedah (IR), inflasi (INF) dan ekonomi bayangan (SE). Kajian ini memastikan kestabilan data melalui ujian akar unit serta mengkaji hubungan jangka panjang menggunakan ujian kointegrasi. Hasil kajian menunjukkan dinamik yang signifikan dalam jangka panjang dan jangka pendek, di mana inflasi dan ekonomi bayangan dikenal pasti sebagai pemacu utama permintaan wang. Penemuan ini menekankan peranan kedua-dua sektor formal dan tidak formal dalam mempengaruhi dasar monetari.

Kata kunci: Permintaan wang, inflasi, ekonomi bayangan, model ARDL, Malaysia

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LIST OF ABBREVIATIONS

MD (M2)	: Money Demand
GDP	: Gross Domestic Product
IR	: Interest Rates
INF	: Inflation
SE	: Shadow Economy
ECM	: Error Correction Model
ARDL	: Autoregressive Distributed Lag

CHAPTER 1

INTRODUCTION

1.0 Introduction

According to Corporate Finance Institute, “The demand for money is the total amount of money that the population of an economy wants to hold”. Money demand plays a fundamental role in shaping economic dynamics, as it directly influences key macroeconomic variables such as inflation, interest rate and overall economic growth. A stable and well-functioning money demand function is essential for ensuring the effectiveness of monetary policy, especially in Malaysia’s economic context.

The stability of the money demand function and its key determinants is crucial for evaluating the success of monetary policies implemented by Bank Negara Malaysia (the Central Bank) in achieving its economic objectives. Malaysia, a small, open and developing country that has continuously used both fiscal and monetary policies to drive economic growth and maintain macroeconomic stability. To ensure the effectiveness of these policies, it is important to carefully select the appropriate measures of monetary aggregates that influence economic outcomes and to identify the key determinants of the money demand function.

In line with Keynesian theory, which views money demand as influenced by the transaction motive, speculative motive and precautionary motive. This study aims to examine how various factors impact money demand in Malaysia. This research focuses specifically on the shadow economy as key determinant that influence money demand in Malaysia.

1.1 Research Background

The demand for money has long been a central topic in monetary economics due to its significant impact on macroeconomic policy and economic stability. In Malaysia, key economic variables such as Gross Domestic Product (GDP), interest rate and inflation are essential factors that shaping money demand. GDP, which measures the country's total economic output, reflects the level of economic activity and drives money demand through increased transaction needs. Interest rate as set by Bank Negara Malaysia influence the cost of holding money. As higher rates typically lead individuals and businesses to shift funds into interest-bearing assets. Inflation, which affects the purchasing power of the Malaysian ringgit, can change money-holding behavior as individuals adapt to rising prices. Analyzing how these factors influence money demand is crucial for effective policy-making in Malaysia to support economic growth and maintain stability.

According to Keynesian theory, the demand for money arises from three primary motives: the transaction, precautionary and speculative motives. The **transaction motive** reflects the need for money to cover everyday expenses. This relationship underscores that when an economy expands, the volume of transactions rises, leading to greater demand for money. The **precautionary motive** involves holding money as a safeguard against unforeseen expenses, with the level of this demand shaped by economic conditions and the degree of uncertainty within the economy. Lastly, the **speculative motive** pertains to the desire to hold money for potential future investments or opportunities. This motive is influenced by changes in interest rate and the attractiveness of alternative investments; when interest rate are high, the opportunity cost of holding money increases, thus affecting the demand for money.

While traditional research has explored the relationship between GDP, interest rate and inflation with money demand, limited analysis has been done on how other factors such as the shadow economy that influence this relationship. The shadow economy refers to economic activities that are not recorded or regulated by the government including informal work and unreported transactions. This study aims to fill that gap by analyzing the determinants of money demand in Malaysia, incorporating the shadow economy as an additional variable.

1.2 Problem Statement

The demand for money is a crucial aspect of monetary economics, influencing macroeconomic policies and economic stability. Many studies have explored the relationship between money demand and key economic variables such as Gross Domestic Product (GDP), interest rate and inflation. However, limited attention has been given to the role of other determinants, such as the shadow economy, particularly in the context of emerging economies like Malaysia. This study aims to focus on the shadow economy as a key determinant influencing money demand in Malaysia, a factor that has been relatively underexplored in existing research.

One key variable that has been underexplored is the shadow economy. This refers to economic activities that are not captured in the official statistics including informal labor, unregistered businesses and illicit trade. In Malaysia, the shadow economy has expanded over the years, driven by factors such as regulatory challenges and changing economic conditions. Analyzing how this sector interacts with money demand is essential because it may alter individuals' and businesses' demand for money in ways that are not reflected in conventional economic models. This study seeks to address this gap by incorporating the shadow economy as a new determinant in the analysis of money demand in Malaysia.

The majority of existing studies on money demand focus on developed economies, with limited research examining emerging markets like Malaysia. Furthermore, much of the research in this area tends to overlook the shadow economy's influence on money demand. By focusing on the period from 1980 to 2023, this study will fill a crucial gap in the literature. By analyzing data over this extended period, this research aims to provide a comprehensive understanding of how economic changes including shifts in the shadow economy have affected money demand in Malaysia.

The COVID-19 pandemic has had a significant impact on Malaysia's economy, leading to changes in economic behavior. As businesses faced restrictions and individuals experienced income disruptions, many shifted to informal, cash-based transactions, often operating outside the formal economy. This shift likely contributed to the growth of the shadow economy, which has been shown to influence money demand. In addition, the pandemic caused fluctuations in key economic variables such as GDP, interest rate and inflation, all of which can affect the demand for money. Given these changes, it is important to analyze how the COVID-19 pandemic has affected the relationship between these factors and money demand in Malaysia.

This study incorporates the pandemic's impact to provide a current and comprehensive understanding of money demand.

This study aims to address these gaps by incorporating the shadow economy as a key variable in the analysis of money demand, extending the research to cover the period from 1980 to 2023. By utilizing the ARDL approach, this research will explore both short-term and long-term relationships between money demand and its key determinants. Ultimately, this research will contribute to a deeper understanding of the evolving factors that influence money demand in Malaysia, providing valuable insights for monetary policy and economic stability.

1.3 Research Objectives

There are several research objectives of the study that are listed as follows:

1. To investigate whether a long-run co-integration relationship exist among gross domestic product, interest rate, inflation, shadow economy and money demand in Malaysia.
2. To analyse the long-run relationship between the endogenous (money demand) and exogenous variables (gross domestic product, interest rate, inflation, shadow economy) in Malaysia.
3. To analyse the short-run relationship between the endogenous (money demand) and exogenous variables (gross domestic product, interest rate, inflation, shadow economy) in Malaysia.

1.4 Research Questions

In order to achieve the objectives of this study, there are several research questions that must be addressed. The research questions are listed as follows:

1. Is there a long-run co-integration relationship among the variables of gross domestic product, interest rate, inflation, shadow economy and money demand in Malaysia?

2. Is there a significant long-run relationship between the endogenous variables (money demand) and exogenous variable (gross domestic product, interest rate, inflation, shadow economy) in Malaysia?

3. Is there a significant short-run relationship between the endogenous variables (money demand) and exogenous variable (gross domestic product, interest rate, inflation, shadow economy) in Malaysia?

1.5 Research Hypothesis

The following hypotheses are proposed to guide this study's empirical investigation:

1.5.1 Hypothesis for cointegration:

H0: There is no co-integration among the variables of gross domestic product, interest rate, inflation, shadow economy and money demand in Malaysia.

H1: There exists a co-integration among the variables of gross domestic product, interest rate, inflation, shadow economy and money demand in Malaysia.

1.5.2 Hypothesis for long-run relationship:

H0: There is no long-run relationship between the endogenous (money demand) and exogenous variables (gross domestic product, interest rate, inflation, shadow economy) in Malaysia.

H1: There is a long-run relationship between the endogenous (money demand) and exogenous variables (gross domestic product, interest rate, inflation, shadow economy) in Malaysia.

1.5.3 Hypothesis for short-run relationship:

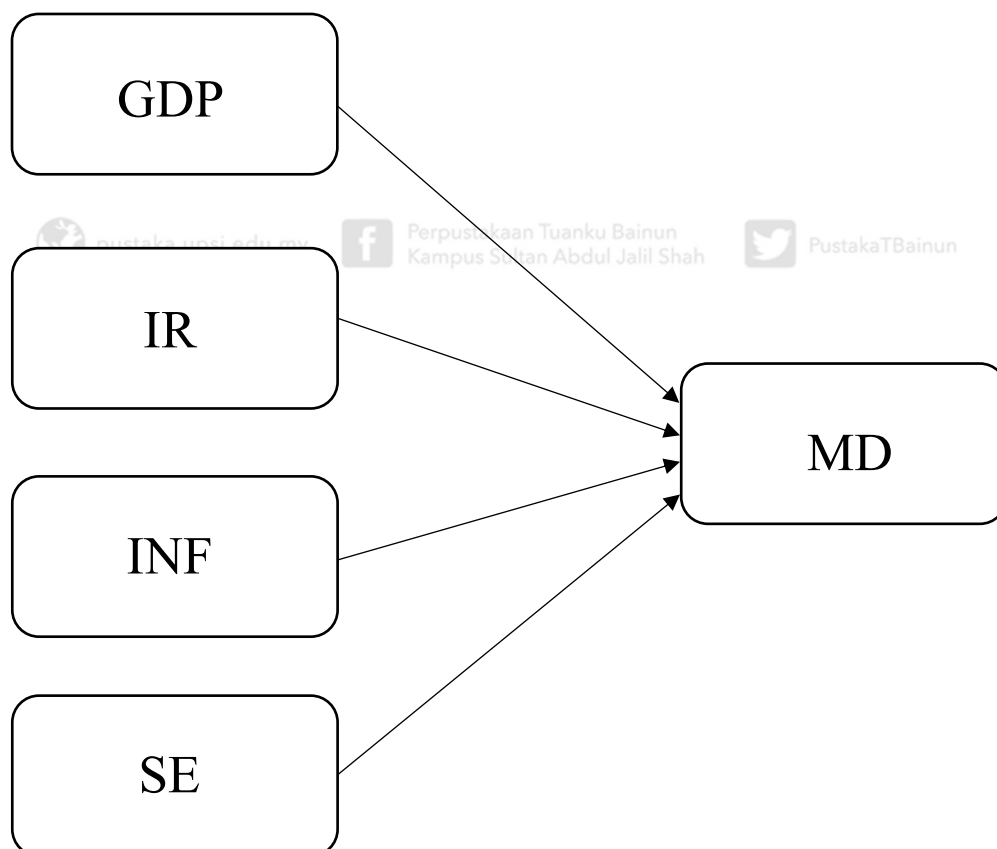
H0: There is no short-run relationship between the endogenous (money demand) and exogenous variables (gross domestic product, interest rate, inflation, shadow economy) in Malaysia.

