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Symmetric or Asymmetric? Money Demand Responses to Economic and Monetary Uncertainty in Pakistan

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Abstract

The current investigation seeks to estimate the demand for money response to economic and monetary sources of uncertainty in Pakistan during the period 1980 to 2019. By distinguishing economic uncertainty from monetary uncertainty, the analysis moves beyond the conventional practice of representing uncertainty with a single aggregate indicator. The estimation is performed employing the Nonlinear Autoregressive Distributed Lag (NARDL) technique. The empirical results support the existence of a stable long-run relationship between demand for real money balances, its traditional determinants and the two measures of uncertainty. The findings also reveal that demand for money is influenced by both types of uncertainty through distinct channels. Moreover, the null hypothesis of symmetry is rejected under the Wald test, suggesting asymmetric short-run and long-run impacts of both dimensions of uncertainty on the demand for money. The analysis provides valuable policy lessons on the demand for money behaviour and the importance of both the source and the asymmetry of uncertainty shocks in evaluating money-holding behaviour.

Keywords: Demand for Money, Economic Uncertainty, Monetary Uncertainty, Nonlinear ARDL.
JEL Classification: C22; E32; E41; E52.

I. Introduction

A stable and predictable demand for money function constitutes one of the fundamental prerequisites for effective monetary management. The ability of a central bank to influence inflation, interest rates, output, and financial stability depends largely on whether the relationship between money holdings and their underlying determinants remains sufficiently stable over time. When this relationship is well understood, monetary authorities can forecast liquidity requirements more accurately, assess the consequences of policy interventions, and implement measures that support macroeconomic stability. Conversely, an unstable money demand function weakens the informational content of monetary aggregates and reduces the effectiveness of monetary policy (Estrella & Mishkin, 1997).

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The demand for money has therefore remained a central theme in monetary economics for several decades. Classical and Keynesian theories, together with subsequent monetarist contributions, consistently identify real income and the opportunity cost of holding money as the main determinants of the demand for money (Fisher, 1911; Pigou, 1917; Keynes, 1936; Friedman, 1956; Tobin, 1958). Real income captures the transaction needs of households and firms, whereas interest rates represent the forgone return from holding non-interest-bearing monetary assets. In open economies, inflation and exchange rate movements further influence portfolio allocation by altering the real value of money holdings and the relative attractiveness of domestic and foreign assets. These conventional determinants continue to provide the theoretical foundation for empirical money demand models.

Despite their widespread acceptance, traditional money demand models have increasingly been challenged by episodes of financial instability, policy uncertainty, and external shocks that influence the behaviour of economic agents in ways not fully captured by conventional macroeconomic variables. Periods of heightened uncertainty often alter expectations regarding future income, prices, and financial conditions, leading households and firms to adjust their desired holdings of liquid assets. As a result, uncertainty has emerged as an important factor that can affect the stability and responsiveness of the demand for money function, particularly in developing economies where macroeconomic conditions are frequently highly volatile. Friedman (1984) contended that the more volatile money growth is the more uncertain monetary policy decisions are and the more likely the velocity of money is to fall, which would make money holders hold more precautionary balances. Along similar lines, Choi and Oh (2003) documented that uncertainty in real economic activity causes income uncertainty and employment insecurity, which lead to higher demand for liquidity. The evidence generally supports the relevance of uncertainty, but the direction of the effects is mixed. Several studies argue that greater uncertainty leads to higher precautionary money holdings (Bruggeman et al., 2003; Greiber & Lemke, 2005), and others claim that higher uncertainty results in a reallocation of portfolio towards alternative safe assets with a corresponding fall in demand for money (Atta-Mensah, 2004; Cronin & Kennedy, 2007).

The literature has highlighted the significance of uncertainty, but two important limitations remain to be articulated. To begin with, the literature on uncertainty is rather homogeneous, assuming that a change in overall uncertainty affects money demand in the same way, regardless of whether the uncertainty concerns the money supply or the real economy. Economic uncertainty is mainly driven by changes in output, employment, and income, while monetary uncertainty is driven by monetary policy fluctuations, inflation, and financial conditions. The mechanisms underlying these two types of uncertainty are therefore different and do not necessarily yield the same reaction in money demand. This monolithic treatment obscures important behavioural distinctions and can lead to misleading policy conclusions. Second, most

empirical studies make the simplifying assumption that the effects of increases and decreases in uncertainty are symmetric. This is a limiting assumption as economic agents do not necessarily react the same way to favourable and unfavourable uncertainty shocks. Rising uncertainty may have more and longer-lasting effects than falling uncertainty because of behavioural considerations, precautionary motives, and expectations regarding future economic conditions. The symmetric assumption is being called into question by recent evidence. Bahmani-Oskooee and Maki-Nayeri (2018a, 2018b) show, using nonlinear modelling techniques, that the Korean and Australian money demand is asymmetric with respect to uncertainty shocks. Specifically, a rise in uncertainty leads to a larger change in money holdings than an equivalent fall in uncertainty, implying that economic agents remain cautious even after uncertainty has passed. The results show that using disaggregated and asymmetric uncertainty provides a more realistic representation of money demand behaviour.

Pakistan's economic environment has been marred by recurring episodes of economic instability, exchange rate depreciation, inflationary pressures, and changing monetary policy frameworks (Zaidi, 2015; Choudhri et al., 2015), which makes it a valuable empirical setting to study the asymmetric impact of the economic and monetary dimensions of uncertainty on demand for real money balances. These macroeconomic events have significantly affected the portfolio allocation decision of households and firms. The existing literature on money demand in Pakistan generally supports the long- run stability of the demand for money function while underscoring the role of real income, interest rate, inflation, and movements in exchange rates as its key determinants (Ahmad & Munir, 2002; Azim et al., 2010; Gul & Sajid, 2020; Akbar, 2021). Despite these contributions, the literature remains silent on the distinct roles of the economic and monetary dimensions of uncertainty and on the asymmetric effects of positive and negative uncertainty fluctuations. Thus, the question of whether various sources of uncertainty affect money demand through separate channels, and whether uncertainty increases and decreases have different impacts on money demand, remains unanswered.

