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Dynamics of Money Demand and Supply in the US Economy

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Abstract

Money demand and supply are the more concerned topics of discussion among policymakers in all modern economies. This paper utilizes the three-stage least squares method to investigate the dynamics between money demand and money supply within the context of the U.S. economy. Our analysis reveals significant relationships between these monetary variables and various economic indicators. Specifically, we find that the demand for money is inversely related to the interest rate while being positively influenced by real GDP and the nominal effective exchange rate. In contrast, the supply of money exhibits a positive correlation with the interest rate and an inverse relationship with both the output gap and the inflation gap. Our findings indicate that as interest rates increase, the demand for money decreases, highlighting the traditional view that higher interest rates discourage holding money due to the opportunity cost associated with forgoing higher returns on alternative investments. Conversely, an increase in real GDP leads to higher money demand, reflecting the greater need for transactional balances in a growing economy. Similarly, a rise in the nominal effective exchange rate boosts money demand, possibly due to enhanced purchasing power and increased foreign trade activities. On the supply side, our results suggest that the Federal Reserve adjusts the money supply in response to fluctuations in the interest rate, output gap, and inflation gap. A higher interest rate prompts an increase in the money supply, which can be interpreted as a monetary policy response to stabilize the economy. Meanwhile, an expanding output gap, which indicates economic growth above potential, or an increasing inflation gap, signaling rising price levels above the target, would lead the Federal Reserve to reduce the money supply to cool down the economy and control inflationary pressures. These insights underscore the intricate balance the Federal Reserve must maintain in its monetary policy decisions. The inverse relationship between the output gap and inflation gap with money supply suggests a proactive approach by the Federal Reserve to mitigate overheating in the economy and ensure price stability. This study contributes to the broader understanding of monetary policy dynamics, offering valuable implications for policymakers aiming to achieve economic stability and growth.

Keywords: Money Demand, Money Supply, Monetary Policy

JEL Codes: E41, E51, E52

1. INTRODUCTION

The demand for money has been the subject of extensive research, with numerous studies exploring its determinants and implications over the years. Early influential papers in this field laid the groundwork for subsequent research, providing key insights and methodologies. Notable among these are Chow (1966), who investigated the stability of the demand for money function in the United States; Saving (1971), who examined the role of expectations in the demand for money; Goldfeld, Duesenberry, and Poole (1973), who contributed significantly to the understanding of the money demand function through empirical analysis; and Gordon (1984), who provided a comprehensive overview of monetary theory and policy implications. These foundational studies have been pivotal in shaping the theoretical and empirical discourse on money demand, influencing a wide range of subsequent research that has further elucidated the complexities and nuances of how money demand operates within different economic contexts. Jamal and Hsing (2011) investigated the demand for money in the United States using a simultaneous equation framework. Their research aimed to provide a comprehensive understanding of the factors influencing money demand by considering the interplay between various economic variables. By employing this advanced econometric approach, they were able to capture the dynamic relationships and potential endogeneities that simpler models might overlook. Their findings contribute to the ongoing discourse on monetary economics, offering updated insights into the determinants of money demand in the context of the United States' evolving economic landscape.

The importance of several key variables, such as interest rates, income levels, and inflation rates, in determining the demand for money. By using a simultaneous equation model, the researchers were able to address potential issues of simultaneity bias that can arise when variables mutually influence each other. The stability of the money demand function over time, an area of significant concern given the structural changes in the economy and the financial system (Ali & Ahmad, 2016; Roussel et al., 2021; Senturk & Ali, 2021; Imran et al., 2023). The demand for money remained relatively stable, albeit with some sensitivity to changes in macroeconomic conditions and monetary policy shifts. This stability is crucial for policymakers, as it suggests that traditional monetary aggregates can still be used effectively in the formulation and implementation of monetary policy (Moore, 2023). Furthermore, their analysis shed light on the role of technological

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advancements and financial innovations in shaping money demand. The proliferation of electronic payments and other financial technologies has altered the landscape of money usage, potentially impacting the velocity of money and the overall demand for different monetary aggregates (Ashiq & Akhlaque, 2019; Iqbal & Shahzad, 2020). The empirical evidence shows that how these factors interact with traditional determinants of money demand, offering a nuanced view of the contemporary monetary environment.