H1: There is a short-run relationship between the endogenous (money demand) and exogenous variables (gross domestic product, interest rate, inflation, shadow economy) in Malaysia.

1.6 Conceptual Framework

The focus point of this research is the annual data of gross domestic product, interest rate, inflation, shadow economy and money demand. The conceptual framework covers the causal relationship between variables gross domestic product (GDP), interest rate (IR), inflation (INF), shadow economy (SE) and money demand (MD) as shown in Figure 1.

Figure 1.1: Conceptual Framework



Based on the Figure 1.1, MD is represented as the dependent variable, while GDP, IR, INF, SE are independent variables. The conceptual framework illustrates the variables that may influence the dependent variable.

1.7 Scope of Study

This study aims to investigate the key determinants of money demand in Malaysia, focusing on Gross Domestic Product (GDP), interest rate (IR), inflation (INF) and the shadow economy. The analysis will utilize annual data from 1980 to 2023, incorporating 43 observations. The study focuses specifically on Malaysia, given its growing role in Southeast Asia's economy and its experience with both formal and informal economic activities. The study will use the Autoregressive Distributed Lag (ARDL) model to examine both short-run and long-run relationships between the variables, which allows for the integration of variables with different levels of stationarity. The results will provide insights into the evolving dynamics of money demand in Malaysia, particularly in light of recent challenges such as the COVID-19 pandemic and the increasing reliance on the shadow economy.

1.8 Summary

This research introduces the concept of the shadow economy as a crucial factor influencing money demand, especially in the context of Malaysia's evolving economic landscape. It highlights the importance of considering both formal and informal economic activities when formulating monetary policy, particularly in light of the COVID-19 pandemic's impact. This study underscores the necessity of a multifaceted approach to monetary policy that accounts for the dynamics of the shadow economy, economic disruptions and changing behavioral patterns in money demand. Ultimately, the study contributes to both theoretical frameworks and practical policymaking, offering new insights that support Malaysia's efforts toward sustainable economic growth and stability. The findings not only enhance the understanding of money demand dynamics but also provide a basis for future research.



CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The demand for money is a crucial aspect of monetary economics in Malaysia influencing macroeconomic policies and economic stability. In Malaysia, the demand for money is influenced by several macroeconomic variables including gross domestic product (GDP), interest rate (IR), inflation (INF) and shadow economy (SE). The Keynesian theory of money demand provides a foundational backdrop, suggesting that variables such as gross domestic product, interest rate and inflation are key determinants in influencing money holding motives. This theory posits that individuals and businesses hold money for transaction, precautionary and speculative reasons. This review synthesizes existing literature, focusing on empirical studies that utilize models such as the Autoregressive Distributed Lag (ARDL) approach to evaluate these determinants.

2.1 Literature Review

The discussion in this section analyzes the key determinants of money demand, focusing on four aspects: how GDP influences money demand, how interest rates impact money demand, how inflation affects money demand, and how the shadow economy influences money demand.

2.1.1 How Does GDP Influence Money Demand?

The relationship between GDP and money demand is widely supported in economic theory, particularly from a Keynesian perspective. Which posits that as a country's income (GDP)



risers, there is an increased demand for money driven by both transaction and precautionary motives. As GDP grows, individuals and businesses engage in more transactions. Requiring more money to facilitate these activities, while also holding more money for precautionary reasons such as unexpected expenses. Empirical studies across different regions have affirmed this relationship. For instance, Kunwar (2020) demonstrated a positive long-term relationship between GDP and money supply in Nepal using ARDL and VECM models. Similarly, Budha (2012) found that real income significantly influences both narrow (M1) and broad money (M2) balances in Nepal, reinforcing the idea that increased economic activity leads to higher money demand. In Malaysia, Garcia and Puspaningtyas (2021) showed that money supply, banking credit and domestic savings positively impact GDP growth, further supporting the interconnectedness between GDP and money demand. Siti Salwa (2011) also highlighted that GDP significantly affects M2 money supply in Malaysia, indicating that economic growth elevates money demand. In China, Shihui et al. (2009) reported a positive relationship between GDP and both M1 and M2, echoing these findings in a broader regional context. However, not all studies align with this pattern. Inam and Ime (2017) found an insignificant relationship between money supply and economic growth in Nigeria, suggesting that the relationship may be influenced by factors such as policy environments and structural differences. For example, countries with underdeveloped financial sectors or informal markets may not exhibit the same sensitivity between GDP and money demand as those with more developed financial systems. Despite these exceptions, the general trend supports the view that as economic activity increases, so does the demand for money.

2.1.2 How Do Interest Rate Impact Money Demand?

Interest rate are a critical determinant of money demand, particularly from the perspective of Keynesian theory which highlights their impact on both speculative and precautionary motives. According to Keynesian economics, when interest rate rise, holding money becomes less attractive due to the higher opportunity cost of not investing it in interest-bearing assets. This relationship is supported by empirical evidence across various countries. Abdulkheir (2013) found a significant long-run relationship between interest rate and money demand in Saudi Arabia, where higher interest rate were associated with a reduction in money demand. This is consistent with He (2017), who observed that increasing interest rate led to a decrease in money supply in China. In Malaysia, Poon and Tong (2009) demonstrated that changes in real money

market rates affected inflation which in turn, indirectly influenced money demand. Similarly, Yuliadi (2020) in Indonesia found a two-way relationship between money supply and interest rate, highlighting the interconnectedness of these variables. Fasiye and Yusuf (2020) also confirmed that interest rate significantly impacted narrow money (M1) in Nigeria, particularly in the short term, reinforcing the Keynesian view that higher interest rate reduce money demand. However, not all studies support this relationship such as Sheefeni (2013) found no cointegration between real money aggregates, interest rate and other variables in Namibia, suggesting that the relationship between interest rate and money demand may vary depending on the economic structure of the country. These contrasting findings imply that while the general trend supports the inverse relationship between interest rate and money demand, the strength of this effect can be influenced by local economic conditions and institutional factors.

2.1.3 How Does Inflation Affect Money Demand?

Inflation as highlighted in Keynesian economics, erodes the real value of money which can lead to a decrease in the demand for money balances. According to Keynesian theory, as inflation rises, the purchasing power of money declines. Making people less likely to hold onto money and more likely to spend or invest it. Empirical studies consistently support this negative relationship between inflation and money demand. Dritsakis (2011) used ARDL modeling to show that inflation negatively impacted money demand in Hungary, suggesting that as inflation rises, the demand for money decreases. Similarly, Budha (2012) and Ozcalik (2014) found comparable results in Nepal and Turkey, respectively, reinforcing the idea that higher inflation reduces the demand for real money balances. In Malaysia, Gamal et al. (2019) confirmed the significant negative effect of inflation on money demand, aligning with broader regional findings. Goestjahjanti (2024) also reported that inflation remained a stable negative determinant in Indonesia, further supporting the theoretical expectation that as inflation increases, the attractiveness of holding money diminishes. Additionally, Al-Habashneh (2022) found that both real interest rate and inflation had negative impacts on GDP in Jordan, reflecting the broader view that inflation reduces money's appeal due to its effect on purchasing power. These findings highlight the consistent pattern that inflation undermines the demand for money, as people seek to protect their wealth from the erosion of value caused by rising prices.

2.1.4 How Does the Shadow Economy Influence Money Demand?

The shadow economy, which includes unregulated and informal economic activities, adds complexity to the analysis of money demand. In Malaysia, the shadow economy is estimated to account for approximately 42.53% of GDP, as reported by Gamal et al. (2019). While there are limited direct studies on its specific impact, existing literature suggests that the shadow economy significantly influences money demand, primarily due to its reliance on cash transactions to avoid regulatory oversight. Aderopo (2020) found that financial liberalization in Nigeria impacted money supply, hinting that informal financial practices, like those in shadow economies can affect broader monetary trends. Similarly, Zaagha (2020) highlighted the role of private sector credit in influencing money demand which indirectly points to the potential influence of the shadow economy on money usage. Dobre (2013) also identified a stable long-run relationship between money demand and variables such as income and tax burden in Romania, suggesting that informal economic activities may increase the demand for currency beyond what is captured in formal economic statistics. In Malaysia, the implications of the shadow economy are particularly significant for monetary policy, as unregulated cash flows complicate the design of effective strategies. The widespread underreporting of cash usage in the shadow economy underscores the need for more comprehensive policy approaches that consider both formal and informal economic sectors to ensure accurate monetary management.

2.3 Summary

In sum, the literature consistently identifies gross domestic product, interest rate, inflation and shadow economy as key determinants of money demand. Gross domestic product generally has a positive effect, with higher economic activity raising money demand. Interest rate negatively impact money demand by increasing the opportunity cost of holding money, while inflation reduces the real demand for money due to eroding purchasing power. Although the shadow economy's role is less studied, its sizeable presence in Malaysia suggests it could significantly influence the demand for money. These insights, supported by empirical findings, emphasize the complex interplay of economic factors that shape money demand, highlighting the need for a nuanced approach to monetary policy in Malaysia.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter explain in detail about the data and methodology used by this study. The data is obtained and analyzed to obtain accurate information. Accordingly, this study should use one of the econometric methods which is the autoregressive distributed lag (ARDL) model. This method is useful for investigating the relationship between gross domestic product (GDP), interest rate (IR), inflation (INF), shadow economy (SE) and money demand.