This paper takes a step towards filling these gaps by estimating an open-economy money demand function for Pakistan that explicitly separates economic and monetary measures of uncertainty and accounts for asymmetric effects of both, employing the Nonlinear Autoregressive Distributed Lag (NARDL) framework. The study tests whether the source and direction of uncertainty shocks matter for determining their effects on money demand by separately introducing positive and negative uncertainty components.

The main contributions of this study to the literature are threefold. First, it advances beyond a traditional monolithic approach to uncertainty by separating economic and monetary measures of uncertainty. Second, it breaks the restrictive symmetry assumption and explores the differential short-run and long-run impacts of uncertainty shocks on money demand. Third, it offers new evidence for Pakistan,

where empirical studies on the asymmetric association between disaggregated uncertainty measures and money demand are virtually nonexistent. Overall, this type of empirical endeavour yields valuable lessons for monetary authorities, showing that the level of uncertainty matters not only in magnitude but also in its nature and direction, thereby informing better monetary policy design and implementation in an uncertain macroeconomic environment.

The remainder of the paper is organised as follows. The relevant literature is reviewed in Section II, and the gaps in existing literature are identified. Data and econometric methodology are presented in Section III. Section IV reports findings of the econometric analysis. The study concludes with implications for monetary authorities in Section V.

II. Theoretical Motivation and Empirical Literature

1. Money Demand and Uncertainty: Theoretical Framework

The mainstream theories of demand for money typically focus on the transaction and opportunity-cost motives, in terms of real income and interest rates, respectively, to explain the demand for real money balances. More modern versions of these theories take into account macroeconomic uncertainty as another factor affecting money demand and consider that fluctuations in economic activity or monetary conditions alter money demand among entrepreneurs and consumers. Demand for real money balances is theoretically affected by uncertainty via two competing channels. The first is the precautionary motive: when economic agents become more uncertain about income or expenditure flows, the demand for money grows because they need to save money in case of unexpected fluctuations. The second is the portfolio substitution motive, in which increases in uncertainty can lead to a decrease in domestic money demand as wealth is reallocated to other assets, such as foreign currency, gold, and other real and financial assets deemed safer stores of value. The relative strength of precautionary and substitution effects depends on institutional and structural characteristics of an economy. Economic uncertainty in developing economies with low financial market development, low policy credibility, and frequent macroeconomic instability could further incentivise portfolio reallocation away from domestic monetary assets, thereby lowering money demand. A rise in monetary uncertainty, in the sense of fluctuations in money growth or inflation, can make people more likely to hold liquidity by increasing demand for financial flexibility. Notably, uncertainty can produce asymmetric responses. Uncertainty reductions do not always lead to immediate portfolio rebalancing due to habit formation, anticipation of increased uncertainty, and the cost of adjustment. Consequently, increases and decreases in uncertainty can affect money demand in different ways.

2. Empirical Evidence

The concept and determinants of money demand are one of the most central and fundamental issues in monetary theory and policy. Empirical research, especially driven by high monetary volatility during the 1970s, as experienced in the United States, strongly suggested that the two most important domestic factors influencing money holdings are real income and real interest rates (Goldfeld, 1976; Baba et al., 1992; Dekle & Pradhan, 1997; Çatık, 2007). Subsequent research has expanded the analysis to incorporate open-economy settings and explicitly introduce the real exchange rate as an important secondary variable, thereby modernising the model and making it more consistent with the more globalised financial climate in which we live (McNown & Wallace, 1992). The same can be said for studies in emerging economies, which also find stable long-run money demand functions when these traditional variables are included (Civcir, 2003; Azim et al., 2010). The studies indicate that a well-specified money demand model can effectively describe long-run behaviour and thus serves as a good basis for policy formulation.

A second line of research concerns macroeconomic uncertainty. To this end, Hall and Noble (1987) documented evidence that the demand for money indeed rises with increased uncertainty about monetary growth. In the study by Atta-Mensah (2004), general economic uncertainty shifts investors' portfolio preferences towards safer assets, which in turn affects money demand. Several studies argue that output volatility increases money demand, using both cointegration and causality analyses (Bruggeman et al., 2003; Greiber & Lemke, 2005; Puah, 2008). Likewise, by constructing indices of macroeconomic uncertainty, Cronin and Kennedy (2007) and Bahmani-Oskooee et al. (2012, 2013, 2015, 2016) find a significant role for output and monetary measures of uncertainty in money in Europe and Asia. Özdemir and Saygılı (2013) demonstrate that incorporating monetary uncertainty improves the performance of demand-for-real-money-balances models in Turkey. In general, the evidence suggests that uncertainty (real or nominal) can significantly affect the money demand function and its stability.

Importantly, some recent studies do permit nonlinear (asymmetric) responses. Shin et al. (2014) introduced the NARDL method to account for the aforementioned effects, and it has been used in numerous applications. In Australia and other Asian countries, Bahmani-Oskooee and Xi (2011, 2014) discovered asymmetric money-demand reactions to uncertainty. In China, Tan et al. (2020) find that negative uncertainty shifts have a greater effect than positive ones; similarly, in Africa, Bahmani-Oskooee and Arize (2020) find that negative uncertainty shifts have a greater impact than their positive counterparts. In general, the results of these works suggest that neglecting asymmetry can lead to the overlooking of important aspects of cash holding. Empirical studies of money demand in Pakistan are limited. Ahmad and Munir (2002) and Azim et al. (2010) find that real income and the interest rate are statistically significant

determinants of money demand, suggesting that transaction and opportunity-cost motives play a crucial role in shaping money-holding behaviour. Akbar (2021) employs a Bayesian method to demonstrate that inflation and exchange rate volatility affect real money demand. Gul and Sajid (2020) show that uncertainty variables are relevant to money demand in Pakistan.