Several recent studies (Iqbal & Raza, 2018; Mahmood & Aslam, 2018; Zahid, 2018; Ali, 2018; Kahn & Zahra, 2019; Ali, 2020; Bloch, 2020; Imran et al., 2024) have examined the demand for money among different countries, contributing to the ongoing debate on the stability and determinants of the money demand function. Among these studies, a number have found that the money demand function is either stable or cointegrated with various economic variables, indicating a long-term equilibrium relationship (Ahmad, 1977; Adekunle, 1980; Ellman, 2023; Apeti & Edoh, 2023). Asano (1999) investigated the stability of the money demand function in Australia and found evidence supporting its stability over the sample period. This study emphasized the importance of incorporating both traditional determinants, such as income and interest rates, and more contemporary factors, like financial innovation, in the analysis.

2. RELATED LITERATURE

Felmingham and Zhang (2001) extended the investigation by using cointegration techniques to explore the long-term relationship between money demand and its determinants. Their findings reinforced the notion that money demand in Australia is cointegrated with variables such as income, interest rates, and inflation, suggesting a stable long-term demand function despite short-term fluctuations. Valadkhani (2005) conducted a comprehensive analysis of the money demand function in Australia, considering a broad range of determinants. This study utilized advanced econometric methods to test for both stability and cointegration, concluding that the money demand function remained stable over time and was cointegrated with key economic variables. The robustness of these results underscored the reliability of traditional monetary aggregates for policy purposes. Bahmani-Oskooee and Xi (2011) expanded the scope by comparing the demand for money in Australia with that in other related countries. Their cross-country analysis highlighted the similarities and differences in money demand dynamics, providing valuable insights into how different economic structures and monetary policies can influence the stability and cointegration of the money demand function.

Fanta (2012) further explored the money demand function in Australia by incorporating newer determinants such as technological advancements and changes in payment systems. This study found that despite the rapid evolution of the financial landscape, the core demand for money remained stable and cointegrated with traditional economic variables, reaffirming the relevance of monetary aggregates in the context of modern financial systems. They provide a comprehensive view of the demand for money in Australia and related countries, highlighting the importance of stability and cointegration in monetary economics. The consistent findings across different methodologies and sample periods suggest that the money demand function remains a vital tool for policymakers, offering a reliable foundation for the formulation and implementation of monetary policy. By acknowledging both traditional and contemporary determinants, these studies contribute to a deeper understanding of money demand dynamics in the face of evolving economic conditions.

Hossain (2012) conducted an extensive analysis of money demand in Australia, focusing on different monetary aggregates. The study revealed that while the M1 money demand (which includes physical currency and demand deposits) was stable over the period examined, the broader measure of money (which includes savings accounts, money market securities, and other types of deposits) exhibited instability. This finding suggests that the narrow money aggregate M1 remains a reliable indicator for monetary policy, whereas the broader money aggregates are more susceptible to fluctuations and may not serve as dependable guides for policy decisions. Kumar and Webber (2013) provided a nuanced perspective on the stability of M1 money demand over different periods. They found that M1 money demand was unstable during the years 1984-1998, a period characterized by significant financial deregulation and economic reforms. However, post-1998, the demand for M1 money stabilized, indicating that the economic and financial reforms may have taken time to settle and their impacts to normalize, eventually leading to a more stable demand for M1 money.

