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Money Demand Balances and Exchange Rate Policy in Pakistan: An ARDL and Non-ARDL Analysis

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ABSTRACT

This paper investigates the impact of exchange rate changes across money demand balances in Pakistan by applying the linear and non-linear ARDL approaches. The study not only examines the impact of exchange rate changes across demand for money but also attempts to analyze whether demand for money is stable or not? For an estimation of money demand function, yearly time-series data have been used from the year 1972 to 2019. Findings of the linear ARDL model disclose that exchange rate and demand for money balances are positively and significantly associated with each other. Moreover, results of the non-linear ARDL model reveal that positive and negative exchange rate shocks have mixed effects on money demand. The results of the asymmetric test also demonstrate that exchange rate changes have symmetric effects on money demand while stability test results propose that money demand remains stable in Pakistan.

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1. Introduction

Nominal exchange rate is defined as the rate at which one currency is exchanged for the other. Exchange rate, which is fixed by monetary authorities, using the foreign exchange reserves, is called fixed exchange rate while the one determined through the supply and demand for currency in foreign exchange markets, is called flexible exchange rate. Countries, especially developing countries have aim to stabilize the exchange rate because stable exchange rate is very meaningful for the achievement of sustainable progress (Edwards, 1989; Berka and Devereux, 2010) while the unstable exchange rate caused the distortion in the trade, investment, inflation and trade balance (Xiaopu, 2002; Eichengreen, 2008). Exchange rate is regarded as an intermediate policy variable that affects the economy through its impact on the domestic currency and inflation, capital flows, financial stability, external sector and exports and imports of the country. Exchange rate changes may affect the comparative prices and the spending level of the persons and firms if the wealth has a large share of foreign currency. Exchange rate may affect the economy via two different ways: depreciation and appreciation (Hanif et al., 2016).

Pakistani rupee was connected with the Pound in early 1971. In 1971, Pakistan pegged its currency with US dollar.

Pakistan adopted the managed floating exchange rate that was helpful to minimize the difference between official and market rate. In Pakistan financial sector transformation improved the banking system by increasing the share of private sector in the banking business in 1991. Multiple exchange rate system has adopted by Pakistan in 1998 through three different exchange rates, official exchange rate, floating interbank rate and composite rate[1]. In 1999, Pakistan was integrated multiple exchange rate system in which rupee is fixed with US dollar and flexible within some limits. But in 2000, Pakistan had adopted the freely floating exchange rate by removing the limits on the exchange rate. Banks had adopted their own exchange rate. Managed floating exchange rate was adopted by the Pakistan during the period 1982 to 2010 and Pakistani rupee was continuously depreciated about 700% from its start against the US dollar. So, Pakistani rupee's value continuously decreases. The exchange rate among rupee and US dollar was 10.39 in 1982 that reached to 85.75 in 2010 that was considered about more than 700% decline in the value of rupee. That showed the large variation in the rupee dollar exchange rate. There were two main point of views of exchange rate determination and forecasting. First view is concerned with the determination of exchange rate through the demand and supply of the currency by using the balance of payment information. Second view is concerned with the relative stock of financial asset means financial asset of one country in terms of other country. The previous research work of exchange rate is based on the balance of payment approach and monetary approach including interest rate parity, QTM and money demand function (Saeed et al., 2012). Demand for money is very important function of the monetary policy. So monetary authorities control the monetary aggregates for the effective monetary policy. In small open economy like Pakistan, foreign interest rate and exchange rate determined the demand for money domestically under floating exchange rate system. Mundell (1963) was the first who introduced the relationship among the exchange rate and demand for money and explained that changes in the capital flows and foreign trade may cause to the changes in the demand for money function (Anwar and Asghar, 2012).

Theoretical background on money demand was started from the classical tradition. Classical view about the concept of money demand is divided into different parts, such as Pigou and Cambridge University economists. According to the Cambridge University economists, demand for money is defined as the people demand for money holdings. They explained choice determined determinants of real demand for money and it is called cash balance approach of money demand. Keynes determined the demand for money with additional variable of interest rate with negative relation. Post-Keynesian provided the various explanations about the money demand. Money as a medium of exchange function explain the transection purpose of money demand with certainty whereas the precautionary demand for money introduced the transaction demand for money with uncertainty. Cash-in-advanced function also explain the medium of exchange function. Asset function investigates the role of demand for money in the portfolio management. Asset role of demand for money was advocated by the overlapping generations models. Money is considered as consumer goods like other goods in the consumer demand approach (Sriram and Adams, 1999).

Money demand is positively related to the exchange rate and the reason behind the positive relation between money demand and exchange rate is that if there is excess supply of money, this excess supply results in form of deficit in the balance of payments. Then there will be an automatic depreciation of the nation's currency. It will lead to increase the prices and thus demand for money will also increase. To absorb the excess supply of money, the demand for money increases sufficiently to absorb this excess supply. According to the Monetary Approach of exchange rate[2]. Exchange rate have positive impact on the demand for money. Empirical studies also advocate the positive relation among ER and money including Megibany and Nourzad,1995; McNown and Wallace,1992; Bahmani-Oskooee, 1991; Bahmani-Oskooee et al., 1998.

The study is organized as: section 2 explains the review of literature, section 3 elucidates model, data and methodology. Section 4 illustrates the results and discussions. Section 5 concludes the whole study.

