

Economic uncertainty, monetary uncertainty and money demand in Pakistan: An asymmetrical analysis

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Abstract

Purpose — Adopting an asymmetric approach, this study analyses the impact of economic and monetary uncertainties on money demand within an open-economy framework for Pakistan. Its primary objective is to assess whether the positive and negative components of each type of uncertainty deliver a differential impact on money demand.

Methods — The study employs the Nonlinear Autoregressive Distributed Lag (NARDL) framework to examine the long-run and short-run money demand function over the period 1975–2024.

Findings — The results reveal distinct asymmetric effects. Rising economic uncertainty decreases money demand, while a decline in economic uncertainty has a positive but comparatively weaker effect. Conversely, increasing monetary uncertainty increases demand, while a decline in monetary uncertainty reduces demand for money. These findings suggest that for the positive component of economic uncertainty, the substitution effect dominates the precautionary effect; however, as monetary uncertainty increases, the precautionary effect overwhelms the substitution effect. The overall findings also indicate that agents are more sensitive to real sector volatility than to monetary volatility. Moreover, the exchange rate, along with traditional determinants, significantly influences short- and long-run money demand.

Implication — The results suggest that monetary authorities should consider the source and sign of uncertainty shocks to properly anticipate liquidity needs and achieve monetary stability.

Originality — This study is the first of its kind in Pakistan to explore the asymmetric relationship among economic volatility, monetary volatility, and money demand within an open-economy framework.

Keywords — Money Demand; Economic Uncertainty; Monetary Uncertainty; NARDL

Introduction

A thorough understanding of money demand is crucial, as it underpins sound monetary policy and financial stability. It provides a link between monetary policy and macroeconomic outcomes and helps central banks gauge liquidity preferences. Its importance was underscored by the 2007–2008 global financial crisis, which highlighted how macroeconomic uncertainty affects portfolio choices and economic behaviour.

The conventional theories of money demand focus on the transaction and opportunity-cost motives, which are usually represented by real income and interest rates (Keynes, 1936). Extrapolations of these models also introduce uncertainty as an additional predictor, as volatility in income or prices can be an important determinant of liquidity preferences. Friedman (1984) pioneered this line of inquiry by arguing that volatility in money growth (a proxy for monetary policy uncertainty) increases overall uncertainty, leading people to hold more cash (i.e., reducing velocity). Similarly, Choi and Oh (2003) theoretically showed that output volatility (real uncertainty) induces labour market and income uncertainty, which, in turn, can increase precautionary money holdings.

Empirical studies have largely supported these ideas: for example, Friedman's (1984) hypothesis was tested by Hall and Noble (1987), who confirmed that uncertainty about money growth increases money demand. Atta-Mensah (2004) and Cronin and Kennedy (2007) found that increased economic uncertainty causes agents to prefer safer assets over cash, while studies like Bruggeman et al. (2003), Greiber and Lemke (2005) and Pua (2008) reported that real or monetary volatility tends to raise money demand. Likewise, by constructing indices of macroeconomic uncertainty, Bahmani-Oskooee et al. (2012), Bahmani-Oskooee et al. (2013), Bahmani-Oskooee et al. (2015), and Ozdemir and Saygili (2013) found a significant role of both output and monetary uncertainty on demand for money. Recently, Kurniawan et al. (2022) underscore the significant negative impact of economic uncertainty on money demand in Indonesia. Choudhry (2023) reported that economic policy uncertainty significantly reduces narrow and broad money demand in the UK. Wu et al. (2025), by employing the Toda-Yamamoto long-run causality method across 28 economies, demonstrated a significant role of economic uncertainty and fear factor in driving precautionary money demand. Nosheen et al. (2025) explained the significant role of economic and monetary uncertainty on money demand in selected Asian countries.

A key insight from recent work is that the response of money demand may be asymmetric. That is, positive and negative shocks to uncertainty might have different effects on cash holdings. Bahmani-Oskooee and Maki-Nayeri (2018), Bahmani-Oskooee and Nayeri (2018) provided evidence of such asymmetries in Korea and Australia: during high uncertainty, people hold more money, but when uncertainty falls, the reduction in holdings is smaller. Expectations about future volatility play a role: even when current uncertainty is low, if people expect future instability, they may still hold large cash balances. These findings suggest that money demand should be modelled with separate effects for increases and decreases in uncertainty. Tan et al. (2020) in China and Bahmani-Oskooee and Arize (2020) in Africa documented that the increase in uncertainty tends to have larger impacts than decrease. These works typically conclude that ignoring asymmetry would miss important dynamics of cash holdings. Recently, using the economic policy uncertainty (EPU) index, studies found an asymmetric impact of EPU on money demand, with different magnitudes and strengths. These studies highlighted the importance of incorporating nonlinearity while examining the relationship among real, monetary, overall policy uncertainty, and money demand (For example, Ongan and Gocer (2019) for Japan; Ivanovski and Churchill (2019) for Australia; Bahmani-Oskooee and Nayeri, 2020 for Japan; Hossain and Arwatchanakarn (2020) for New Zealand; Bahmani-Oskooee and Aftab (2022) for China; Nusair et al. (2024) for advanced economies; and Elroukh (2024) for GCC countries).