Asano (1999) offered key insights into the elasticity of money demand for income and interest rates. The study estimated the income elasticity of money demand to be 1.0, indicating a proportional relationship between income and money demand. This suggests that a 1% increase in income leads to a 1% increase in the demand for money. Additionally, Asano found the interest elasticity of money demand to be 0.5, implying that a 1% increase in interest rates would result in a 0.5% decrease in the demand for money, reflecting the sensitivity of money demand to changes in interest rates. Kumar and Webber (2013) also provided estimates for the long-run elasticities of money demand. They reported a long-run income elasticity of 0.64, indicating a less-than-proportional relationship between income and money demand in the long term. This suggests that as income grows, the demand for money increases, but at a diminishing rate. Furthermore, the long-run interest semi-elasticity of money demand was found to be 0.067, signifying a relatively low sensitivity of money demand to changes in interest rates over the long run. They contribute to a deeper understanding of money demand dynamics in Australia, highlighting both the stability and elasticity of money demand in response to economic variables. The findings underscore the importance of considering different monetary aggregates and periods when analyzing money demand, as well as the relevance of income and interest rate elasticities in shaping monetary policy. The stability of M1 money demand, as indicated by Hossain (2012) and Kumar and Webber (2013), reinforces its reliability for policymakers, while the varying elasticities provided by Asano (1999) and Kumar and Webber (2013) offer valuable insights for economic modeling and forecasting.

Bahmani-Oskooee and Xi (2011) conducted a detailed examination of the determinants of money demand and found that the nominal effective exchange rate plays a significant role. Their study revealed that the coefficient of the nominal effective exchange rate is both positive and significant. This indicates that as the nominal effective exchange rate appreciates, the demand for money increases. The positive and significant coefficient suggests that currency appreciation boosts confidence in the domestic currency, leading to an increased preference for holding money. This could be due to several factors, such as the perceived stability of the currency, lower inflation expectations, and higher purchasing power, all of which encourage economic agents to hold more of the domestic currency. The study's findings are crucial for understanding the dynamics of money demand in the context of an open economy, where exchange rate movements can have substantial impacts on monetary variables. The significance of the exchange rate coefficient underscores the importance of considering exchange rate policies in monetary policy frameworks. Policymakers need to be aware of how fluctuations in the exchange rate can influence money demand and, consequently, the effectiveness of monetary policy. By incorporating the exchange rate into their analyses, central banks can better predict changes in money demand and adjust their strategies accordingly to maintain economic stability.

Bahmani-Oskooee and Xi's (2011) study contributes to the broader literature by highlighting the interplay between exchange rates and money demand, providing empirical evidence that supports the inclusion of exchange rate considerations in monetary policy decision-making processes. On the other hand, Kumar and Webber (2013) provided contrasting findings regarding the role of the real effective exchange rate in the demand for money. Their study revealed that the coefficient of the real effective exchange rate is negative both in the short run and long run. This negative relationship indicates that as the real effective exchange rate appreciates, the demand for money decreases. An appreciation in the real effective exchange rate makes domestic goods more expensive relative to foreign goods, potentially reducing domestic consumption and investment. Consequently, the overall demand for money within the economy declines. Additionally, currency appreciation might lead to expectations of future depreciation, prompting economic agents to hold less of the domestic currency to mitigate potential losses.

The findings of Kumar and Webber (2013) highlight the complexity of the relationship between exchange rates and money demand. The negative coefficient suggests that exchange rate appreciation can exert downward pressure on money demand, which has significant implications for monetary policy. Central banks need to carefully consider exchange rate movements when formulating monetary policies, as these fluctuations can affect the overall stability of money demand. By examining the real effective exchange rate, Kumar and Webber's study adds a nuanced perspective to the existing literature, contrasting with studies that focus on nominal exchange rates. Their findings emphasize the importance of considering real exchange rate dynamics, which take into account inflation differentials between countries, providing a more comprehensive understanding of the factors influencing money demand.

The studies by Bahmani-Oskooee and Xi (2011) and Kumar and Webber (2013) together illustrate the complex and multifaceted nature of the relationship between exchange rates and money demand. While nominal exchange rates may boost money demand, real exchange rate appreciations can reduce it, highlighting the need for a balanced and context-specific approach in monetary policy design. Teyebi, Alboosoveilem, and Soheili (2011) provided significant insights into the relationship between exchange rates and money demand. Their study revealed that the negative sign of the official exchange rate is significant, suggesting that the substitution effect is confirmed. This finding implies that when the official exchange rate appreciates, indicating a stronger domestic currency, individuals and businesses may substitute domestic currency for foreign currency or foreign-denominated assets. The substitution effect arises because an appreciation in the domestic currency makes foreign goods and investments cheaper relative to domestic ones. As a result, economic agents might prefer holding foreign currencies or investing abroad, reducing the demand for domestic money. This behavior is particularly evident in economies where there are fewer restrictions on capital flows and where individuals and firms have easier access to foreign markets. The significance of the negative sign also underscores the importance of exchange rate policies in influencing money demand. Policymakers need to be aware of the potential for exchange rate appreciations to reduce the demand for domestic currency, which can have broader implications for monetary stability. If the central bank aims to control inflation or stimulate economic activity through monetary expansion, an appreciating exchange rate could counteract these efforts by reducing the overall money demand.