Notwithstanding these contributions, the literature has not yet explored the asymmetric impact of uncertainty. A thorough search of the literature reveals three salient facts. First, the robust evidence cited in favour of Friedman's hypothesis underscores the importance of incorporating uncertainty into models of the demand for money. Second, empirical studies on the demand for money in Pakistan remain limited to conventional model specifications and fail to adequately address the important gap in the literature. Hence, it is evident that there is a pressing need to augment the model with the pertinent uncertainty indicators so that one can rigorously re-evaluate the validity of the demand for money model in the context of Pakistan's economy. Third, even though the asymmetric relationship is recognised globally, its specific dynamics in Pakistan remain poorly understood. Given Pakistan's distinct economic scenario, which is characterised by ongoing structural reforms, persistent inflationary pressures, and vulnerabilities in the external sector, an asymmetric empirical investigation of the demand for money is warranted to better capture its dynamics and support the formulation of effective stabilisation policies.

III. Empirical Methodology

1. Model Specification and Data

The mainstream framework identifies two broad categories of determinants of money demand. The first is the scale variables, usually measured in terms of real income, which reflect the transaction motive for holding money. As the level of real income expands, so do the needs for transaction money balances, and hence, the demand for real money balances. The second is opportunity-cost variables, typically the nominal interest rate and inflation, which reflect the loss of return from using non-interest-bearing money instead of other financial assets. As a result, an increase in interest rates or inflation will lower the demand for money because its opportunity cost has risen. An open economy has exchange rates as an additional determinant of money demand. Variations in exchange rates affect portfolio allocation via currency substitution and capital mobility, as Mundell (1963) put it. An economic agent may be tempted to buy foreign currency or foreign assets denominated in foreign currency with domestic money as a consequence of the depreciation of the domestic currency, thereby adjusting domestic money holdings. Accordingly, the exchange rate has become an essential part of the present-day models of money demand in an open economy. These traditional factors account for the transactional and portfolio motives for

holding money, but do not explicitly include the impact of macroeconomic uncertainty. This study follows the theoretical framework of Friedman (1984) and Choi and Oh (2003). It expands the empirical specifications of Bahmani-Oskooee et al. (2015) and related studies by adding uncertainty as an additional determinant of liquidity preference in the conventional money demand model. In particular, two distinct sources of uncertainty are taken into account. Output volatility provides a proxy for economic uncertainty, which represents uncertainty about future income and real economic activity.

In contrast, monetary uncertainty is proxied by money supply volatility, which represents uncertainty about monetary conditions and policy. Distinguishing between the two sources means assessing the different effects of real-sector and monetary shocks on money demand. Thus, the long-run specification of demand for real money balances is expressed as follows in Equation (1):

$$LM_t = \theta_0 + \theta_1 LY_t + \theta_2 R_t + \theta_3 INF_t + \theta_4 LEX_t + \theta_5 EU_t + \theta_6 M_t + \varepsilon_t \qquad (1)$$

The regression specification in Equation (1) includes the following variables. The dependent variable is the natural log of real money balances (LM), which is the total money supply (M2) divided by the GDP deflator. The explanatory variables are in line with the standard money demand literature and include the natural logarithm of real GDP (LY) for the scale effect, the call money rate (R) and inflation rate (INF) for the opportunity cost of holding money, and the natural logarithm of the nominal exchange rate (LEX) as a measure of the currency substitution effect in a small open economy. The model introduces two conceptually different measures to account for the uncertainties. Economic uncertainty (EU) is proxied by the three-year rolling standard deviation of real GDP growth, which is a measure of the instability of real economic activity.

In contrast, monetary uncertainty (MU) is measured by the three-year rolling standard deviation of nominal M2 growth, which is a measure of the instability of monetary conditions. To investigate possible nonlinearities, each uncertainty measure is split into positive and negative partial sums, as in the nonlinear ARDL framework, to account for differences in how positive and negative changes in uncertainty affect money demand. ε is a white-noise error term, and t is the annual time period in Equation (1).

The study employs annual data from 1980 to 2019 to conduct its empirical analysis in Pakistan. Data on broad money (M2), nominal GDP and the consumer price index-based inflation rate are gathered from the World Bank's World Development Indicators (WDI) database. The call money rate, GDP deflator, and nominal exchange rate (expressed in Pakistani rupees per USUS dollar) data are collected from the International Financial Statistics (IFS) database maintained by the International Monetary Fund.

2. Estimation Strategy

To quantify the role of economic and monetary measures of uncertainty in shaping demand for real money balances, the analysis is undertaken with the NARDL framework developed by Shin et al. (2014). The NARDL framework relaxes the symmetry assumption, allowing positive and negative changes in the explanatory variables to elicit different responses in the dependent variable, in contrast to the conventional linear ARDL model. The technique simultaneously estimates the short-run and long-run asymmetric relationships within a unified cointegration framework by decomposing main predictors into their positive and negative components. Although widely used in the demand for money literature, the Engle-Granger and Johansen cointegration techniques, as well as the ARDL model, assume a symmetric adjustment process and cannot account for possible asymmetries and nonlinearities. The restrictive assumption of symmetric adjustment is not necessarily valid, especially during periods of macroeconomic uncertainty, structural reforms or policy changes, when economic agents are likely to respond differently to favourable and unfavourable shocks (Ibrahim, 2015). Linear models, therefore, do not capture important nonlinear adjustments of money demand. The NARDL model is designed to avoid this drawback by splitting each key regressor into its cumulative positive and negative changes as part of its estimation mechanism. This is especially important for the current study, since the sensitivity of money demand to increases in uncertainty may differ from its sensitivity to decreases in uncertainty. Thus, for instance, greater uncertainty might lead to greater precautionary money holdings than the decrease in money demand that would result from reduced uncertainty. The NARDL approach explicitly models these asymmetric responses, consequently allowing for a more realistic representation of money demand behaviour.