Pakistan provides a relevant case for exploring these issues. The country has experienced significant financial and policy reforms (Zaidi, 2015; Choudri et al., 2015) – including liberalisation of markets, inflationary episodes, and shifts in exchange-rate policy – all of which can influence money demand. Previous studies of Pakistan's money demand (Ahmad & Munirs, 2002; Azim et al., 2010; Gul & Sajid, 2020) generally reported a stable long-run relationship driven by income and interest rates, while Akbar (2021) examined the significant impact of inflation uncertainty and exchange-rate volatility on money demand. In the context of economic and policy uncertainty, Mukhtar and Jehan (2022) established a significant response of money demand to economic and monetary uncertainty in Pakistan. They identified that economic agents are more responsive to economic uncertainty than to monetary uncertainty. Hence, the existing literature mainly explores the determinants of money demand in Pakistan, whereas only a limited

body of literature examines the role of uncertainty in determining it. However, none of these studies tests for asymmetric effects. A review of the extant literature makes three salient conclusions. First, the strong empirical support for Friedman's hypothesis emphasises the importance of including measures of uncertainty in the money demand function. Second, the empirical work that has been done so far on Pakistan is still mostly limited to the estimation of traditional specifications, thus highlighting a major gap. Consequently, there is an unquenchable need to enrich the model with relevant uncertainty proxies to re-examine the operational validity of the demand-for-money framework in Pakistan's economic context. Thirdly, although the asymmetric relationship is acknowledged globally, its specific dynamics in Pakistan remain poorly understood. Pakistan's unique economic conditions, marked by structural reforms, persistent inflationary pressures, and external sector vulnerabilities, require a dedicated asymmetric analysis to model money demand accurately and formulate effective stabilisation policies. To bridge this gap, the present research estimates a money demand function in an open-economy context for Pakistan that incorporates measures of both economic and monetary uncertainty and uses the Nonlinear Autoregressive Distributed Lag (NARDL) framework to capture potential nonlinearity. We show that money demand in Pakistan indeed responds asymmetrically to uncertainty shocks, with different implications for policy.

The rest of the study is divided into the following structure. Section 2 explains the methodological framework, such as the data sources and method of estimation used in the analysis. The empirical results are reported in Section 3. Lastly, section 4 provides conclusions and considers the broader policy implications of the research.

Methods

Model and Data

The standard model of money demand posits a functional relationship in which MD is commonly expressed as a function of a scale variable (i.e., real income) and the opportunity cost of holding money (i.e., the interest rate and inflation rate). In addition, the integration of the domestic financial market with international financial markets highlights the potential for currency substitution, thereby providing a strong theoretical rationale for including the exchange rate in the standard money demand equation (Mundell, 1963). Building upon this conventional approach and following Choi and Oh (2003) and Bahmani-Oskooee et al. (2015), our study extends the conventional monetary framework by incorporating economic uncertainty (proxied by output uncertainty) and monetary uncertainty (measured by money supply uncertainty) as the main regressors. This modification gives the following regression specification:

$$LM_t = \theta_0 + \theta_1 LY_t + \theta_2 R_t + \theta_3 INF_t + \theta_4 LEX_t + \theta_5 VY_t + \theta_6 VM_t + u_t \quad (1)$$

The empirical model, as indicated in Eq. (1), is estimated using the following variables. The dependent variable is the natural logarithm of real money balances (LM), defined as M2 deflated by the GDP deflator. The key determinants are the natural logarithm of real GDP (LY), the scale variable, the interest rate (R), represented by the discount rate, the inflation rate (INF) to measure opportunity cost, and the natural logarithm of the nominal exchange rate (LEX) to account for currency substitution. In this extended specification, the model uses two measures of uncertainty: economic uncertainty (VY), the rolling standard deviation of real GDP growth, and monetary uncertainty (VM), the rolling standard deviation of nominal money (M2) growth. Asymmetric effects are accounted for by decomposing each uncertainty measure into positive and negative partial sums, which indicate the incremental and decremental effects on uncertainty, respectively. Where the subscript t is the time per year, and u symbolises the white-noise error term.