3.1 Model Specification

It is common to assume that the desired level of nominal money demand is influenced by the price level, a transaction or scaling variable and a set of opportunity costs (Goldfeld and Sichel, 1990), expressed as:

$$(M/P) = f(Y, R_1, R_2 \dots) \quad (1)$$

Where M stands for nominal money demand, P for the price level, Y for the real income which represents the scale variable and R_1 for the elements of the vector of the opportunity cost which possibly also includes the inflation rate. A money demand of this type is not only the result of traditional money demand theories but also of modern micro founded stochastic general equilibrium model (Walsh, 2003). Following Goldfeld and Sichel (1990), the form of money demand function employed in this study is specified as:

$$\ln M_t^r = \beta_0 + \beta_1 \ln Y_t + \beta_2 R_t + \beta_3 \pi_t + \beta_4 SE_t + \varepsilon_t \quad (2)$$

Where M_t^r represent real money balances (e.g., M/P) which are focus of the study as the dependent variable. Y_t stands for real GDP, used as a measure of economic activity or income. According to Keynesian theory, the income elasticity coefficient β_1 is expected to be positive, implying that higher economic activity leads to greater demand for money due to increased transaction needs. Empirical evidence from Malaysia, such as studies by Siti Salwa (2011) supports this relationship. R_t denotes the interest rate, representing the opportunity cost of holding money. A negative relationship ($\beta_2 < 0$) is expected, as higher interest rates make holding non-monetary assets more attractive compared to holding money. This is consistent with the studies of Poon and Tong (2009) that show interest rate changes affect money demand indirectly through inflation and other factors. π_t is the inflation rate, acting as a proxy for expected inflation. The coefficient β_3 is hypothesized to be negative, as inflation erodes the real value of money, thereby discouraging people from holding money balances. This aligns with findings by Gamal et al. (2019) for Malaysia, which showed inflation's significant negative impact on money demand. SE_t represents the shadow economy, an additional variable incorporated into the model to account for unregulated and informal economic activities. In Malaysia, the shadow economy, which averages around 42.53% of GDP (Gamal et al., 2019), has implications for cash-based transactions that could affect real money demand. The sign of β_4 may vary based in the scale and nature of informal economic activities. ε_t is the error term, assumed to follow a normal distribution with $\varepsilon_t \sim N(0, \sigma^2)$, capturing any unexplained variations in money demand.

3.2 Data and Methodology

For analysis purpose, all the Malaysia data sources of gross domestic product, interest rate, inflation, shadow economy and money demand were composed from various issues. This study is based on the annual data series from 1980 to 2023. Broad money (M2) has been employed as monetary aggregates. The proxy for the interest rate (R) is the rate of interest rate on the saving deposits at the commercial banks. To measure the real terms after adjusting for inflation, the consumer price index (CPI) is also collected from the resources and used to deflate the data from the nominal form into real form data.

Table 3.1: Data sources for all the variables

Data	Abbreviation	Sources	Link
Money demand	M2	World Bank Open Data	https://data.worldbank.org/indicator/FM.LBL.BMNY.CN?locations=MY&start=1980
Gross domestic product	GDP	World Bank Open Data	https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=MY&start=1980
Interest rate	IR	World Bank Open Data	https://data.worldbank.org/indicator/FR.INR.RINR?locations=MY&start=1980
Inflation	INF	World Bank Open Data	https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=MY&start=1980
Shadow economy	SE	Articles	https://www.econstor.eu/bitstream/10419/183248/1/wp1710.pdf https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=896c6906f1f688be1a3ecab1f6c07146a845ccb4

The autoregressive distributed lag (ARDL) cointegration procedure is applied to analyze the dynamics between money demand and its determinants. The model is specified as follows:

$$\Delta \ln M_t = \beta_0 + \sum_{i=1}^n \beta_1 \ln Y_{t-i} + \sum_{i=1}^n \beta_2 R_{t-i} + \sum_{i=1}^n \beta_3 \pi_{t-i} + \sum_{i=1}^n \beta_4 SE_{t-i} + \varepsilon_t \quad (3)$$

Where:



- $\Delta \ln M_t$: The first difference of the natural logarithm of money demand at time t . This represents the percentage change in money demand.
- β_0 : The constant or intercept term in the model.
- $\ln Y_{t-i}$: The natural logarithm of income or GDP lagged by i periods. This represents the influence of past income levels on money demand.
- R_{t-i} : The interest rate lagged by i periods. It reflects the effect of past interest rates on money demand.
- π_{t-i} : Inflation rate lagged by i periods. This captures the impact of past inflation rates on money demand.
- SE_{t-i} : Shadow economy lagged by i periods. This measures how the shadow economy affects money demand over time.
- $\beta_1, \beta_2, \beta_3, \beta_4$: Coefficients of the lagged variables $\ln Y_{t-i}$, R_{t-i} , π_{t-i} , SE_{t-i} respectively. These coefficients indicate the magnitude and direction of each variable's influence on changes in money demand.
- n : The number of lags included in the model for each variable, as determined by the ARDL framework.
- ε_t : The error term, representing unobserved factors affecting money demand at time t .



3.2.1 Unit Root Test

The Correlogram test, an informal method, is commonly applied to evaluate the presence of stationary patterns in time series data. The formalized counterpart of this test is known as the unit root test. There are three variations of the formal unit root test: the Philip Perron (PP) test, the Augmented Dickey-Fuller (ADF) test and the Generalized Least Squares (GLS) test. For this investigation, the formal unit root test will be conducted using the Augmented Dickey-Fuller (ADF) test, a statistical method developed by Dickey and Fuller (1979). The hypotheses for the unit root test are structured as follows:

$H_0: \delta = 0$ Null hypothesis (Failed to reject H_0 , series is non-stationary)

$H_1: \delta \neq 0$ Alternative hypothesis (Accept to reject H_0 , series is stationary)

According to the ADF test, time series data is considered to have a unit root and be non-stationary if the dataset fails to reject the null hypothesis ($\delta = 0$; H_0) at the first difference $I(1)$, and the ADF t-statistic value is less than the 5% significance level of the critical value. This



outcome implies that the null hypothesis is not rejected at the first difference I(1). Iordanova (2022) highlights that the validity of non-stationary data is questionable, as such data cannot be reliably modeled or predicted. This is because non-stationary data may lead to misleading relationships between variables. In essence, the time series data must exhibit stationarity when compared at the first difference.

Similar to the unit root test, selecting appropriate lag lengths is crucial, as it influences the model's outcomes. There are various approaches for determining the optimal lag value for each variable. To establish a consistent model, this study employs the Schwarz Information Criterion (SIC) to select the optimal lag length for both the ADF test and the ARDL model. This ensures the consistency and reliability of the model results.

3.2.2 The Bound Test

The Bound Test is conducted after obtaining the results of the unit root test to evaluate whether a long-run relationship exists among the variables. This involves performing an F-test to assess the presence of such a relationship. Specifically, Equation 3 is calculated, and the coefficients of the one-period lagged variables are examined to determine whether they collectively sum to zero. The hypotheses for this test are formulated as follows:

$$H_0: \beta_1 = \beta_2 = 0 \text{ (Fail to reject } H_0: \text{ No long-run relationship exists)}$$

$$H_1: \beta_1 \neq 0 \cup \beta_2 \neq 0 \text{ (Reject } H_0: \text{ A long-run relationship exists)}$$

In the ARDL framework, the F-test does not follow a standard distribution. Instead, its distribution depends on several factors, including:

1. The combination of independent variables classified as I(0) and I(1).
2. The number of independent variables.
3. The inclusion of intercept and/or trend terms in the model.

Critical values for the F-test are provided in tabulated form by Pesaran et al. (2001) and are bounded at both upper and lower levels. The calculated F-statistic is compared with these critical values to determine the outcome of the test as follows:

- If the F-statistic exceeds the upper bound, the null hypothesis is rejected, confirming the existence of a long-term relationship, regardless of the integration order of the variables.
- If the F-statistic falls below the lower bound, the null hypothesis cannot be rejected, indicating that no significant cointegration exists.
- If the F-statistic lies between the upper and lower bounds, the result is inconclusive, as outlined by Pesaran et al. (2001):

$$Fail\ to\ Reject\ H_0 < Inconclusive < Reject\ H_0$$

3.2.3 Short-Run Error Correction Model

The Error Correction Model (ECM) is utilized to integrate short-run dynamics with long-run equilibrium in time series analysis, addressing issues such as spurious relationships caused by non-stationary data. According to Shrestha and Bhatta (2018), the ECM ensures that short-term fluctuations are adjusted while preserving long-run information. The equation for the ECM is expressed as:

$$\Delta \ln M_t = \beta_0 + \sum_{i=1}^p \delta_j \Delta \ln Y_{t-i} + \sum_{i=1}^q \tau_j \Delta R_{t-i} + \sum_{i=1}^r \omega_j \Delta \pi_{t-i} + \sum_{i=1}^s \chi_j \Delta SE_{t-i} + \varepsilon_t$$

(4)

The primary aim of this estimation is to develop a model that closely aligns with equilibrium. For the model to demonstrate equilibrium, the ECM coefficient (λ) must be statistically significant and have a negative value. These conditions confirm the presence of a stable long-run relationship and cointegration between the independent and dependent variables. Additionally, the magnitude of the ECM coefficient indicates the speed at which the system returns to equilibrium.

Since the ARDL model strives to achieve the Best Linear Unbiased Estimator (BLUE), diagnostic tests are essential. This study employed the Breusch-Godfrey test to check for serial correlation and the ARCH test for heteroskedasticity. If these tests confirm the absence of bias, and the model produces satisfactory results, the findings can be deemed reliable for analysis. Conversely, unsatisfactory results necessitate model adjustments.