Apart from capturing nonlinear adjustment processes, the NARDL approach has several econometric benefits. First, it simultaneously estimates the long-run equilibrium relationships and the short-run dynamics within the same error-correction framework. Second, like the linear ARDL model, it can be used if the regressors are integrated of order zero (I(0)), of order one (I(1)), or a mixture of the two, with none integrated of order two (I(2). Third, the estimator performs well even with relatively small samples (Arize et al., 2017; Jareno et al., 2019), which is suitable for the present study, which uses annual data for 1980-2019. The nonlinear specification of Equation (1) can then be estimated in the NARDL framework as follows in Equation (2):

$$\begin{aligned}\Delta LM_t = {} & \gamma_0 + \gamma_1 LM_{t-1} + \gamma_2 LY_{t-1} + \gamma_3 R_{t-1} + \gamma_4 INF_{t-1} + \gamma_5 LEX_{t-1} + \gamma_6 EU^{+}_{t-1} \\ & + \gamma_7 EU^{-}_{t-1} + \gamma_8 MU^{+}_{t-1} + \gamma_9 MU^{-}_{t-1} + \sum_{i=1}^{p} \delta_{1i} \Delta LM_{t-i} + \sum_{i=0}^{q} \varphi_{1i} \Delta LY_{t-i} + \sum_{i=0}^{q} \phi_i \Delta R_{t-i} \\ & + \sum_{i=0}^{q} k_{1i} \Delta Inf_{t-i} + \sum_{i=0}^{q} \omega_{1i} \Delta LEX + \sum_{i=0}^{q} \theta_{1i} \Delta EU^{+}_{t-i} + \sum_{i=0}^{q} \eta_{1i} \Delta EU^{-}_{t-i} \\ & + \sum_{i=0}^{q} \pi_{1i} \Delta MU^{+}_{t-i} + \sum_{i=0}^{q} \rho_{1i} \Delta MU^{-}_{t-i} + \nu_t \end{aligned} \tag{2}$$

where the cointegrating relationship between the demand for money and its determinants is reflected by the coefficients of the one-period lagged level variables, and the short-run dynamics of money demand is represented by the coefficients of the Δ variables. *EU* and *MU* are partitioned into cumulative sums of their positive and negative changes, defined as in Equation (3):

$$EU_t = EU_0 + EU_t^+ + EU_t^- \tag{3}$$

where EU_0 represents the initial value of the *EU* series, meaning that the threshold for distinguishing between positive and negative changes is set at zero. Thus, EU_t^+ is the cumulative positive partial sum process of changes in the *EU* series and is defined as in Equation (4):

$$EU_t^+ = \sum_{i=1}^{t} \Delta EU_i^+ = \sum_{i=1}^{t} max\,(\Delta EU_i, 0) \tag{4}$$

Similarly, EU_t^- refers to the cumulative negative partial sum process of changes in the EU series, which is defined as in Equation (5):

$$EU_t^- = \sum_{i=1}^{t} \Delta EU_t^- = \sum_{i=1}^{t} min\,(\Delta EU_i, 0) \tag{5}$$

Following the same decomposition process, MU is expressed as follows in Equation (6):

$$MU_t = MU_0 + MU_t^+ + MU_t^- \tag{6}$$

where MU_0 refers to the initial value of the *MU* series. The decomposition is performed using a zero threshold: positive and negative changes are detected relative to zero. Accordingly, MU_t^+ is the cumulative positive partial sum process of changes in *MU*, defined as in Equation (7):

$$MU_t^+ = \sum_{i=1}^{t} \Delta MU_i^+ = \sum_{i=1}^{t} max\,(\Delta MU_i,\ 0) \tag{7}$$

The cumulative negative partial sum process of changes in the *MU* series, MU_t^-, is calculated as in Equation (8):

$$MU_t^- = \sum_{i=1}^{t} \Delta MU_i^- = \sum_{i=1}^{t} min\,(\Delta MU_i, 0) \tag{8}$$

By normalising the coefficients of the lagged level regressors in relation to the coefficient of the lagged demand for money variable, the long-run coefficients are obtained. The long-run asymmetry coefficients *EU* and *MU* are obtained by using the same normalisation process on their positive and negative components. i.e. $-\gamma_6/\gamma_1$,$-\gamma_7/\gamma_1$, $-\gamma_8/\gamma_1$, and $-\gamma_9/\gamma_1$.