The study uses annual observations from 1975 to 2024. Data on broad money (M2), nominal GDP, and consumer price index—used to construct the inflation rate—are compiled using the World Bank's World Development Indicators database. Data pertaining to discount rate, GDP deflator, and nominal exchange rate are taken from the International Financial Statistics maintained by the International Monetary Fund. The data and variable descriptions are in Table 1.

Table 1. Variables Construction and Data Sources

Variable Name	Operational Definition for Empirical Analysis	Data Source
Monetary Aggregate/Broad Money (M2)	Natural log of Real Money Balance = M2/GDP deflator (LM)	World Development Indicators by World Bank (2025)
Gross Domestic Product (constant US Dollar)	Natural Log of Real GDP (LY)	World Development Indicators by World Bank (2025)
Interest Rate	Discount Rate (% per annum)	International Financial Statistics by IMF (2025)
Inflation Rate	Percentage Change in the Consumer Price Index (Inflation Rate)	World Development Indicators by World Bank (2025)
Exchange Rate	Natural Log of Nominal Exchange Rate (i.e. Pak Rupee per US Dollar)	International Financial Statistics by IMF (2025)
Economic Uncertainty	Rolling Standard Deviation of Real GDP Growth	Authors' Own Construction
Monetary Uncertainty	Rolling Standard Deviation of Nominal Money (M2) Growth.	Authors Construction
GDP Deflator	GDP Deflator	International Financial Statistics by IMF (2025)

Econometric Technique

The study makes use of the NARDL model put forward by [Shin et al. \(2014\)](#) to examine the short-run and long-run reactions of money demand to the changes in VY and VM. Traditional prior research on the topic of money demand has used linear time-series models, such as the Engle-Granger, Johansen Cointegration, and ARDL models. Whereas these econometric methodologies are effective in determining long-run equilibrium relations and short-term dynamics, they have an inherent assumption of being symmetric (linear) of interaction between money demand and its determinants. The assumption of symmetry, however, could be too limiting, especially during economic policy interventions or structural change within the studied sample period ([Ibrahim, 2015](#)). In such cases, the reaction of economic agents may differ depending on whether an explanatory variable increases or decreases. As a result, the econometric models that allow nonlinear and asymmetric adjustments provide a more realistic description of economic behaviour. The assumption of symmetry presumes that the influence of a 1 percent rise in explanatory variable(s) like X on the dependent variable like Y is identical to a 1 percent fall in X on Y, while the phenomenon of asymmetry argues that such impacts of increase and decrease are not equal.

[Shin et al. \(2014\)](#) advanced the NARDL model and, thus, endowed it with several substantive advantages over traditional approaches to cointegration. The most important of them is the ability of the model to combine both the testing of asymmetric long-run relations with short-run dynamics into a single framework that is coherent and enhances the strength of cointegration tests in a significant way, particularly with small samples. In addition, the NARDL methodology departs from the rigid assumption that all regressors share the same integration order. The model is robust despite the inclusion of variables that are either I(0) or I(1), which enhances both its flexibility and practical applicability. The model (1) presented in the NARDL framework is given below:

$$\begin{aligned} \Delta LM_t = & \gamma_0 + \gamma_1 LM_{t-1} + \gamma_2 LY_{t-1} + \gamma_3 R_{t-1} + \gamma_4 INF_{t-1} + \gamma_5 LEX_{t-1} + \gamma_6 \Delta VY_{t-1}^+ + \gamma_7 \Delta VY_{t-1}^- + \\ & \gamma_8 \Delta VM_{t-1}^+ + \gamma_9 \Delta VM_{t-1}^- + \sum_{i=1}^p \delta_{1i} \Delta LM_{t-i} + \sum_{i=0}^q \phi_{1i} \Delta LY_{t-1} + \sum_{i=0}^q \phi_{1i} \Delta R_{t-i} + \\ & \sum_{i=0}^q \phi_{1i} \Delta Inf_{t-i} + \sum_{i=0}^q \omega_{1i} \Delta LEX + \sum_{i=0}^q \theta_{1i} \Delta VY_{t-i}^+ + \\ & \sum_{i=0}^q \eta_{1i} \Delta VY_{t-i}^- + \sum_{i=0}^q \pi_{1i} \Delta VM_{t-i}^+ + \sum_{i=0}^q \rho_{1i} \Delta VM_{t-i}^- + v_t \end{aligned} \quad (2)$$

where, VY and VM are divided into their partial sum components in model (2), with the positive and negative partial sums being the focus as:

$$VY_t = VY_0 + VY_t^+ + VY_t^-$$

VY_0 denotes no change in the VY series (i.e. a threshold value of zero), VY_t^+ is the partial sum of positive changes in the VY series given by:

$$VY_t^+ = \sum_{i=1}^t \Delta VY_i^+ = \sum_{i=1}^t \max(\Delta VY_i^+, 0)$$

VY_t^- is the partial sum of negative changes in the VY series calculated by:

$$VY_t^- = \sum_{i=1}^t \Delta VY_i^- = \sum_{i=1}^t \min(\Delta VY_i^-, 0)$$

Similarly, VM is divided into its positive and negative partial sums in model (2) as:

$$VM_t = VM_0 + VM_t^+ + VM_t^-$$

VM_0 indicates no change in the VM_0 series (i.e. threshold value equal to zero), VM_t^+ is the partial sum of positive changes in the VM series calculated by:

$$VM_t^+ = \sum_{i=1}^t \Delta VM_i^+ = \sum_{i=1}^t \max(\Delta VM_i^+, 0)$$

VM_t^- is the partial sum of negative changes in the VM series given by:

$$VM_t^- = \sum_{i=1}^t \Delta VM_i^- = \sum_{i=1}^t \min(\Delta VM_i^-, 0)$$

Eq. (2) represents the error correction model (ECM) specification. In this chosen formalisation, the coefficients on the first-differenced terms (Δ) capture short-run dynamics, and the parameters on the one-period lagged level variables reflect the long-run relationships.

The long-run impacts of positive and negative changes in VY and VM on money demand are given by $-\frac{\gamma_6}{\gamma_1}$, $-\frac{\gamma_7}{\gamma_1}$, $-\frac{\gamma_8}{\gamma_1}$, and $-\frac{\gamma_9}{\gamma_1}$, respectively. For evidence of a short-run relationship in model (2), the lagged level variables can be substituted with the lag of the error correction term (ECT_{t-1}). After estimating the parameters of model (2), the null hypothesis of no cointegration is tested using the cointegration test as follows:

$$\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = \gamma_8 = \gamma_9 = 0$$

To this end, the estimated F- test value is compared to [Pesaran et al. \(2001\)](#) lower and upper bounds critical values of the F-test statistic. The presence of cointegration between money demand and all of the explanatory variables in model (2) is indicated by the rejection of the null hypothesis. If cointegration between money demand and all explanatory variables is established, the long-run asymmetry inferences in model (2) can be drawn using the Wald test and the following null hypotheses of symmetry:

$$\text{Null Hypothesis: } -\frac{\gamma_6}{\gamma_1} = -\frac{\gamma_7}{\gamma_1}$$

$$\text{Null Hypothesis: } -\frac{\gamma_8}{\gamma_1} = -\frac{\gamma_9}{\gamma_1}$$

In the same way, the short-run asymmetric association is identified using the Wald test on the following null hypotheses of symmetric influence of VY and VM on money demand in Pakistan:

$$\text{Null Hypothesis: } \sum_{i=0}^q \theta_{1i} = \sum_{i=0}^q \eta_{1i}$$

$$\text{Null Hypothesis: } \sum_{i=0}^q \pi_{1i} = \sum_{i=0}^q \rho_{1i}$$

This research employs the NARDL model, adhering to the methodological approach as developed by [Shin et al. \(2014\)](#). To this end, the first and essential step is to decide how the variables are to be integrated. This is necessary because the NARDL bounds test assumes that none of the variables is second-order integrated, as any $I(2)$ variable would invalidate the asymptotic distribution of its test statistic for cointegration. In this direction, the Dickey-Fuller Generalised

Least Squares (DF-GLS) unit-root test is used to ensure that all series are either $I(0)$ or $I(1)$, thereby ensuring that the NARDL estimator is consistent. After this, Eq. (2) is estimated in the NARDL framework to check the existence of a nonlinear or asymmetric long-run relationship. As [Shin et al. \(2014\)](#) note, the positive and negative partial sums are also treated as a single regressor in estimation; this way, the normal F-test of the levels relationship can be preserved, even as the linear specification is replaced by a nonlinear, asymmetric specification. Lastly, standard post-estimation diagnostics are conducted to assess the model's statistical fitness of the model.

Results and Discussion

Unit Roots and Cointegration

Our first empirical endeavour is the stationarity check. Such evaluation is essential to the use of the NARDL bounds test, whose accuracy would be undermined when including second-order integrated ($I(2)$) variables. In this regard, we use the Dickey-Fuller Generalised Least Squares (DF-GLS) unit root test to assess the null hypothesis that each of the individual series contains a unit root. The stationarity test results, presented in [Table 2](#), reveal that LM, LY, R, VM, VY, and LEX are integrated of order 1, while VY and INF are stationary at the level. The fact that the suitability of the NARDL framework to Eq (1) is being supported by the integration properties of the regressors, though of mixed order, the absence of the $I(2)$ series confirms the suitability of the chosen methodology. As a result, we use the NARDL technique to estimate Eq. (1).