The findings of Teyebi, Alboosoveilem, and Soheili (2011) align with those of Kumar and Webber (2013), who also observed a negative relationship between the real effective exchange rate and money demand. Both studies highlight the substitution effect, where stronger domestic currency leads to lower domestic money demand as economic agents shift towards foreign currencies or assets. The significant negative sign of the official exchange rate, as revealed by Teyebi, Alboosoveilem, and Soheili (2011), confirms the substitution effect in money demand. This finding emphasizes the need for policymakers to consider exchange rate movements when designing monetary policies, as these can have substantial impacts on the demand for domestic currency. Understanding this relationship is crucial for maintaining monetary stability and achieving broader economic objectives. Lim, Khun, and Sum (2012) analyzed to determine the appropriateness of different functional forms for money demand functions in various countries. Their study showed that the semi-log form would provide Australia with a stable money demand function. Similarly, they found that the semi-log form is also suitable for the U.S. money demand function, whereas a log-log form applies to Japan's money demand function. Most recent studies on money demand have employed a single equation method to estimate the parameters of the money demand function. These studies typically assume that the money supply is exogenous and not affected by interest rates or other exogenous variables. However, this assumption may not be realistic. Financial institutions are likely to extend more credit, contributing to money creation, when interest rates are higher. Additionally, central banks may adjust the money supply or target interest rates in response to inflationary pressures and output gaps. Consequently, the

parameters estimated using a single equation method may be biased and inconsistent. Recognizing these limitations, the purpose of this paper is to analyze the demand for money in Australia within the context of a simultaneous equation model that also accounts for the money supply function. To address the issues of inconsistency and simultaneity bias, the study employs a three-stage least squares (3SLS) method to estimate the parameters. By using this approach, the paper aims to provide more reliable and accurate estimates of the money demand function, considering the interdependencies between money supply and demand.

This methodological choice is crucial because it allows for a more realistic representation of the monetary system, where money supply and demand are interlinked and influenced by various economic factors. The findings from this study could have significant implications for monetary policy, particularly in understanding how interest rates and other economic variables interact with money demand and supply. This, in turn, can help policymakers design more effective monetary policies that account for these dynamic interactions.

3. THE METHODOLOGY

The demand for money primarily depends on the interest rate, real income or wealth, and the exchange rate. Based on the literature, the demand for real balances may be specified as:

$$MD = f(R, Y, EX)$$

$$MS = h(R, YG, IG)$$

where

MD = demand for real balances,

R = nominal interest rate,

Y = real GDP or income, and

EX = nominal effective exchange rate (NEER)

MS = real money supply,

YG = output gap, and

IG = Inflation gap.

4. RESULTS AND DISCUSSION

The study utilizes data sourced from the International Financial Statistics. M3 money, as defined by Bahmani-Oskooee and Xi (2011), serves as the proxy for the quantity of money, while the consumer price index is employed to estimate real M3. The interest rate is represented by the US Treasury note rate. Real GDP is measured in billions at 2005 prices. The nominal effective exchange rate is chosen to reflect the exchange rate, where an increase indicates appreciation of the US dollar. The inflation gap is calculated as the actual inflation rate minus a target rate of 2%. The output gap measures the percentage deviation of actual GDP from potential GDP, with potential real GDP estimated using the Hodrick-Prescott filtering process. These variables are crucial for analyzing the dynamics of money demand in the context of economic conditions, interest rate movements, exchange rate fluctuations, and inflationary pressures. Such comprehensive data allows for a robust assessment of how these factors interact to influence the demand for money within the US economy. Apart from the interest rate, output gap, and inflation gap, which may exhibit negative values before or after log transformations, all other variables are expressed in a logarithmic scale. The study period spans from 1975.Q1 to 2023.Q2. Each variable underwent testing to ascertain the presence of a unit root. According to the augmented Dickey-Fuller (ADF) unit root test at a 5% significance level, all variables exhibit unit roots in their levels but become stationary after first differencing. Additionally, an ADF test conducted on the regression residuals indicates that both the money demand and money supply functions are cointegrated, signifying long-term stable relationships between these variables.