In accordance with Shin et al. (2014), the bounds testing procedure is used to determine whether demand for real money balances and its determinants, including *EU* and *MU*, have a stable cointegrating relationship. If cointegration is found, the lagged level variables in Equation (2) can be restructured as a single lagged error-correction term (ECT_{t-1}). The speed at which the short- run deviations from the equilibrium are corrected is measured by the coefficient of (ECT_{t-1}). This coefficient is expected to be negative and statistically significant, indicating a stable long-run equilibrium relationship and convergence from the short run to the long run. Therefore, the following bounds test is used to test the null hypothesis that there is no cointegration: $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = \gamma_8 = \gamma_9 = 0$

The computed F-statistic is then compared with the corresponding lower and upper critical bounds suggested by Pesaran et al. (2001) to determine whether there is a long-run equilibrium relationship. If the value of the estimated F-statistic is greater than that of the upper critical bound, the null hypothesis of no cointegration is rejected, which suggests that money demand and its determinants have a stable long-run relationship. On the other hand, the null hypothesis of no cointegration cannot be rejected if the computed F-statistic is below the lower critical bound, indicating the absence of a long-run relationship between money demand and the explanatory variables in Model (2). If the F-statistic falls within the two critical bounds, the result regarding the cointegration is inconclusive. The Wald test is used to determine whether long-run asymmetry exists in Model (2) once a long-run cointegrating relationship has been established. In particular, the long-run coefficients associated with the positive and negative partial sum processes for *EU* and *MU* are compared to test the null hypothesis of long-run symmetry. The following are the corresponding null hypotheses:

$$-\frac{\gamma_6}{\gamma_1} = -\frac{\gamma_7}{\gamma_1}$$

$$-\frac{\gamma_8}{\gamma_1} = -\frac{\gamma_9}{\gamma_1}$$

Similarly, the short-run asymmetry is assessed using the Wald test to determine whether the coefficients associated with positive and negative increases in *EU* and *MU* are statistically identical. The following is a description of the short-run symmetry null hypotheses:

$$\sum_{i=0}^{q} \theta_{1i} = \sum_{i=0}^{q} \eta_{1i} \quad ,$$

$$\sum_{i=0}^{q} \pi_{1i} = \sum_{i=0}^{q} \rho_{1i}$$

We use the methodology proposed by Shin et al. (2014) for the NARDL model. The first and most important step in the estimation procedure is to determine the order of integration of the variables. It is important because the NARDL bounds testing ap-

proach assumes that the dependent variable is an I (1) variable. In contrast, the explanatory variables can be I(0), I(1) or a mix of I(0) and I(1). None of the variables must be integrated of order two, i.e., I(2), because the presence of I(2) variables would make the asymptotic critical values of the bounds test unreliable and the cointegration analysis meaningless. These conditions are verified using the Dickey–Fuller Generalised Least Squares (DF-GLS) unit root test to check for the order of integration of each series.

After identifying the integration properties of the variables, Equation (2) is estimated within the NARDL framework to explore the possible presence of a nonlinear long-run relationship between money demand and its determinants. According to the asymmetric decomposition suggested by Shin et al. (2014), EU and MU variables are decomposed into the cumulative positive and negative partial sums. The positive and negative partial-sum processes for EU and MU are then added to the NARDL model as two separate regressors, with each process potentially affecting money demand differently. The positive and negative partial-sum processes are both linked to the original variable, and the conventional bounds testing procedure is maintained (Shin et al., 2014). So, the classic F-test used to determine if there is any long- run level relationship between money demand and the explanatory variables given in model (2) is still applicable even though the linear specification has been changed to an asymmetric nonlinear specification.

IV. Empirical Findings and Analytical Discussion

1. Unit Root and Cointegration Analysis

Time-series characteristics of the variables are first analysed in the empirical analysis to assess the suitability of the NARDL estimation procedure. Table 1 gives the outcomes of the DF-GLS unit root test. The results show that the variables have mixed order of integration. In particular, EU is stationary at level (I(0)), while all the other time series are stationary after once-differencing (I(1). Importantly, none of the variables is integrated of order two, I(2). This fulfils the main criterion for using the NARDL bounds testing method, as suggested by Shin et al. (2014), and supports estimating the model without compromising its assumptions. Additionally, the presence of both I(0) and I(1) variables further supports the use of the NARDL methodology over traditional cointegration approaches because the former explicitly allows for the presence of mixed orders of integration in regressors as well as for the estimation of short-run dynamics and long-run asymmetric relationships.

The results of the bounds test for cointegration are reported in Table 2. The estimated F-statistic is greater than the upper critical value at the conventional level of significance, which allows the null hypothesis of no cointegration to be rejected. This evidence confirms the existence of the long-run equilibrium relationship between the real money demand, its conventional determinants, and the disaggregated measures

TABLE 1

DF-GLS Unit Root Test Results

Variable	Test Statistic		Critical Values at 5% Level of Significance	Order of Integration
	At Level	At First Difference		
LM	-2.56	-4.65	-3.19	I(1)
LY	-0.44	-4.55	-3.19	I(1)
R	-2.35	-4.95	-3.19	I(1)
INF	-2.86	-7.08	-3.19	I(1)
LEX	-1.91	-6.17	-3.19	I(1)
EU	-4.44	-	-3.19	I(0)
MU	-1.98	-6.53	-3.19	I(1)

Source: Authors' estimation.

of EU and MU. In this case, the estimated long- run coefficients are, therefore, valid as representing a true long-run relationship and not a spurious regression.

Given the confirmation of the long-run relationship, the focus now shifts to the long-run asymmetric responses of money demand to economic and monetary uncertainty.

2. Long-Run Asymmetric Analysis

The estimated long-run coefficients of the nonlinear money demand model are given in Table 3. The findings on money demand in Pakistan are consistent with the central hypothesis of this study, as they show that money demand is sensitive to both EU and MU in an asymmetric manner. The Wald statistics reject the null hypothesis of long-run symmetry for both measures of uncertainty, suggesting that rises in uncertainty have a significantly different impact on money demand than falls. The results

TABLE 2

NARDL Bounds Test Results

Dep. Variable	Ind. Variable	F-Stat Calculated Value	F-Stat Critical Value (at 5% Significance Level)		Outcome
			I(0)	I(1)	
LM	LY, R, INF, LEX, EU_Positive, EU_Negative, MU_Positive, MU_Negative	9.47	2.22	3.39	Cointe-gration

Source: Authors' estimation.

indicate that introducing uncertainty in the model as a single symmetric variable obscures certain behavioural aspects and could yield incorrect policy implications.