Once the optimal lag length is determined via the Schwartz Bayesian Criteria (SBC), cointegration among the model's variables can be tested for and ascertained. For this purpose, F_{PSS} test proposed by [Pesaran et al. \(2001\)](#) is employed. For model (2), this test evaluates the null hypothesis of no cointegration ($H_0: \gamma_1, \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = \gamma_8 = \gamma_9 = 0$). As reported in [Table 3](#), the computed F-statistic exceeds the upper critical bound, compelling the rejection of the null hypothesis, affirming the presence of a cointegrated relationship in model (2).

Table 2. Results of the DF-GLS Stationarity Test

Variable	Test Statistic		Critical Values at 5% Level of Significance	Order of Integration
	At Level	At First Difference		
LM	-1.47	-15.36	-3.19	$I(1)$
LY	-0.51	-11.56	-3.19	$I(1)$
R	-2.39	-6.34	-3.19	$I(1)$
INF	-3.33	-	-3.19	$I(0)$
LEX	-1.85	-5.99	-3.19	$I(1)$
VY	-5.43	-	-3.19	$I(0)$
VM	-2.35	-7.34	-3.19	$I(1)$

Table 3. Bound Test for Cointegration

Dept.Var.	Ind.Variable	F-Stat Calculated Value	F-Stat Critical Value(at 5% Significance Level)		Outcome
			$I(0)$	$I(1)$	
LM	LY,R,INF,LEX, VY_Positive, VY_Negative, VM_Positive, VM_Negative	13.25	2.55	3.68	Cointegration

Long-Run Asymmetry

The NARDL decomposes a given time series into positive and negative partial sums for gauging asymmetries between dependent and independent variables. Pertaining to the objectives of the study, we have disaggregated VY and VM into their positive and negative components to examine the existence of a potential asymmetric relationship with money demand. The existence of a

cointegrating relationship, as ascertained in the last step, does not say anything about the nature of the economic association between the regressors. This study assesses whether VY and VM exert an asymmetric influence on money demand, which constitutes its primary empirical objective. To this end, we begin our empirical analysis with the results of model (2), as displayed in Table 4. The Wald test result is reported at the bottom of Table 4, where we tested the null hypothesis that the positive and negative partial sums of changes in VY and VM have equal or symmetric effects on money demand in Pakistan.

$$\text{Null Hypothesis: } -\frac{\gamma_6}{\gamma_1} = -\frac{\gamma_7}{\gamma_1}$$

$$\text{Null Hypothesis: } -\frac{\gamma_8}{\gamma_1} = -\frac{\gamma_9}{\gamma_1}$$

The significant Wald test statistics allow us to reject the null hypothesis of symmetry, thereby establishing that the influence of VY and VM on money demand is asymmetric. This implies that the positive components of both types of uncertainty differ significantly from their negative components in their effects on money demand in Pakistan. Hence, such an outcome calls into question the suitability of the linear ARDL or any other linear cointegration technique for quantifying the role of macroeconomic uncertainty in money demand in the context of Pakistan. Therefore, the study validates the use of the NARDL to examine the long-run relationship among VY, VM, and money demand in Pakistan.

Table 4. NARDL Long-Run Asymmetric Estimates for Money Demand

Dependent Variable: LM			
Selected Model: NARDL (1,3,1,1,1,2,1)			
Regressor	Coefficient	t-value	
LY	0.71***	5.39	
R	-0.08***	-5.84	
INF	-0.11**	-2.11	
LEX	-0.87***	-6.48	
VM_Positive	0.24***	7.92	
VM_Negative	0.09***	3.17	
VY_Positive	-0.18***	-3.11	
VY_Negative	-0.03**	-2.22	
Wald Test (H0: Symmetry)	Chi-Square (p-value)	43.87(0.00)	
LM-VM			
Wald Test (H0: Symmetry)	Chi-Square (p-value)	17.57 (0.00)	
LM-VY			

Note: ***, ** and * denote significant at 1%, 5% and 10% levels, respectively.

Having confirmed the long-run asymmetric relationship, we move to the discussion of the long-run parameter estimates presented in the upper section of Table 3. The results showed that the coefficients of the positive and negative components of VY are statistically significant and negative. This implies that a positive change in economic uncertainty reduces money demand, whereas a negative change in uncertainty increases it. The asymmetric effect is further demonstrated by the difference in the magnitudes of the positive and negative economic uncertainty coefficients: a rise in uncertainty significantly reduces money demand (-0.18), whereas a decrease in uncertainty increases money demand by a smaller amount (-0.03).