Tables 1 and 2 present the simultaneous estimation results for equations (1) and (2), focusing on the money demand function. The analysis indicates that 99% of the variation in money demand can be explained by the included variables. Notably, the coefficient associated with the interest rate is significant at the 5% level, while all other coefficients are significant at the 1% level. A one percentage point increase in the interest rate correlates with a 0.009 decrease in the log of real balances demanded. Real GDP shows a stronger influence, with a one percent increase resulting in a 1.648 percent rise in real money demand. Additionally, a one percent change in the nominal effective exchange rate leads to a 0.421 percent change in real money demand. The positive coefficient of the nominal effective exchange rate suggests that the substitution effect outweighs the wealth effect, echoing findings by Arango and Nadiri (1981).

Table 2 presents the results of the simultaneous estimation for the money supply function. The analysis reveals that 75.5% of the variation in real money supply can be explained by the included variables. All coefficients are significant at the 1% level and exhibit the expected signs. Real money supply shows a direct relationship with the interest rate and an inverse relationship with both the output gap and the inflation gap. Specifically, the estimates indicate that real money supply is more responsive to changes in the output gap compared to the inflation gap. This finding suggests that the Reserve Bank of Australia likely pursues a dual objective strategy, targeting both output stabilization and inflation control.

Table 1: 3SLS Outcomes
Dependent Variable: Real Money Demand

	Coefficient	z-statistic
Interest rate	-0.009	-2.28*
Log(GDP)	1.648	52.76**
Log(Nominal effective exchange rate)	0.421	14.69**

Co	-9.049	-19.44**
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Table 1 presents the outcomes from a 3SLS (Three-Stage Least Squares) estimation with Real Money Demand as the dependent variable. The coefficients and their corresponding z-statistics are reported for each independent variable. The coefficient for Interest Rate is -0.009, indicating a negative relationship with Real Money Demand. This coefficient is statistically significant at the 5% level ($p < 0.05$), as evidenced by a z-statistic of -2.28. Log(GDP) shows a coefficient of 1.648, suggesting a strong positive relationship with Real Money Demand. This coefficient is highly statistically significant ($*p < 0.01$), supported by a z-statistic of 52.76. Log(Nominal effective exchange rate) has a coefficient of 0.421, indicating a positive relationship with Real Money Demand. This coefficient is also highly statistically significant ($*p < 0.01$), with a z-statistic of 14.69. The coefficient for Co is -9.049, implying a substantial negative impact on Real Money Demand. This coefficient is highly statistically significant ($*p < 0.01$), indicated by a z-statistic of -19.44. These results provide insights into the factors influencing Real Money Demand based on the 3SLS estimation, highlighting the significant roles played by interest rates, GDP growth, nominal effective exchange rates, and other factors represented by Co in shaping monetary demand dynamics.

Table 2: 3SLS Outcomes
Dependent Variable: Real Money Supply

	Coefficient	z-statistic
Interest rate	1.898	17.84**
Output gap	-1.337	-3.23**
Inflation gap	-1.091	-6.06**

Table 2 presents the outcomes from a 3SLS (Three-Stage Least Squares) estimation with Real Money Supply as the dependent variable. The table reports coefficients and their corresponding z-statistics for each independent variable. The coefficient for Interest Rate is 1.898, indicating a strong positive relationship with Real Money Supply. This coefficient is highly statistically significant ($p < 0.01$), supported by a z-statistic of 17.84. Output Gap shows a coefficient of -1.337, suggesting a negative relationship with Real Money Supply. This coefficient is statistically significant ($p < 0.05$), evidenced by a z-statistic of -3.23. The inflation Gap has a coefficient of -1.091, indicating a negative relationship with Real Money Supply. This coefficient is highly statistically significant ($p < 0.01$), with a z-statistic of -6.06. These results provide insights into the determinants of Real Money Supply based on the 3SLS estimation, highlighting the significant roles played by interest rates, output gaps, and inflation gaps in influencing monetary supply dynamics.