The results show that an increase in EU has a significant negative effect on real money demand, while a decrease in EU has a relatively smaller, opposite effect. This asymmetry suggests that the impact of a decline in macroeconomic conditions is far more pronounced than that of an improvement for both households and firms. The portfolio substitution mechanism is a possibility for this. An increase in output volatility creates uncertainty about agents' future income and economic activity, leading them to hold less domestic money and more substitutes, such as foreign currency, real assets, or inflation hedges. Conversely, during an improvement in economic conditions, it will take time for confidence to be restored; the economy's past instability will continue to shape expectations, and past information and transaction costs will affect the cost of portfolio adjustments. Therefore, the rise in uncertainty causes money demand to fall, and the fall in uncertainty causes money demand to rise. However, not as much as the fall in uncertainty causes money demand to fall. The findings align with those reported by Choi and Oh (2003), Atta-Mensah (2004), Dahmardeh et al. (2011), Bahmani-Oskooee and Baek (2017), and Tan et al. (2020), and contribute to the existing literature by explicitly demonstrating the asymmetric impact of economic uncertainty.

TABLE 3

NARDL Estimates of Long-Run Money Demand Model

Dependent Variable: LM Selected Model: NARDL (2,3,2,2,2,3,3,2,2)		
Regressor	Coefficient	t-value
LY	0.59***	3.27
R	-0.06*	-1.95
INF	-0.16***	-2.9
LEX	-1.08***	-2.94
EU_Positive	-0.21**	-2.83
EU_Negative	-0.05**	-2.91
MU_Positive	0.14**	2.68
MU_Negative	0.03***	3.35
Wald Test (H0:Symmetry) LM-EU	Chi-Square (p-value)	4.25 (0.03)
Wald Test (H0:Symmetry) LM-MU	Chi-Square (p-value)	34.32(0.000)

Source: Authors' estimation.
Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The pattern is very different in the case of MU. Positive changes in MU have a relatively large impact on money demand, whereas decreases in monetary uncertainty have a relatively small impact. This suggests that MU mainly affects the precautionary demand for liquidity, rather than portfolio substitution. When money growth becomes more volatile, households and firms may wish to hold cash balances as a buffer against adverse financial events. The impact on precautionary balances is relatively small when MU decreases, suggesting that economic agents do not become complacent once uncertainty about money is removed. It thus reinforces the asymmetric adjustment evidence, and supports Friedman's (1984) precautionary liquidity hypothesis, as well as the empirical results of Hall and Noble (1987), Bahmani-Oskooee et al. (2012, 2013, 2015, 2016) and Özdemir and Saygılı (2013). The surprising finding is that the transmission of both measures of uncertainty into the demand for money works differently. Domestic money holding is negatively affected by the EU, as it increases income risk and prompts people to shift their assets from money to other components of the portfolio. At the same time, the MU boosts money demand by increasing precautionary liquidity demand. This distinction is the main merit of the present study. The results show that uncertainty is not a uniform phenomenon but that the source of uncertainty is as important as its intensity, consistent with previous studies. Thus, combining various types of uncertainty into a single index can obscure significant behavioural responses and lead to misleading results regarding money demand.

The estimated coefficients of the conventional determinants are also broadly consistent with monetary theory. The relationship between real income and money demand is positive and significant, hence supporting the transaction motive of holding money. Specifically, a one per cent increase in real income corresponds to roughly a 0.59 per cent increase in real money demand, suggesting that an increase in economic activity leads to growth in transaction demand and liquidity needs. It corroborates previous findings in Pakistan and is consistent with the predictions of both the Keynesian liquidity preference theory and the quantity theory of money. The signs of opportunity-cost variables are also as expected theoretically. The call money rate and inflation have negative effects on money demand, with estimated elasticities relatively small. The negative interest-rate elasticity implies that when the market interest rate rises, economic agents will shift from money to higher-yielding financial assets. Similarly, rising inflation reduces the demand for real money balances because the value of money declines, making real assets more desirable. The magnitudes of these elasticities are relatively low, suggesting that the demand for money in Pakistan is not very responsive to domestic financial returns, as revealed by Gul and Sajid (2020) and Akbar (2021).

The coefficient on the exchange rate is negative and statistically significant, providing strong evidence of currency substitution in Pakistan. If the domestic currency depreciates, real money demand will fall because households and firms will switch from domestic money assets to foreign-currency assets. In particular, the estimated exchange-rate elasticity is higher in absolute terms than the income elasticity, suggest-

ing that external monetary conditions have a larger impact on the demand for money than income growth does. The outcome underscores the growing relevance of exchange-rate developments in an open economy facing sustained depreciation pressures and external-sector vulnerabilities. Overall, the long-run estimates provide strong support for the disaggregated and asymmetric nature of Pakistan's money demand function. Economic and monetary shocks affect liquidity demand in different ways, and positive uncertainty shocks are not necessarily met with the same reactions as negative uncertainty shocks. The results are both a reminder of the need to go beyond the symmetric specification of conventional money demand models and a reflection that separating uncertainty into different types significantly enhances understanding of money demand behaviour and the design of monetary policy.

3. Short-Run Asymmetric Effects and Parameter Stability

The NARDL error-correction model estimated the short-run asymmetric parameters, as reported in Table 4. The short-run estimates also support the long-run findings and show that money demand in Pakistan is highly sensitive to both dimensions of uncertainty, in an asymmetric fashion. The Wald statistics support rejecting the null hypothesis of short-run symmetry for both measures of uncertainty, suggesting that changes in uncertainty have significantly different short-run effects on money demand. The results support the claim that linear specifications are not suitable for studying the adjustment properties of money demand under macroeconomic uncertainty. In the short run, positive (negative) changes in EU have statistically significant negative effects on money demand, as suggested by the estimated coefficients. A greater response to positive uncertainty shocks would indicate that the demand for domestic money balances falls immediately during periods of higher output volatility. This discovery suggests that deteriorating macroeconomic conditions force households and firms to act quickly, alter their portfolio compositions, and reduce their cash holdings. Reductions in EU also affect money demand, but their impact tends to be relatively small, suggesting that changes in macroeconomic conditions will not automatically restore confidence and undo previous portfolio decisions. The short-run estimates complement the long-run findings and demonstrate that the asymmetric reaction to EU starts immediately and persists.