For VM, which is a proxy for monetary policy uncertainty, both negative and positive components are positively associated with the money demand function. This relationship suggests that money demand rises as VM rises and falls as VM falls, albeit with varying magnitudes (0.24 and 0.09, respectively). The Wald test also verifies that the coefficients are not statistically similar. Theoretically, it is in accordance with Friedman's (1984) hypothesis that exceptional volatility of monetary growth elevates the level of perceived uncertainty, thereby increasing the public's demand for money as a precautionary asset. Empirically, Bahmani-Oskooee & Arize (2020) reported similar results for Algeria, Mauritius, Morocco, Tanzania and Tunisia.

The theoretical impact of uncertainty on money demand is defined by two countervailing channels: a precautionary effect and a substitution effect. An increase in VY/VM may have both a precautionary effect and a substitution effect (moving away from cash-holding behaviour toward less volatile assets). The substitution effect suggests that money demand reduces with an increase in VY/VM. It demonstrates that people are more likely to maintain alternative, less risky assets (such as gold or real estate) rather than cash balances over the long run, and to avoid remaining liquid during periods of economic instability.

On the other hand, the public can become more cautious and motivated to conserve liquidity when both measures of uncertainty rise simultaneously, leading to a precautionary effect and indicating a positive link between uncertainty and money demand. In summary, the theoretical relationship between VY, VM, and money demand is described by two counteracting forces: one a negative substitution effect, which encourages a shift in the demand for money toward alternative assets, and the other a positive precautionary effect, which increases liquidity preference. Consequently, the overall effect of an increase in VY or VM on money demand is unclear and depends on which of the opposing effects is more prominent.

Our results for both VY and VM are very intriguing in several ways, given this theoretical conjecture. First, for the positive component of VY, the substitution effect dominates the precautionary effect, and people tend to hold less money in their asset portfolios. With the increase in VM, the precautionary effect overwhelms the substitution effect, and money holding increases. These results imply that economic agents are treating both uncertainties differently. Existing literature, such as [Atta-Mensah \(2004\)](#), [Choi and Oh \(2003\)](#), [Dahmardeh et al. \(2011\)](#), [Bahmani-Oskooee and Baek \(2017\)](#), and [Tan et al. \(2020\)](#), confirms our result of an increase in VY. Second, the data demonstrate that the positive components of both types of uncertainty have a stronger influence on money demand than their negative counterparts. Asymmetry for VY also exists in public decisions to hold money with positive and negative sums of volatility, in addition to its magnitude. For VM, asymmetry is present only in the magnitude of response (both components are positive), not in the sign of the relationship. Moreover, in the case of Pakistan, VY with both partial sums is more decisive for money demand behaviour than VM, contrary to [Bahmani-Oskooee and Nayeri \(2020\)](#) in many African countries.

The traditional determinants in the model have intuitive coefficients. Real income has a positive elasticity: a 1% increase in real GDP raises money demand by about 0.71%. This Keynesian/Monetarist result reflects more transactions in a growing economy. The interest rate has the expected negative sign but is relatively small. This implies that money demand in Pakistan is fairly insensitive to interest-rate movements, consistent with a relatively stable velocity of money ([Gul & Sajid, 2020](#); [Akbar, 2021](#)). Inflation also reduces real money demand, but its coefficient is small. In fact, comparing coefficients suggests that high inflation provides a slightly stronger incentive to economise on cash than a high nominal interest rate does. The conventional interpretation holds: higher inflation erodes the real value of cash, so people prefer real assets. These magnitude results are consistent with recent studies ([Murad et al., 2021](#); [Khan et al., 2021](#)) and reinforce the view that economic uncertainty plays a more decisive role than monetary variables in determining cash holdings in Pakistan. Exchange rate enters negatively: a 1% depreciation of the rupee vis-à-vis the US dollar reduces real money balances by about 0.87% in the long run. This suggests a strong currency-substitution effect: when the currency weakens, residents move wealth abroad or into foreign assets, shrinking domestic money holdings ([Akbar, 2021](#)). Notably, exchange-rate elasticity (-0.87) slightly exceeds income elasticity (0.71), indicating that exchange-rate changes are a powerful influence on Pakistan's money demand.