Given that time series data are sensitive to global events and the ARDL model is susceptible to structural changes, the stability of the coefficients must also be evaluated. To address this, the CUSUM and CUSUM of Squares tests were conducted to assess the stability of the coefficients in both the short and long run.

3.2.4 Stability Test

The stability test is a critical diagnostic tool within the ARDL framework used to verify the consistency and robustness of the estimated coefficients over time. This ensures that the relationships derived between variables remain stable and are not influenced by structural breaks, shifts in data trends, or external shocks.

To perform this, the **CUSUM (Cumulative Sum)** and **CUSUM of Squares tests** are applied:

1. **CUSUM Test:** This test monitors the cumulative sum of recursive residuals over time to detect whether the model's coefficients exhibit systematic deviations. It tracks changes against predefined significance thresholds. When plotted, the CUSUM graph illustrates the cumulative behaviour of residuals. If the plot stays within the critical bounds, the coefficients are stable. However, deviations suggest structural breaks.
2. **CUSUM of Squares Test:** This test is similar to the CUSUM but focuses on variance changes in the residuals. It is particularly useful for evaluating whether shifts in variance have impacted the ARDL model's short-run and long-run stability.

Both tests are vital for ensuring that the estimated relationships in the ARDL model are not compromised by sudden events, external shocks, or inherent variability. Stability ensures the reliability of the model for making accurate forecasts or policy implications.

By confirming that the test results show no instability (the plots remaining within their respective critical bounds), the study validates that the ARDL estimates are robust and unaffected by structural changes over time. If the stability tests indicate instability, this would suggest re-specification or adjustment of the ARDL model.

3.3 Summary

This chapter outlines the methodology stages that will be addressed in the subsequent chapter, along with the processes of data collection, analysis and methodology. The results derived from the ARDL framework are also discussed in the next chapter. Initially, the unit root test is employed to assess the stationarity of each variable. Once the stationarity of the variables is established, the bound test is applied to examine the long-run relationships between them. The short-run dynamics are then analyzed using the error correction model (ECM). Finally, diagnostic tests are performed to ensure that the data is appropriately processed within the ARDL framework.

CHAPTER 4

FINDINGS AND REPORTS

4.0 Introduction

This chapter presents the findings of the study on the macroeconomic determinants of money demand (M2) in Malaysia, analyzed using the Autoregressive Distributed Lag (ARDL) approach. By examining the relationships between Money Demand (M2) and its key macroeconomic drivers which are Gross Domestic Product (GDP), Interest Rate (IR), Inflation (INF) and the Shadow Economy (SE), structured as follows: 4.1 Empirical Results and 4.2 Summary. As previously mentioned, the Autoregressive Distributed Lag (ARDL) model is employed to analyze the long-run and short-run relationships among M2, GDP, IR, INF and SE variables.

4.1 Empirical Result

The findings of this study are presented in the following subsections, covering the Unit Root Test, the Cointegration Test, the Long Run Coefficient, Short Run ECM Model and Diagnostic Test, the Histogram (Normality Test), and the Stability Test.

4.1.1 Unit Root Test

The Correlogram test, an informal method, is commonly applied to evaluate the presence of stationary patterns in time series data. The formalized counterpart of this test is known as the unit root test. There are three variations of the formal unit root test: the Philip Perron (PP) test, the Augmented Dickey-Fuller (ADF) test and the Generalized Least Squares (GLS) test. For this investigation, the formal unit root test will be conducted using the Augmented Dickey-Fuller (ADF) test, a statistical method developed by Dickey and Fuller (1979). The hypotheses for the unit root test are structured as follows:

$$H_0: \delta = 0 \text{ Null hypothesis (Failed to reject } H_0, \text{ series is non-stationary)}$$



$H_1: \delta \neq 0$ Alternative hypothesis (Accept to reject H_0 , series is stationary)

The following table presents the findings that were obtained from applying the Augmented Dickey-Fuller (ADF) Test to Malaysia's focused variables using both the Level Form and the First Difference Form:

Table 4.1: Result of unit root test at level and at first difference

Variables	At Level		At First Difference		Order of integration
	T-statistics (at level)	5% critical value	T-statistics (at first difference)	5% critical value	
Money Demand (M2)	- 1.520727 (0)	- 2.931404 (0)	- 6.037237 (1)	- 2.935001 (1)	I(1)
GDP	- 5.279632 (0)	- 2.931404 (0)	- 8.324491 (1)	- 2.935001 (1)	I(0)
Interest Rate	- 6.867806 (0)	- 2.931404 (0)	- 7.708392 (1)	- 2.935001 (1)	I(0)
Inflation	- 4.030971 (0)	- 2.931404 (0)	- 9.414692 (0)	- 2.933158 (0)	I(0)
Shadow Economy	- 0.539745 (2)	- 2.935001 (2)	- 5.601470 (1)	- 2.605836 (1)	I(1)

Notes: The tests for all variables are conducted using EViews with constant and trend. The optimal lag selection is selected automatically by the Schwarz information criteria for the ADF test.



Based on the Table 4.1: Result of unit root test at level and at first difference above, the ADF test result shows that at the level, Money Demand (M2) has a t-statistics value of -1.520727, which is greater than the 5% critical value of -2.931404, indicating non-stationarity. However, after first differencing, the t-statistics value improves significantly to -6.037237, which is less than the critical value of -2.935001. This confirms that M2 is integrated of order I(1). GDP is stationary at levels, as evidenced by its t-statistics value of -5.279632, which is less than the 5% critical value of -2.931404. This suggests that GDP is integrated of order I(0), requiring no differencing for stationarity. Similarly, the Interest Rate (IR) demonstrates stationarity at levels, with a t-statistics value of -6.867806, well below the critical value of -2.931404. Thus, IR is also integrated of order I(0) and Inflation (INF) is stationary at levels with a t-statistics value of -4.030971, which is less than the 5% critical value of -2.931404. This indicates that INF is integrated of order I(0). The Shadow Economy (SE) is non-stationary at levels, with a t-statistics value of -0.539745, exceeding the 5% critical value of -2.935001. After first differencing, SE becomes stationary, with a t-statistics value of -5.601470, which is less than the critical value of -2.608536. Thus, SE is integrated of order I(1).

The variable Money Demand (M2) and the Shadow Economy (SE) were non-stationary at their levels but became stationary upon first differencing, implying an order of integration of I(1). Conversely, GDP, Interest Rate (IR) and Inflation (INF) were stationary at their levels, denoted as I(0). This mixed order of integration justifies the use of the ARDL approach, which is suitable for handling variables with different integration orders. These results set the foundation for subsequent analyses, ensuring the validity of the ARDL application.

4.1.2 Cointegration test

In the next stage, the examination focuses on the presence of a cointegrated long-run relationship between the dependent variable (M2) and its independent variables: GDP, interest rate (IR), inflation (INF), and shadow economy Ln(SE). Using the ARDL bounds test approach, the following results are presented in Table 4.1.

The optimal maximum lag order of $k = 4$ was selected based on AIC for this analysis. The null hypothesis, which asserts no cointegration, was tested against the alternative hypothesis that suggests the existence of a long-run cointegration relationship. The outcome will be presented in the table that can be found below:

Table 4.2: Bounds Cointegration Test Result

Model	Calculated <i>F</i> -Statistic	
(M2)=F((GDP), (IR), (INF), Ln(SE))	6.513564**	
	K=4, N=40	
Critical value for bounds test: case III: unrestricted intercept and no trend	I(0)	I(1)
1%	3.967	5.455
5%	2.893	4
10%	2.427	3.395

Notes: ** refers to the 5% significance level, while k is the number of explanatory variables.
Critical bounds of F-statistic are shown in Narayan (2005).

The calculated F-statistic (6.513654**) exceeds both its lower and upper bound (2.893 and 4.000) at the 5% significance level. This strong evidence against the null hypothesis of no cointegration confirms the existence of a long-run relationship between Money Demand (M2) and the independent variables (GDP, IR, INF and SE). This indicates that all research variables have been integrated in the long-run.

4.1.3 Long Run Coefficient, Short Run ECM Model and Diagnostic Test

Table 4.3: Long-Run and Short-Run Estimates

Panel A: ARDL (1,4,1,6,5) Long-Run Coefficients Estimates							
C	GDP	IR	INF	LSE			
-7.02 (-1.54)	-7.08 (-0.67)	0.08 (0.06)	53.70 (2.10)	1.62 (4.44)			
Panel B: ARDL (1,4,1,6,5) Short-Run Coefficients Estimates							
Lag order							
Regressors	0	1	2	3	4	5	6
$\Delta M2$	0.79 (1.54)						
ΔGDP		0.29 (1.63)	-0.55 (-2.63)	-0.02 (-0.04)	-1.05 (-5.07)		
ΔIR		-0.19 (-2.01)					
ΔINF		-0.04 (-0.06)	6.22 (7.12)	3.26 (3.73)	-1.15 (-0.90)	0.52 (0.59)	3.30 (6.25)
ΔLSE		-0.06 (-1.78)	0.17 (4.99)	0.22 (6.13)	-0.12 (-2.01)	-0.08 (-1.80)	
Panel C: Diagnostic Statistics Tests							
ECM (-1)	$\chi^2_{SC}^{(1)}$	$\chi^2_{ff}^{(1)}$	$\chi^2_H^{(1)}$	$\chi^2_N^{(2)}$	$ADJ.R^2$	F- Sta/P.V	
-0.11 (7.16)	0.00 (0.22)	5.52 (0.02)	0.93 (0.93)	2.14 (0.34)	0.64	2.35 (0.15)	

Notes: The number in the parentheses as in Panels A and B refer to the value of the t-ratio. χ^2_{SC} , χ^2_{ff} , χ^2_H and χ^2_N in Panel C are Lagrange multiplier statistics for tests of residual correlation, functional form misspecification, heteroscedasticity and normality, respectively. These statistics are distributed as chi-squared variants with degrees of freedom as in the parentheses, while the Probability values are in brackets. The chi-squared critical values at the 5% significance level with one and two degrees of freedom are 3.84 and 5.99, respectively. The ARDL approach for cointegration is applied to estimate Equation 2 in the form of MCDFM with a maximum lag of 4.