The positive and negative changes in MU both have statistically significant effects on money demand in the short run, with positive changes having a larger effect. The result implies that rising volatility of monetary conditions immediately boosts the precautionary demand for liquidity. When uncertainty about the future of monetary policy and money growth increases, economic agents will increase their stock of liquid balances. However, a decrease in MU increases money demand, but the increase is smaller, suggesting that precautionary balances are released slowly. The results are similar to those obtained in the long run and corroborate the validity of Friedman’s (1984) precautionary liquidity hypothesis.

TABLE 4

NARDL Short-Run Asymmetric Estimates for Money Demand

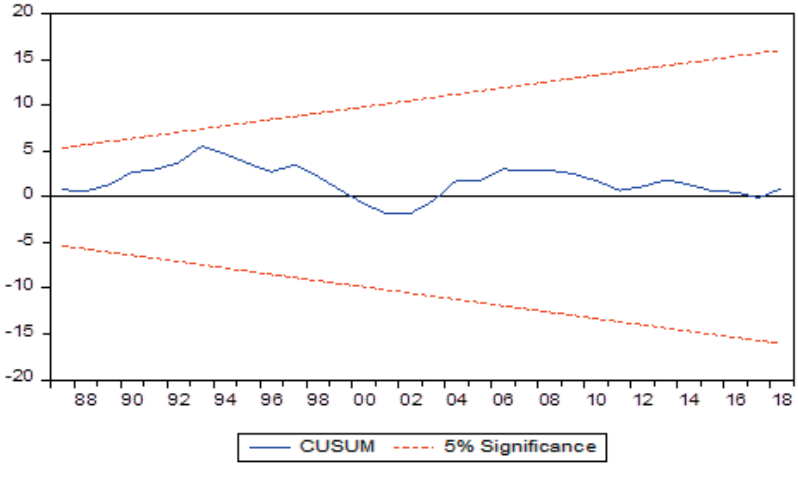
Dependent Variable: D(LM) Selected Model: NARDL (2,3,2,2,2,3,3,2,2)		
Regressor	Coefficient	t-value
Constant	5.36***	26.51
DLM(-1)	0.52**	3.09
DLY	0.13**	2.02
DLY(-1)	1.42***	18.02
DLY(-2)	0.59***	7.66
DR	-0.014***	-4.64
DR(-1)	-0.011***	-5.9
DINF	-0.02***	-9.06
DINF(-1)	-0.02***	-11.25
DLEX	0.14	0.69
DLEX(-1)	-0.09	0.84
DEU_Positive	-0.008***	-12.29
DEU_Positive (-1)	-0.002***	-22.47
DEU_Positive (-2)	-0.001***	-14.47
DEU_Negative	-0.090***	-7.02
DEU_Negative (-1)	-0.014***	-19.04
DEU_Negative (-2)	-0.06***	-6.38
DMU_Positive	0.001***	14.85
DMU_Positive (-1)	0.001***	19.99
DMU_Negative	0.007***	4.74
DMU_Negative (-1)	0.009***	12
ECT(-1)	-0.656***	-26.11
Wald Test (H0:Symmetry) LM-EU	Chi-Square (p-value)	4.755(0.029)
Wald Test (H0:Symmetry) LM-MU	Chi-Square (p-value)	13.496(0.000)

Source: Authors' estimation.
Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

The estimated coefficients for the conventional determinants closely resemble the long-run coefficients. The positive and statistically significant impact of real income in both contemporaneous and lagged terms shows that a rise in economic activity quickly translates into increased money demand for transactions. On the other hand, the call money rate and the inflation rate have negative and significant short-run effects, which suggests that a rise in the opportunity cost of holding money immediately decreases the desired money holdings. The exchange rate, however, has no statistically significant short-run effect, unlike the long-run estimates. This discovery implies that currency substitution in Pakistan is not a short-term phenomenon but rather a gradual process. Therefore, households and firms seem to adjust their foreign currency holdings gradually rather than respond immediately to short-term fluctuations in foreign exchange rates.

The coefficient of the lagged error-correction term is an important characteristic of the estimated model. The estimated ECT(-1) coefficient is negative and significant at the 1% level, thus providing strong evidence of movement towards the long-run equilibrium after short-run disturbances. The estimated value of −0.656 suggests that about 66 per cent of the disturbances from the long- run equilibrium are corrected in a year. This was a relatively rapid adjustment, which suggests that short-run disequilibria in the demand for money in Pakistan are quickly eliminated and therefore supports the presence of a stable long-run money demand relationship.