Short-Run Dynamics and Stability

The efficacy of monetary policy is contingent upon a rigorous examination of the short-run determinants of money demand. The positive and negative partial sums of VY ([Table 5](#)) are significant and negative. They disclose that both increases and decreases in VY have an immediate negative effect on money demand. This synchronised short-run contraction is the dynamical push that propagates into a persistent long-run asymmetry, and it is confirmed that the system lacks

short-run symmetry on its way to a long-run asymmetric equilibrium. The short-run outcomes, even with all lags, are very consistent with the long-run outcome. It demonstrates how people, following a lag, adjust their money holdings systematically. This is also the case for VM. The adjustment in money holding toward VM is even more spontaneous. Notably, while each lag of the uncertainty variable enters the model with a statistically significant coefficient in the short run, it increases substantially over time, yielding a much greater effect, as indicated by the long-run coefficients. This finding is crucial in determining the short-run and long-run stances of monetary policy. Moreover, the Wald test rejects the hypothesis of a symmetric relationship in favour of an asymmetric relationship. The short-run results regarding the impact of income, inflation, and interest rates on money demand are largely consistent with the long-run counterparts in terms of the direction of the relationship. However, the exchange rate has emerged as an insignificant determinant of money demand in the short run.

Table 5. NARDL Short-Run Asymmetric Estimates for Money Demand

Dependent Variable: D(LM)		
Selected Model: NARDL (1,3,1,1,1,2,1)		
Regressor	Coefficient	t-value
Constant	3.44***	12.73
DLM(-1)	0.67***	8.26
DLY	0.17**	2.18
DLY(-1)	0.09***	2.35
DLY(-2)	0.13	1.37
DR	-0.02**	-2.05
DINF	-0.02***	-5.32
DLEX	-0.06***	-7.21
DVM_Positive	0.03***	8.37
DVM_Positive (-1)	0.09*	1.86
DVM_Negative	0.07*	1.79
DVM_Negative (-1)	0.01**	2.26
DVY_Positive	-0.09**	-1.97
DVY_Negative	-0.03***	-5.33
ECT(-1)	-0.74***	-11.38
Wald Test (H0:Symmetry)	Chi-Square (p-value)	12.79(0.00)
LM-VM		
Wald Test (H0:Symmetry)	Chi-Square (p-value)	20.68(0.00)
LM-VY		

Note: ***, ** and * denote significant at 1%, 5% and 10% levels, respectively.