The analysis in Table 4.3, **Panel A**, directly addresses the objective of understanding the long-run relationships between money demand (M2) and its determinants, including GDP, interest rate, inflation, and the shadow economy, in Malaysia. The results reveal that GDP (-7.08) and interest rate (-7.02) have negative but statistically insignificant coefficients, indicating their limited influence on money demand in the long run. However, inflation exhibits a positive and statistically significant coefficient (53.70), signifying its critical role as a driver of money demand. This aligns with the theoretical expectation that higher inflation increases transactional demand for money. Additionally, the shadow economy demonstrates a positive and significant coefficient (1.62), suggesting that informal economic activities play a significant role in shaping money demand dynamics in Malaysia over the long run. These findings emphasize the key long-term determinants of M2 and fulfill the study's second objective.

Table 4.3, **Panel B**, focuses on the short-run relationships between money demand and its determinants, contributing to the study's third objective which is to analyse the short-run relationship between the endogenous (money demand) and exogenous variables (gross domestic product, interest rate, inflation, shadow economy) in Malaysia. The Error Correction Model (ECM) coefficient (-0.11) is statistically significant, indicating a gradual adjustment mechanism where approximately 11% of deviations from the long-run equilibrium are corrected each period. For GDP, the coefficient at lag 1 is 0.29 with a t-statistic of 1.63, indicating statistical insignificance in its short-run effect on money demand; however, GDP shows a significant negative coefficient of -0.55 at lag 2 (t-statistic: -2.63), reflecting a significant inverse relationship at this lag, and by lag 5, the coefficient is -1.05 (t-statistic: -5.07), which remains highly significant, emphasizing the delayed impact of GDP on M2. For the interest rate (IR), the coefficient at lag 1 is -0.19 with a t-statistic of -2.01, showing a significant negative short-run effect on money demand, suggesting that higher interest rates reduce money demand by encouraging shifts toward alternative investment options. Inflation (INF) displays strong and persistent effects across lags, beginning with an insignificant coefficient of -0.04 (t-statistic: -0.06) at lag 1 but becoming highly significant at lag 2 with a coefficient of 6.22 (t-statistic: 7.12), and its significant impact persists at lag 3 (coefficient: -3.26, t-statistic: -4.15), reflecting its dynamic influence on money demand. For the shadow economy (SE), the coefficient at lag 1 is -0.06 (t-statistic: -1.78) and statistically insignificant, but at lag 4, the coefficient becomes 0.22 (t-statistic: 4.99), highlighting a significant positive short-run impact of informal economic activities on M2. These results emphasize the dynamic

and varied short-term effects of the determinants on money demand, underscoring the importance of lagged relationships in understanding monetary dynamics.

Panel C of Table 4.3 provides diagnostic statistics to assess the robustness and reliability of the ARDL model. The error correction term (ECM (-1)) is statistically significant with a coefficient of -0.11 and a t-statistic of 7.16, indicating that approximately 11% of deviations from the long-run equilibrium are corrected each period, reflecting a moderate speed of adjustment toward equilibrium. The Serial Correlation LM Test ($X^2SC(1)$) yields a test statistic of 0.00 with a p-value of 0.22, indicating no evidence of serial correlation in the residuals, suggesting the model is free from autocorrelation issues. The Ramsey RESET Test ($X^2FF(1)$) produces a p-value of 0.93, demonstrating no evidence of functional form misspecification, which affirms the appropriateness of the model's functional form. Similarly, the Heteroscedasticity Test ($X^2H(1)$) returns a p-value of 0.93, indicating no significant heteroscedasticity, meaning the residuals have constant variance, which supports the model's validity. The Normality Test ($X^2N(2)$) shows a p-value of 0.34, suggesting that the residuals follow a normal distribution, a key assumption for model reliability. The adjusted R^2 value of 0.64 implies that the model explains about 64% of the variation in money demand ($M2$), indicating a strong fit. However, the F-statistic of 2.35 with a p-value of 0.15 suggests that the overall model may not be statistically significant at conventional levels. Overall, these results highlight the ARDL model's robustness while identifying areas for potential refinement to improve its explanatory power and predictive accuracy.

4.1.4 Histogram (Normality Test)

The histogram normality test provides a visual depiction of the residuals' distribution, indicating that the error terms follow a normal distribution. To verify this, the Jarque-Bera statistic is examined to determine whether the residuals conform to a normal distribution. The findings from the normality test conducted in this study are as follows:

Figure 4.4: Normality Test

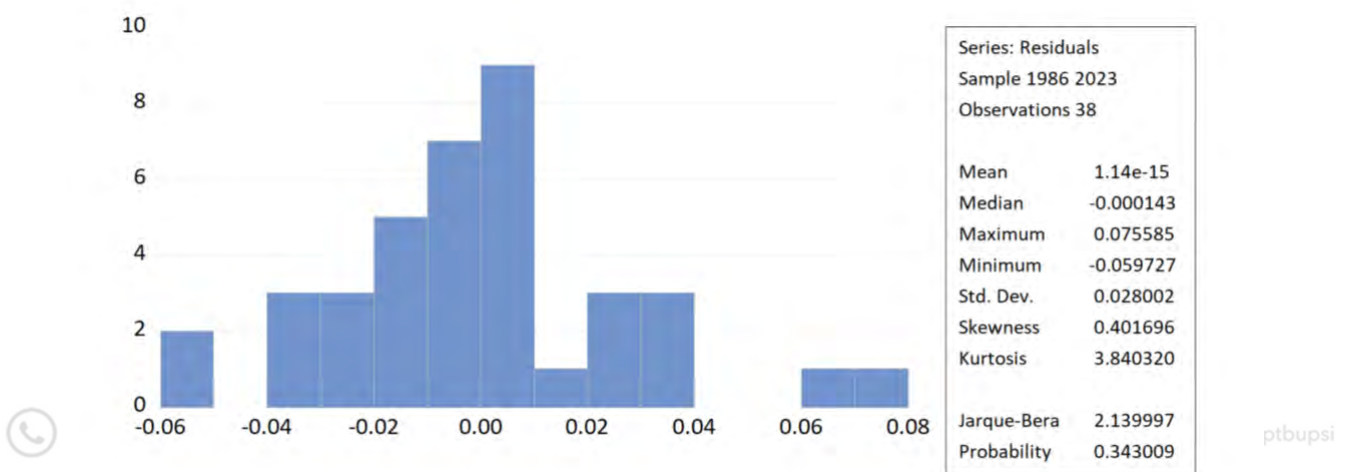


Figure 1 illustrates the histogram of the residuals, providing a visual representation of their distribution. The accompanying Jarque-Bera statistic yields a probability value of 0.343, which exceeds the significance level of 0.05. This result indicates that the residuals conform to a normal distribution, satisfying the assumption of normality. Such conformity is essential for the reliability of the econometric model, as it ensures that the error terms are well-behaved and unbiased.

4.1.5 Stability Test

Figure 4.5: Plot of CUSUM statistics for Stability of Money Demand in Malaysia

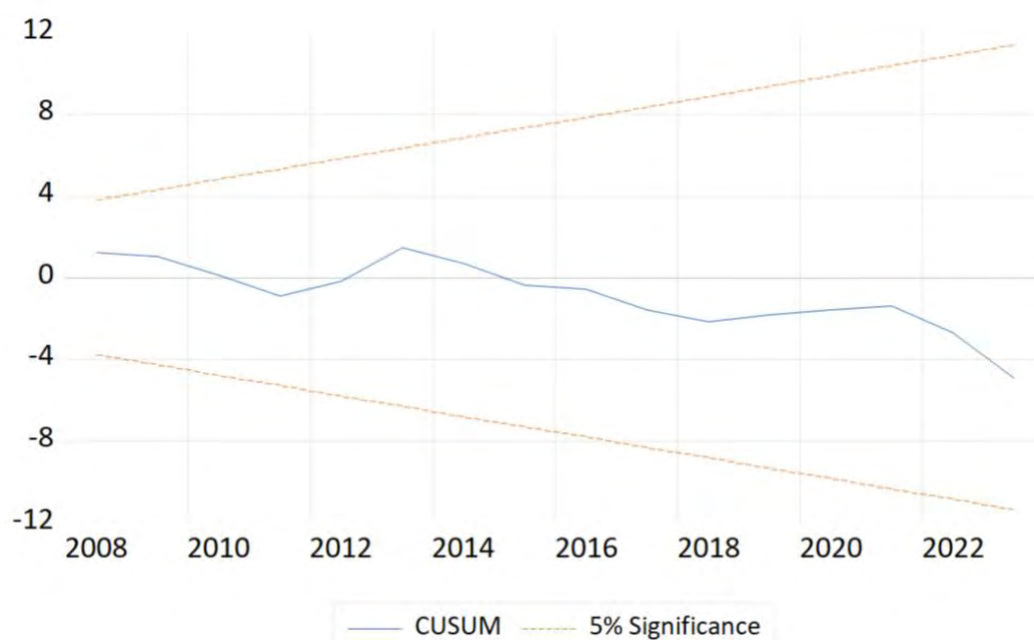
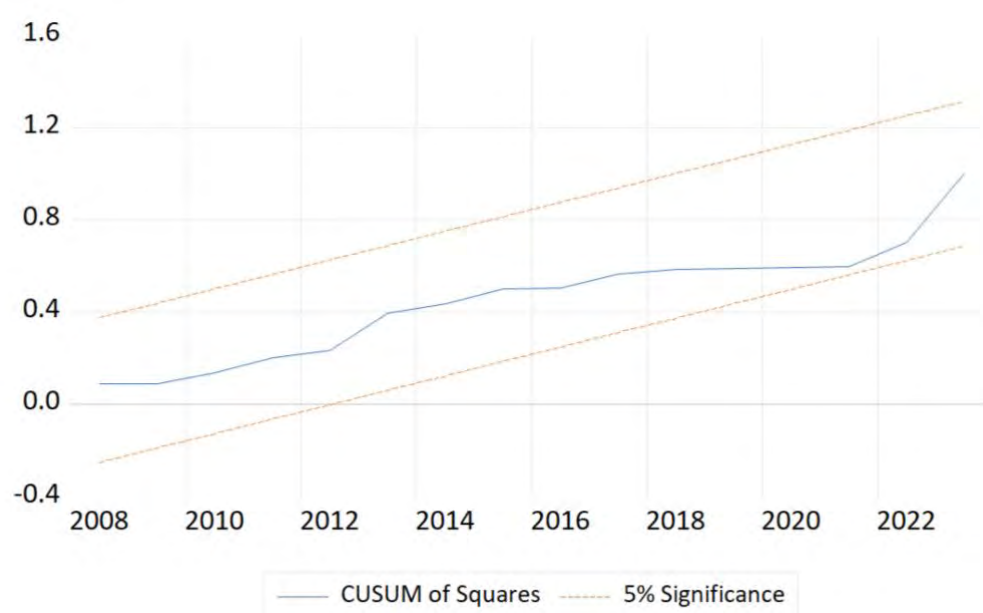