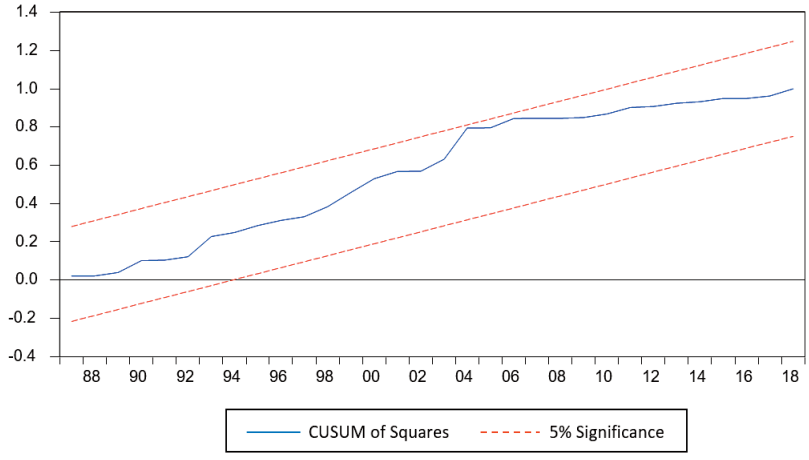
The recursive residual CUSUM and CUSUMSQ tests (Figures 1 and 2) are also used to investigate further the structural stability of the estimated money demand model. In both cases, the test statistics remain within the 5% critical bounds, suggest-



Source: Authors' estimation.

FIGURE 1

Plot of Cumulative Sum of Recursive Residuals



Source: Authors' estimation.

FIGURE 2

Plot of Cumulative Sum of Squares of Recursive Residuals

ing no evidence of parameter instability or structural change over the sample period. This evidence demonstrates the structural stability of the estimated money demand function and boosts confidence in the reliability of the estimated short- and long-run coefficients.

IV. Conclusions, Policy Insights and Future Research

This study revisits the demand for money in Pakistan and examines whether the sources and direction of uncertainty have differential effects on it. This approach departs from the literature, which usually treats uncertainty as a single, symmetric phenomenon, by separating economic uncertainty (measured by output volatility) from monetary uncertainty (measured by money supply volatility). The analysis relies on annual data for 1980–2019 and the Nonlinear Autoregressive Distributed Lag model to estimate an open-economy money demand function that allows for asymmetric effects of positive and negative uncertainty shocks. The empirical results strongly support the existence of short- and long-run asymmetries in Pakistan's money demand function. In fact, a rise in economic uncertainty has a large negative impact on money demand, whereas a fall in economic uncertainty has a relatively small favourable impact. The pattern thus implies that an increase in uncertainty in the real sector induces portfolio reallocation by households and firms from money back into other forms of wealth, and that, when macroeconomic conditions improve, the surge in confidence is gradual. Conversely, when monetary uncertainty increases, the demand for money rises because

people hold more liquid balances to guard against uncertainty about monetary conditions, a motivation known as the precautionary liquidity motive. Reductions in monetary uncertainty also affect money demand, but the impact is much smaller, lending further support to the asymmetric nature of the reaction to monetary uncertainty. Together, these results support the notion of asymmetric adjustment, as the impact of uncertainty depends not only on its level but also on its source and direction.

The estimated values of the traditional determinants are broadly in line with the predictions of monetary theory. An increase in interest rates and inflation reduces the demand for real money by raising the opportunity cost of holding money. In contrast, an increase in real income has a positive effect on the demand for real money. The exchange rate has a strong negative long-run relationship, indicating the vital role of currency substitution in Pakistan's increasingly open economy. Interestingly, in the short run, exchange rate changes have no impact on money demand. In contrast, in the long run they have a large effect, implying that the process of reallocating portfolios towards foreign-currency-denominated assets is not an instantaneous response to exchange rate changes. Furthermore, the negative and statistically significant error-correction term suggests that the model estimated in this study is converging towards the long-run equilibrium.

Overall, the results show, from a theoretical perspective, that uncertainty is not a homogeneous macroeconomic phenomenon. The effects of economic and monetary sources of uncertainty differ because they transmit through distinct channels in the economy and hence have different effects on money demand. These differences, if neglected by using aggregate uncertainty measures or by applying symmetry restrictions, could mask relevant behavioural responses and lead to biased estimates of money demand. The evidence thus bolsters the case for a more disaggregated and nonlinear liquidity-preference model, especially in a country like Pakistan where macroeconomic volatility is recurring. The study's findings yield important policy insights for monetary authorities in Pakistan. The first is the stable long-run money demand function; it means that monetary aggregates still have some relevance to the formulation of monetary policy and liquidity management in Pakistan. Second, the estimated coefficients indicate that economic uncertainty is a somewhat more important determinant of money demand than monetary uncertainty.

Therefore, policies that reduce macroeconomic volatility and promote economic stability could improve the predictability of money demand. Thereafter, policy measures that bolster fiscal discipline, foster structural reform, and maintain sound macroeconomic policy can help reduce uncertainties in economic activity and lead to more stable liquidity preferences and greater effectiveness of monetary policy. Third, the positive response of money demand to monetary uncertainty supports maintaining an open and credible monetary policy framework. Communication by the State Bank of Pakistan about its policy goals and activities can help anchor expectations, minimise uncertainty, and curb over-precautionary demand for money. Finally, the exchange

rate itself has a strong long-run impact, underscoring the importance of exchange rate stability. If the domestic currency depreciates, the impact of domestic monetary policy will be reduced, and the tendency towards currency substitution will increase. This study sheds new light on asymmetric effects of two distinct dimensions of uncertainty economic and monetaryЙ on money demand in Pakistan, but there are some areas for future research. To analyse the role of both types of uncertainty, the study uses annual data for the period 1980–2019, in line with its objective. Future studies could also include more recent observations, especially using quarterly data, and account for significant changes, such as the COVID-19 pandemic and rising global economic uncertainty, and their impact on Pakistan's monetary policy framework. An extension of such a study would give further clues to the behaviour and stability of the money demand function in a changing macroeconomic environment. Moreover, the study employs two approaches to measuring uncertainty: output volatility and money supply volatility. Future research could explore additional uncertainty indices, such as financial market uncertainty, economic policy uncertainty, and geopolitical risk indices, to determine whether the asymmetric relationships found in this research are consistent across different dimensions of uncertainty.

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