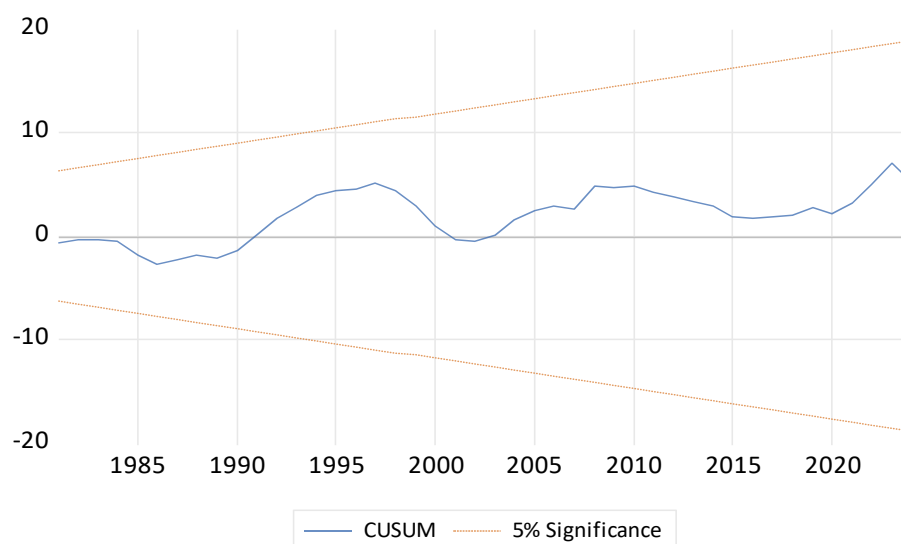


Figure 1. Plot of Cumulative Sum of Recursive Residuals

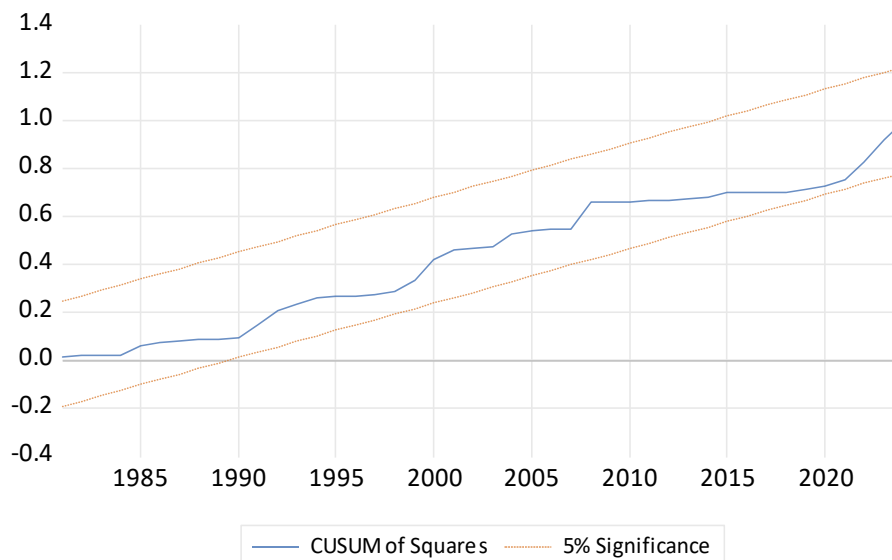


Figure 2. Plot of Cumulative Sum of Squares Recursive Residual

The error-correction term (ECT) exhibits a negative and statistically significant coefficient, providing strong evidence of a stable long-run equilibrium in Pakistan's money demand function. The finding regarding the stability of the money demand model in the long run received additional support from the results of the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests applied to the residuals (Figures 1 and 2). These tests indicated the absence of structural breaks, which proves that the money demand function remained stable during the study period.

Conclusion

This study re-examines Pakistan's demand for money by incorporating macroeconomic uncertainty in a nonlinear framework. Using data from 1975–2024, we estimated an open-economy money-demand function that includes real income, the interest rate, inflation, the exchange rate, and proxies for economic and monetary uncertainty. Employing the NARDL methodology, we find clear evidence of asymmetric long-run effects. Rising economic (output) uncertainty significantly reduces money demand (suggesting a substitution away from cash), whereas increases in monetary (policy) uncertainty raise money demand (indicating a precautionary motive). In both cases, the effects of positive shocks are not offset by the equal effects of negative shocks. These asymmetric responses are novel findings for Pakistan and imply that symmetric models of money demand would miss important dynamics.

In addition, the traditional determinants behave as expected: real income has a strong positive effect, rupee depreciation has a large negative effect, while interest and inflation have modest negative effects in the long run. Overall, once uncertainty and exchange-rate factors are included, the money-demand function is stable and well-specified. The adjustment toward equilibrium (error correction) is rapid, and diagnostic tests indicate the model is free from major specification problems. The estimated elasticities suggest that currency substitution (via the exchange rate) has a larger impact on money demand than income does in the long run, highlighting the openness of Pakistan's economy.

Our findings yield several policy insights. Crucially, the asymmetric effect of uncertainty means that policymakers should distinguish between positive and negative shocks. Real-side (economic) uncertainty has a larger influence on cash holdings than monetary uncertainty in Pakistan. This suggests that macroeconomic policies aimed at stabilising output and expectations can have important effects on liquidity preferences. In contrast, volatility in monetary policy or money growth also matters, but its impact on money demand follows a precautionary pattern. Considering these results, we emphasise two key points for policymakers: first, Stability of money demand: The evidence of a stable long-run money-demand function (even with uncertainty

included) implies that monetary aggregates remain useful policy anchors. In practice, this means that M2 growth targets or similar monetary aggregate measures can be reliable guides for policy. When interest-rate tools are constrained (for example, near the zero lower bound), the monetary authority can still monitor the money supply to assess liquidity in Pakistan. Second, the importance of real uncertainty: Since economic uncertainty strongly affects money demand, policymakers should focus on reducing real-sector volatility. Clear and credible fiscal policies, structural reforms, and transparent communication can lower output and inflation uncertainty. By doing so, the monetary authority may prevent excessive precautionary hoarding of cash. In other words, stabilising the real economy helps stabilise money demand.

In summary, our study highlights the need to incorporate macroeconomic uncertainty into analyses of money demand. Accounting for asymmetric effects provides a more complete picture of liquidity behaviour in Pakistan. Policymakers who recognise these dynamics, by maintaining stable economic policies and by tracking uncertainty indicators, will be better positioned to forecast money demand and to design effective stabilisation measures.

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Author contribution

Tahir Mukhtar: Conceptual framework, Data management, Analysis, and finalization of write-up

Saira Tufail: Conceptual framework, Data management, Analysis, and finalization of write-up

Zainab Jehan: Conceptual framework, Data management, Analysis, and finalization of write-up

Use of AI tools declaration

Artificial intelligence tools were used to assist with language editing and to enhance the clarity and readability of the manuscript. The authors remain fully responsible for the content and conclusions of this study.

Conflict of interest

The authors declare that there are no competing interests related to this manuscript.

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