Figure 4.6: Plot of CUSUMSQ statistics for Stability of Money Demand in Malaysia



The results of the stability test of CUSUM and CUSUM of Square showed stability in the period of 1980 to 2023. In this study, the graphical results indicate that both the CUSUM and CUSUMQ plots remain within the 5% critical bounds as shown by the lines in the Figure 2 and Figure 3.

4.2 Summary

This chapter has presented a detailed analysis of the macroeconomic determinants of money demand (M2) in Malaysia using the ARDL model. The findings underscore the importance of GDP, interest rates, inflation, and the shadow economy in shaping money demand dynamics both in the short and long run. While GDP and interest rates exhibit a limited long-term influence, inflation and the shadow economy emerge as significant drivers. Short-term analyses reveal the dynamic effects of these variables, highlighting their lagged relationships with M2. Diagnostic and stability tests confirm the robustness and validity of the model. These results provide critical insights into monetary policy formulation and emphasize the interconnectedness of formal and informal economic activities in influencing monetary aggregates in Malaysia.

CHAPTER 5

CONCLUSION, DISCUSSION AND SUGGESTION

5.0 Introduction

This chapter provides a comprehensive overview of the study's findings and integrates them into a coherent conclusion. It is divided into three main sections: 5.1 Conclusion, 5.2 Discussion and 5.3 Recommendations. The empirical results presented in previous chapters are synthesized here with a focus on how they align with the objective. This chapter concludes with a summary of the study's overall contributions to monetary economics particularly within the context of Malaysia.

5.1 Conclusion

This study explores the macroeconomic determinants of money demand (M2) in Malaysia from 1980 to 2023 using the ARDL approach to examine both short-run and long-run relationships. The main variables analyzed include Gross Domestic Product (GDP), Interest Rate (IR), Inflation (INF) and the Shadow Economy (SE). The unit root test results confirm a mixed order of integration with variables stationary at levels (I(0)) and first differences (I(1)). This justifies the use of the ARDL approach. The F-bound test confirms the existence of a long-run relationship between M2 and its determinants. The Error Correction Term (ECT) coefficient is -0.11, indicating that 11% of disequilibrium is corrected each period. Ensuring convergence to long-run equilibrium. The analysis reveals distinct long-run and short-run dynamics in the determinants of M2. In the long run, GDP and interest rates exhibit negative but statistically insignificant effects suggesting minimal influence. While inflation and the shadow economy

demonstrate positive and statistically significant impacts underscoring their critical roles in transactional and informal sector-driven money demand respectively. In the short run, GDP shows a significant negative effect at specific lags indicating a delayed inverse relationship with M2 and interest rates exert a significant negative influence reflecting a shift toward alternative investments when rates rise. Inflation exhibits strong dynamic effects across lags consistent with theoretical expectations while the shadow economy has a significant positive impact at selected lags highlighting its importance in short-term money demand fluctuations. Model validation confirms the robustness of the findings with diagnostic tests indicating no serial correlation, heteroskedasticity and stability tests (CUSUM and CUSUMS of Square) affirming model stability over the study period.

5.2 Discussion

This study investigates the macroeconomic determinants of money demand (M2) in Malaysia, focusing on the roles of GDP, interest rates, inflation and the shadow economy. The ARDL approach is employed to analyze data spanning from 1980 to 2023, providing insights into both short-run and long-run relationships. The goal is to establish how these variables influence money demand and to validate their theoretical impacts in the Malaysian context. The estimation results confirm the presence of a long-run cointegration relationship among the variables as evidenced by the significant and negative Error Correction Term (ECT) coefficient. This indicates that deviations from the long-run equilibrium are corrected over time ensuring the model's stability. Inflation and the shadow economy emerge as significant long-term drivers of money demand with inflation increasing transactional needs and the shadow economy reflecting the influence of informal economic activities.

In the short run, GDP demonstrates a significant delayed negative impact on money demand, suggesting nuanced interactions between economic growth and monetary dynamics. Interest rates exhibit a consistent negative effect, indicating that higher rates discourage money holding in favor of alternative investments. Inflation shows strong and dynamic effects, aligning with theoretical expectations of its influence on money demand, while the shadow economy's impact becomes significant at certain lags, emphasizing its relevance in short-term

fluctuations. Model diagnostics reinforce the robustness of the findings. The absence of serial correlation, heteroskedasticity, and functional form misspecification, along with stability confirmed by CUSUM and CUSUMSQ tests, highlights the reliability of the ARDL model. These results indicate a statistically and economically stable framework for understanding money demand dynamics in Malaysia.

The findings align with economic theory and provide valuable insights for policymakers. They highlight the importance of managing inflation and addressing informal economic activities to maintain monetary stability. Additionally, the nuanced roles of GDP and interest rates in both short- and long-run dynamics emphasize the need for careful consideration of these factors in monetary policy formulation.

5.3 Suggestion

Policymakers should prioritize effective inflation management to stabilize money demand. Initiatives such as inflation targeting frameworks and adaptive monetary policies can mitigate inflationary pressures. In addition, integrating shadow economy participants into the formal sector is essential. Strategies could include tax incentives, simplified regulations, and the promotion of digital payment platforms to encourage formalization. Future studies should invest in detailed data collection on informal economic activities within ASEAN countries to provide a more comprehensive understanding of regional monetary dynamics.

Finally, examining the post-pandemic impacts on money demand and informal economic activities could yield valuable insights for adapting monetary policies to evolving economic conditions. By implementing these recommendations, Malaysia can develop resilient monetary policies that accommodate both formal and informal sectors, fostering sustainable economic growth and stability.

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APPENDIX

Dependent Variable: M2				
Method: ARDL				
Date: 12/13/24 Time: 16:27				
Sample (adjusted): 1986 2023				
Included observations: 38 after adjustments				
Maximum dependent lags: 1 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (6 lags, automatic): GDP IR INF LSE				
Fixed regressors: C				
Number of models evaluated: 2401				
Selected Model: ARDL(1, 4, 1, 6, 5)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
M2(-1)	1.111928	0.077007	14.43931	0.0000
GDP	0.287217	0.248109	1.157624	0.2640
GDP(-1)	-0.043115	0.241352	-0.178641	0.8605
GDP(-2)	0.531566	0.582978	0.911812	0.3754
GDP(-3)	-1.036516	0.548930	-1.888249	0.0773
GDP(-4)	1.052980	0.286723	3.672460	0.0021
IR	-0.118543	0.098610	-1.202146	0.2468
IR(-1)	0.109663	0.090976	1.205401	0.2456
INF	-0.037876	0.889707	-0.042571	0.9666
INF(-1)	0.244847	0.920070	0.266118	0.7935
INF(-2)	-2.958475	1.395617	-2.119833	0.0500
INF(-3)	-4.405292	1.759040	-2.504372	0.0235
INF(-4)	1.662423	1.912227	0.869365	0.3975
INF(-5)	2.777172	1.361455	2.039856	0.0582
INF(-6)	-3.293342	0.728706	-4.519439	0.0003
LSE	-0.058812	0.043165	-1.362511	0.1919
LSE(-1)	0.052092	0.050938	1.022644	0.3217
LSE(-2)	0.047489	0.059171	0.802574	0.4340
LSE(-3)	-0.338602	0.080372	-4.212947	0.0007
LSE(-4)	0.040541	0.080383	0.504351	0.6209
LSE(-5)	0.076522	0.053438	1.431990	0.1714
C	0.786151	0.512099	1.535153	0.1443
R-squared	0.996217	Mean dependent var	11.75330	
Adjusted R-squared	0.991252	S.D. dependent var	0.455275	
S.E. of regression	0.042583	Akaike info criterion	-3.181841	
Sum squared resid	0.029013	Schwarz criterion	-2.233765	
Log likelihood	82.45499	Hannan-Quinn criter.	-2.844523	
F-statistic	200.6403	Durbin-Watson stat	1.883942	
Prob(F-statistic)	0.000000			
*Note: p-values and any subsequent tests do not account for model selection.				