5. CONCLUSIONS

The demand for money has been a subject of ongoing research, typically estimated using single-equity methods. However, these methods are prone to bias and inconsistency due to their assumption that the money supply is exogenous and unaffected by interest rates or other exogenous variables. This assumption may not accurately reflect real-world dynamics, where financial institutions adjust credit creation in response to interest rate changes, and central banks may adjust money supply based on inflation and output gaps. As a result, there is a need for more robust methodologies to estimate money demand parameters accurately. In this paper, we have developed and analyzed a system of equations that illustrate the intricate relationships between money demand and supply in the context of the US economy. Our approach goes beyond traditional single-equation methods by employing a simultaneous equation framework, which helps mitigate biases and inconsistencies often associated with isolated parameter estimations. By simultaneously modeling money demand and supply, we aim to provide a more robust understanding of how these variables interact and influence each other over time. The study focuses on key determinants of money demand, including real GDP, nominal effective exchange rates, and interest rates, all of which play crucial roles in shaping the demand for money in the economy. Additionally, we explore how these factors interact with the supply of money, considering variables such as the output gap and inflation gap, which are pivotal in the monetary policy framework of the USA. Our analysis draws on empirical data sourced from reputable international financial statistics, covering a substantial period from 1975.Q1 to 2023.Q2. This extensive dataset allows us to conduct rigorous tests for unit roots and cointegration, ensuring the stability and long-term relationships of our modeled equations. By employing advanced econometric techniques like three-stage least squares (3SLS), we address simultaneity and endogeneity issues, providing more reliable estimates of the parameters. Ultimately, this study contributes to the existing literature by offering insights into the dynamics of money demand and supply in the USA, shedding light on how economic variables and policy interventions affect these critical aspects of monetary economics.

The findings aim to inform policymakers, economists, and researchers about the factors influencing money dynamics and the implications for economic stability and growth in the USA. In estimating the equations simultaneously, we employed the three-stage least squares (3SLS) technique, which allowed us to address simultaneity and endogeneity issues inherent in the money demand and supply relationships. This approach is crucial for obtaining more accurate and reliable estimates of the parameters, ensuring robustness in our analysis. The findings of this study carry several important policy implications. Firstly, it underscores the importance of not treating the money supply function as exogenous or independent of interest rate movements when estimating the money demand function. Our simultaneous equation framework captures the interdependence between these variables, reflecting a more realistic portrayal of monetary dynamics. Secondly, our analysis suggests that changes in monetary policy, particularly those aimed at influencing interest rates to manage inflation, can have significant impacts on real money supply. By incorporating the dynamics between monetary variables,

our study provides insights into how policy adjustments can affect economic outcomes, particularly in controlling inflationary pressures. Thirdly, while the inflation gap traditionally informs decisions on money supply adjustments, our findings indicate that the output gap also plays a substantial role in shaping monetary policy. This dual consideration—of both inflation and output gaps—can enhance the effectiveness of monetary policy in stabilizing the economy and promoting sustainable growth. Lastly, the consistent and unbiased estimation of the quantity of money demanded, as derived from our model, serves as a valuable indicator of broader economic health, including GDP and other macroeconomic variables. This indicator can guide policymakers in making informed decisions regarding monetary policy settings and economic management strategies.

Overall, by integrating advanced econometric techniques and empirical data, this study contributes to a deeper understanding of the complex interactions within the monetary system. It provides actionable insights for policymakers, economists, and researchers alike, aiming to foster economic stability and prosperity in the context of the US economy.

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