ARDL Long Run Form and Bounds Test				
Dependent Variable: D(M2)				
Selected Model: ARDL(1, 4, 1, 6, 5)				
Case 2: Restricted Constant and No Trend				
Date: 12/13/24 Time: 16:30				
Sample: 1980 2023				
Included observations: 38				
Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.786151	0.512099	1.535153	0.1443
M2(-1)*	0.111928	0.077007	1.453483	0.1654
GDP(-1)	0.792131	0.971948	0.814994	0.4270
IR(-1)	-0.008881	0.126040	-0.070459	0.9447
INF(-1)	-6.010543	3.026547	-1.985940	0.0644
LSE(-1)	-0.180770	0.109523	-1.650525	0.1183
D(GDP)	0.287217	0.248109	1.157624	0.2640
D(GDP(-1))	-0.548029	0.833497	-0.657506	0.5202
D(GDP(-2))	-0.016464	0.615208	-0.026761	0.9790
D(GDP(-3))	-1.052980	0.286723	-3.672460	0.0021
D(IR)	-0.118543	0.098610	-1.202146	0.2468
D(INF)	-0.037876	0.889707	-0.042571	0.9666
D(INF(-1))	6.217514	2.869039	2.167106	0.0457
D(INF(-2))	3.259039	2.191941	1.486827	0.1565
D(INF(-3))	-1.146253	1.901966	-0.602667	0.5552
D(INF(-4))	0.516170	1.226481	0.420854	0.6795
D(INF(-5))	3.293342	0.728706	4.519439	0.0003
D(LSE)	-0.058812	0.043165	-1.362511	0.1919
D(LSE(-1))	0.174049	0.122642	1.419169	0.1750
D(LSE(-2))	0.221539	0.098695	2.244689	0.0393
D(LSE(-3))	-0.117064	0.081475	-1.436811	0.1700
D(LSE(-4))	-0.076522	0.053438	-1.431990	0.1714
* p-value incompatible with t-Bounds distribution.				
Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP	-7.077126	10.61145	-0.666933	0.5143
IR	0.079342	1.142791	0.069428	0.9455
INF	53.69989	25.64290	2.094143	0.0525
LSE	1.615052	0.363835	4.438969	0.0004
C	-7.023695	4.517477	-1.554783	0.1396
EC = M2 - (-7.0771*GDP + 0.0793*IR + 53.6999*INF + 1.6151*LSE - 7.0237)				
F-Bounds Test				
Null Hypothesis: No levels relationship				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic k	6.513564 4	Asymptotic: n=1000		
		10%	2.2	3.09
		5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Actual Sample Size	38	Finite Sample: n=40		
		10%	2.427	3.395
		5%	2.893	4
		1%	3.967	5.455
		Finite Sample: n=35		
		10%	2.46	3.46
		5%	2.947	4.088
		1%	4.093	5.532



ARDL Error Correction Regression

Dependent Variable: D(M2)

Selected Model: ARDL(1, 4, 1, 6, 5)

Case 2: Restricted Constant and No Trend

Date: 12/13/24 Time: 16:32

Sample: 1980 2023

Included observations: 38

ECM Regression

Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP)	0.287217	0.176123	1.630774	0.1225
D(GDP(-1))	-0.548029	0.208252	-2.631573	0.0181
D(GDP(-2))	-0.016464	0.381631	-0.043140	0.9661
D(GDP(-3))	-1.052980	0.207496	-5.074691	0.0001
D(IR)	-0.118543	0.059115	-2.005306	0.0621
D(INF)	-0.037876	0.615631	-0.061523	0.9517
D(INF(-1))	6.217514	0.873161	7.120696	0.0000
D(INF(-2))	3.259039	0.873563	3.730742	0.0018
D(INF(-3))	-1.146253	1.276399	-0.898037	0.3825
D(INF(-4))	0.516170	0.876502	0.588897	0.5642
D(INF(-5))	3.293342	0.527045	6.248691	0.0000
D(LSE)	-0.058812	0.032976	-1.783471	0.0935
D(LSE(-1))	0.174049	0.034850	4.994244	0.0001
D(LSE(-2))	0.221539	0.036144	6.129268	0.0000
D(LSE(-3))	-0.117064	0.058281	-2.008623	0.0618
D(LSE(-4))	-0.076522	0.042435	-1.803292	0.0902
CointEq(-1)*	0.111928	0.015628	7.162005	0.0000

R-squared	0.793164	Mean dependent var	0.036941
Adjusted R-squared	0.635575	S.D. dependent var	0.061571
S.E. of regression	0.037169	Akaike info criterion	-3.444999
Sum squared resid	0.029013	Schwarz criterion	-2.712395
Log likelihood	82.45499	Hannan-Quinn criter.	-3.184344
Durbin-Watson stat	1.883942		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test

Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.513564	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37





Breusch-Godfrey Serial Correlation LM Test: Null hypothesis: No serial correlation at up to 6 lags				
F-statistic	1.686493	Prob. F(6,10)	0.2217	
Obs*R-squared	19.11234	Prob. Chi-Square(6)	0.0040	
Test Equation: Dependent Variable: RESID Method: ARDL Date: 12/13/24 Time: 16:35 Sample: 1986 2023 Included observations: 38 Presample missing value lagged residuals set to zero.				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
M2(-1)	0.070468	0.080588	0.874418	0.4024
GDP	0.121308	0.323144	0.375399	0.7152
GDP(-1)	0.247423	0.258253	0.958064	0.3606
GDP(-2)	-0.386983	0.604987	-0.639655	0.5368
GDP(-3)	0.111496	0.493730	0.225824	0.8259
GDP(-4)	0.041907	0.263278	0.159173	0.8767
IR	0.092455	0.102163	0.904970	0.3868
IR(-1)	-0.012597	0.083964	-0.150024	0.8837
INF	0.508663	0.831751	0.611557	0.5545
INF(-1)	0.266761	0.896184	0.297662	0.7721
INF(-2)	0.488700	1.361688	0.358893	0.7271
INF(-3)	-1.509524	1.804117	-0.836711	0.4223
INF(-4)	1.675538	1.892625	0.885299	0.3968
INF(-5)	0.766656	1.434923	0.534284	0.6048
INF(-6)	0.707173	0.739391	0.956427	0.3614
LSE	-0.033311	0.044543	-0.747839	0.4718
LSE(-1)	-0.027924	0.050406	-0.553980	0.5918
LSE(-2)	0.007835	0.057351	0.136614	0.8940
LSE(-3)	-0.050971	0.079624	-0.640153	0.5365
LSE(-4)	0.053404	0.082911	0.644114	0.5340
LSE(-5)	0.031871	0.056838	0.560731	0.5873
C	-0.693369	0.540607	-1.282575	0.2286
RESID(-1)	-0.491618	0.370433	-1.327144	0.2140
RESID(-2)	-0.939908	0.354931	-2.648142	0.0244
RESID(-3)	-0.675229	0.390386	-1.729644	0.1144
RESID(-4)	-1.167975	0.489561	-2.385758	0.0382
RESID(-5)	-0.691532	0.498030	-1.388534	0.1951
RESID(-6)	-0.449666	0.521091	-0.862931	0.4084
R-squared	0.502956	Mean dependent var	1.14E-15	
Adjusted R-squared	-0.839061	S.D. dependent var	0.028002	
S.E. of regression	0.037974	Akaike info criterion	-3.565129	
Sum squared resid	0.014420	Schwarz criterion	-2.358487	
Log likelihood	95.73746	Hannan-Quinn criter.	-3.135815	
F-statistic	0.374776	Durbin-Watson stat	2.051036	
Prob(F-statistic)	0.979315			



Heteroskedasticity Test: ARCH				
F-statistic	0.007271	Prob. F(1,35)	0.9325	
Obs*R-squared	0.007685	Prob. Chi-Square(1)	0.9301	
Test Equation: Dependent Variable: RESID^2 Method: Least Squares Date: 12/13/24 Time: 16:37 Sample (adjusted): 1987 2023 Included observations: 37 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000749	0.000256	2.928748	0.0060
RESID^2(-1)	0.014411	0.169001	0.085271	0.9325
R-squared	0.000208	Mean dependent var	0.000760	
Adjusted R-squared	-0.028358	S.D. dependent var	0.001322	
S.E. of regression	0.001340	Akaike info criterion	-10.33920	
Sum squared resid	6.29E-05	Schwarz criterion	-10.25212	
Log likelihood	193.2751	Hannan-Quinn criter.	-10.30850	
F-statistic	0.007271	Durbin-Watson stat	2.001140	
Prob(F-statistic)	0.932532			

Ramsey RESET Test				
Equation: UNTITLED				
Omitted Variables: Squares of fitted values				
Specification: M2 M2(-1) GDP GDP(-1) GDP(-2) GDP(-3) GDP(-4) IR				
IR(-1) INF INF(-1) INF(-2) INF(-3) INF(-4) INF(-5) INF(-6) LSE LSE(-1) LSE(-2) LSE(-3) LSE(-4) LSE(-5) C				
	Value	df	Probability	
t-statistic	1.531951	15	0.1464	
F-statistic	2.346873	(1, 15)	0.1464	
Likelihood ratio	5.523759	1	0.0188	
F-test summary:				
	Sum of Sq.	df	Mean Squares	
Test SSR	0.003925	1	0.003925	
Restricted SSR	0.029013	16	0.001813	
Unrestricted SSR	0.025087	15	0.001672	
LR test summary:				
	Value			
Restricted LogL	82.45499			
Unrestricted LogL	85.21687			
Unrestricted Test Equation:				
Dependent Variable: M2				
Method: Least Squares				
Date: 12/13/24 Time: 16:38				
Sample: 1986 2023				
Included observations: 38				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
M2(-1)	4.610694	2.285060	2.017756	0.0619
GDP	1.184845	0.632536	1.873167	0.0807
GDP(-1)	-0.148245	0.241738	-0.613246	0.5489
GDP(-2)	2.054607	1.140998	1.800710	0.0919
GDP(-3)	-4.439458	2.283015	-1.944559	0.0708
GDP(-4)	4.493291	2.262526	1.985962	0.0656
IR	-0.453683	0.238386	-1.903147	0.0764
IR(-1)	0.499620	0.269127	1.856445	0.0831
INF	-0.236395	0.864240	-0.273530	0.7882
INF(-1)	0.672087	0.926595	0.725330	0.4794
INF(-2)	-11.89446	5.985088	-1.987349	0.0655
INF(-3)	-17.41603	8.659310	-2.011249	0.0626
INF(-4)	7.713154	4.355772	1.770789	0.0969
INF(-5)	12.22301	6.303004	1.939236	0.0715
INF(-6)	-13.91869	6.971046	-1.996643	0.0643
LSE	-0.234422	0.121897	-1.923114	0.0737
LSE(-1)	0.210034	0.114117	1.840520	0.0856
LSE(-2)	0.220065	0.126173	1.744153	0.1016
LSE(-3)	-1.370174	0.677781	-2.021558	0.0614
LSE(-4)	0.212377	0.136167	1.559683	0.1397
LSE(-5)	0.369733	0.198158	1.865848	0.0817
C	-16.04245	10.99608	-1.458924	0.1652
FITTED^2	-0.140322	0.091597	-1.531951	0.1464
R-squared	0.996729	Mean dependent var	11.75330	
Adjusted R-squared	0.991931	S.D. dependent var	0.455275	
S.E. of regression	0.040896	Akaike info criterion	-3.274572	
Sum squared resid	0.025087	Schwarz criterion	-2.283401	
Log likelihood	85.21687	Hannan-Quinn criter.	-2.921921	
F-statistic	207.7490	Durbin-Watson stat	1.779357	
Prob(F-statistic)	0.000000			



Null Hypothesis: M2 has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1.520727	0.5137
Test critical values:	1% level		-3.592462	
	5% level		-2.931404	
	10% level		-2.603944	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(M2) Method: Least Squares Date: 12/13/24 Time: 17:04 Sample (adjusted): 1981 2023 Included observations: 43 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
M2(-1)	-0.025477	0.016753	-1.520727	0.1360
C	0.335743	0.194649	1.724868	0.0921
R-squared	0.053393	Mean dependent var		0.040038
Adjusted R-squared	0.030306	S.D. dependent var		0.058594
S.E. of regression	0.057700	Akaike info criterion		-2.821736
Sum squared resid	0.136499	Schwarz criterion		-2.739820
Log likelihood	62.66732	Hannan-Quinn criter.		-2.791528
F-statistic	2.312611	Durbin-Watson stat		2.006978
Prob(F-statistic)	0.136004			



Null Hypothesis: D(M2) has a unit root Exogenous: Constant Lag Length: 1 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-6.037237	0.0000
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(M2,2) Method: Least Squares Date: 12/13/24 Time: 17:05 Sample (adjusted): 1983 2023 Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(M2(-1))	-1.297766	0.214960	-6.037237	0.0000
D(M2(-1),2)	0.315130	0.153051	2.058986	0.0464
C	0.050671	0.012513	4.049536	0.0002
R-squared	0.545667	Mean dependent var		-0.000976
Adjusted R-squared	0.521755	S.D. dependent var		0.083799
S.E. of regression	0.057951	Akaike info criterion		-2.788070
Sum squared resid	0.127618	Schwarz criterion		-2.662686
Log likelihood	60.15543	Hannan-Quinn criter.		-2.742412
F-statistic	22.81956	Durbin-Watson stat		1.937036
Prob(F-statistic)	0.000000			





Null Hypothesis: GDP has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.279632	0.0001
Test critical values:	1% level		-3.592462	
	5% level		-2.931404	
	10% level		-2.603944	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(GDP) Method: Least Squares Date: 12/13/24 Time: 17:06 Sample (adjusted): 1981 2023 Included observations: 43 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.809192	0.153267	-5.279632	0.0000
C	0.044078	0.010307	4.276339	0.0001
R-squared	0.404714	Mean dependent var	-0.000860	
Adjusted R-squared	0.390195	S.D. dependent var	0.048816	
S.E. of regression	0.038120	Akaike info criterion	-3.650748	
Sum squared resid	0.059579	Schwarz criterion	-3.568831	
Log likelihood	80.49108	Hannan-Quinn criter.	-3.620540	
F-statistic	27.87451	Durbin-Watson stat	1.950100	
Prob(F-statistic)	0.000005			



Null Hypothesis: D(GDP) has a unit root Exogenous: Constant Lag Length: 1 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-8.324491	0.0000
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(GDP,2) Method: Least Squares Date: 12/13/24 Time: 17:19 Sample (adjusted): 1983 2023 Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-1.960605	0.235523	-8.324491	0.0000
D(GDP(-1),2)	0.476339	0.146409	3.253474	0.0024
C	-0.000800	0.006682	-0.119781	0.9053
R-squared	0.736020	Mean dependent var	-0.000976	
Adjusted R-squared	0.722126	S.D. dependent var	0.081142	
S.E. of regression	0.042773	Akaike info criterion	-3.395456	
Sum squared resid	0.069523	Schwarz criterion	-3.270073	
Log likelihood	72.60685	Hannan-Quinn criter.	-3.349798	
F-statistic	52.97504	Durbin-Watson stat	2.172697	
Prob(F-statistic)	0.000000			



Null Hypothesis: IR has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-6.867806	0.0000
Test critical values:	1% level		-3.592462	
	5% level		-2.931404	
	10% level		-2.603944	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(IR) Method: Least Squares Date: 12/13/24 Time: 17:20 Sample (adjusted): 1981 2023 Included observations: 43 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
IR(-1)	-1.070941	0.155936	-6.867806	0.0000
C	0.021348	0.028085	0.760104	0.4515
R-squared	0.534972	Mean dependent var		0.001000
Adjusted R-squared	0.523630	S.D. dependent var		0.265347
S.E. of regression	0.183141	Akaike info criterion		-0.511724
Sum squared resid	1.375168	Schwarz criterion		-0.429807
Log likelihood	13.00206	Hannan-Quinn criter.		-0.481516
F-statistic	47.16677	Durbin-Watson stat		1.993267
Prob(F-statistic)	0.000000			

Null Hypothesis: D(IR) has a unit root Exogenous: Constant Lag Length: 1 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-7.708392	0.0000
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(IR,2) Method: Least Squares Date: 12/13/24 Time: 17:25 Sample (adjusted): 1983 2023 Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(IR(-1))	-2.064930	0.267881	-7.708392	0.0000
D(IR(-1),2)	0.341708	0.152626	2.238854	0.0311
C	-0.003297	0.034486	-0.095598	0.9243
R-squared	0.795623	Mean dependent var		0.002634
Adjusted R-squared	0.784866	S.D. dependent var		0.476008
S.E. of regression	0.220785	Akaike info criterion		-0.112903
Sum squared resid	1.852342	Schwarz criterion		0.012480
Log likelihood	5.314511	Hannan-Quinn criter.		-0.067245
F-statistic	73.96548	Durbin-Watson stat		2.184648
Prob(F-statistic)	0.000000			



Null Hypothesis: INF has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.030971	0.0030
Test critical values:	1% level		-3.592462	
	5% level		-2.931404	
	10% level		-2.603944	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(INF) Method: Least Squares Date: 12/13/24 Time: 17:26 Sample (adjusted): 1981 2023 Included observations: 43 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.513764	0.127454	-4.030971	0.0002
C	0.013504	0.004343	3.109597	0.0034
R-squared	0.283827	Mean dependent var	-0.000977	
Adjusted R-squared	0.266359	S.D. dependent var	0.018681	
S.E. of regression	0.016001	Akaike info criterion	-5.386972	
Sum squared resid	0.010497	Schwarz criterion	-5.305056	
Log likelihood	117.8199	Hannan-Quinn criter.	-5.356764	
F-statistic	16.24873	Durbin-Watson stat	2.106085	
Prob(F-statistic)	0.000235			



Null Hypothesis: D(INF) has a unit root Exogenous: Constant Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-9.414692	0.0000
Test critical values:	1% level		-3.596616	
	5% level		-2.933158	
	10% level		-2.604867	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(INF,2) Method: Least Squares Date: 12/13/24 Time: 17:30 Sample (adjusted): 1982 2023 Included observations: 42 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	-1.345936	0.142961	-9.414692	0.0000
C	-0.001986	0.002667	-0.744692	0.4608
R-squared	0.689046	Mean dependent var	-0.000929	
Adjusted R-squared	0.681272	S.D. dependent var	0.030588	
S.E. of regression	0.017269	Akaike info criterion	-5.233385	
Sum squared resid	0.011928	Schwarz criterion	-5.150638	
Log likelihood	111.9011	Hannan-Quinn criter.	-5.203055	
F-statistic	88.63642	Durbin-Watson stat	1.919535	
Prob(F-statistic)	0.000000			



Null Hypothesis: LSE has a unit root Exogenous: Constant Lag Length: 2 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-0.539745	0.8727
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(LSE) Method: Least Squares Date: 12/13/24 Time: 17:32 Sample (adjusted): 1983 2023 Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSE(-1)	-0.050624	0.093792	-0.539745	0.5926
D(LSE(-1))	-0.413251	0.179906	-2.297032	0.0274
D(LSE(-2))	-0.048440	0.169794	-0.285290	0.7770
C	0.646049	1.006589	0.641821	0.5249
R-squared	0.189914	Mean dependent var		0.065632
Adjusted R-squared	0.124232	S.D. dependent var		0.359576
S.E. of regression	0.336500	Akaike info criterion		0.752032
Sum squared resid	4.189598	Schwarz criterion		0.919210
Log likelihood	-11.41665	Hannan-Quinn criter.		0.812909
F-statistic	2.891396	Durbin-Watson stat		1.983644
Prob(F-statistic)	0.048231			

Null Hypothesis: D(LSE) has a unit root Exogenous: Constant Lag Length: 1 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.601470	0.0000
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(LSE,2) Method: Least Squares Date: 12/13/24 Time: 17:32 Sample (adjusted): 1983 2023 Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSE(-1))	-1.528056	0.272796	-5.601470	0.0000
D(LSE(-1),2)	0.073980	0.161540	0.457965	0.6496
C	0.103584	0.055311	1.872772	0.0688
R-squared	0.713464	Mean dependent var		-0.007586
Adjusted R-squared	0.698384	S.D. dependent var		0.606974
S.E. of regression	0.333348	Akaike info criterion		0.711094
Sum squared resid	4.222586	Schwarz criterion		0.836477
Log likelihood	-11.57743	Hannan-Quinn criter.		0.756752
F-statistic	47.30938	Durbin-Watson stat		1.982707
Prob(F-statistic)	0.000000			