[1] It is the combination of official exchange rate and floating interbank rate

[2] Monetary approach under exchange rate was presented by Robert Mundell and Harry Johnson at the end of 1960 and it was fully developed during 1970.

2. Review of Literature

This section illustrates the review of literature on the relationship between exchange rate and demand for money in Pakistan and rest of the world. Bah et al. (2019) pointed out that dollar appreciation had long lasting impact than the dollar depreciation. Study also determined that exchange rate had short-run impact on the demand for money rather than long run in Gambia. Vargas-Silva (2009) by using structural VAR model concluded that shocks in remittances was positively related to the demand for money. Remittances and exchange rate had bi-directional relationship. Exchange rate was negatively related to the positive shocks in the remittances. Hsing, (2007) explained that real demand for money balances had positive impact on real output. Real effective exchange rate had positive impact on the deposit rate and WIR. Moreover, depreciation in Poland currency and lower world interest rate increased the real output.

Kang et al. (2005) used VAR model and variance decomposition to explore the impact of pre-crisis and post-crisis period in industrial production in Korea. During pre-crisis, industrial production in Korea was not responded due to the depreciation of yen against dollar but after crisis period industrial production significantly declined. Nyumuah, (2018) explained that exchange rate volatility and interest rate volatility did not significantly impact demand for money in developing countries. Money demand of these countries had unstable function. The study suggested that the monetary authorities should have adopted the interest rate as a policy instrument. Mcgibany and Nourzad (1995) pointed out that fluctuations and instability in the exchange rate was negatively related to the demand for money. Hsing (2008) investigated that real demand for money balances had positive impact on the peso depreciation and real output whereas it had negative relationship between deposit rate, inflation expectation, foreign interest rate and demand for money. Marquez (1987) probed that domestic money and foreign money were both substitutable and elasticity of substitution of currencies was high. Foreign exchange consideration had significant impact on the demand for money in Venezuela. Bahmani-Oskooee and Malixi (2013) analyzed that short-run impact of the depreciation on the demand for money was not sure but the long run impact of the depreciation had negative impact on the demand for domestic money. Alsamara and Mrabet (2018) inferred that long-run negative impact of exchange rate was stronger than the short-run impact. Money demand was strongly influenced by the currency appreciation than currency depreciation because people of Turkey expected further appreciation after the appreciation occured. Bahmani and Bahmani-Oskooee (2012) concluded that exchange rate in Iran had long-run as well as short-run influence on demand for money. Nyumuah (2018) found that demand for money functions in developing countries were verified to be unstable and that was why the impact of interest rate and exchange rate volatility on the money demand function in the developing countries was insignificant. The study suggested that monetary authorities should have imposed the inflation targeting monetary policy and used rate of interest as a policy instrument. Bahmani and Oskooee (1996) analyzed that black market exchange rate's depreciation had positively related to the demand for money. Rehman and Afzal, (2003) concluded that demand for M_2 increased if black market exchange rate increased. M_2 was appropriate monetary aggregate for the effective policy construction. The study also highlighted the impact and importance of black-market exchange rate on Pakistan's economy. Ghumro and Karim (2016) pointed out that exchange rate had positive and long run as well short run impact of exchange rate on the demand for money in Pakistan by using the linear ARDL approach.

Various empirical pieces of research have been conducted on the relationship between demand for money and exchange rate in different groups of countries like developed and developing countries and provided different results. Rest of studies apply various econometric techniques mostly simple linear ARDL technique. However, these previous studies have not applied non-linear ARDL to examine the results of positive and as well as negative shocks effect of exchange rate on the demand for money which has been applied in this paper.

3. Model, Data and Methodology

The following model is money demand and exchange rate model, which estimates the impact of official exchange rate on the money demand with other independent variable which are GDP per capita growth, lending rate, inflation, federal fund rate.

$$M_2G = f(GDPG, LR, INF, FFR, ER) \quad (1)$$

The econometric representation of the model is:

$$M_2G = \varphi_0 GDPG + \varphi_1 LR + \varphi_2 INF + \varphi_3 FFR + \varphi_4 ER + \varepsilon \quad (2)$$

Where:
M_2G = Broad money (% of GDP)
GDPG= GDP growth (annual %)
LR= Lending interest rate (%)
INF= Inflation, consumer prices (annual %)
FFR= Federal Fund Rate (annual %)
ER= Official exchange rate (LCU per US$, period average)
To estimate the money demand function time series data are used from 1972 to 2019 for Pakistan. Data on GDPG, INF, M_2G and ER are collected from World Development Indicators. Data on LR are collected from Handbook of Statistics on Pakistan Economy and data on FFR are collected from Federal Reserve System, USA. Linear and non-linear ARDL methodology is used for the estimation.

4. Results and Discussions

Now we elucidate results related to money demand balances and exchange rate policy in Pakistan.

4.1 Descriptive Statistics and Correlation Analysis

This section explains descriptive statistics and correlation analysis. Descriptive statistic is very beneficial for explaining the basic characteristics of the data. Descriptive statistic is helpful for handling and describing the large data. Descriptive analysis describes about the central tendencies like mean and median, measure of dispersions through max, min value and standard deviation. Measure of symmetries are skewness and Kurtosis. Descriptive statistics of key variables is presented in Table 1.

Table 1: Descriptive Statistics of Selected Variables (1972-2019)

	Mean	Median	Max	Min	SD	Skew	Kurt	JB	Prob.	Obs.
M2G	45.66	44.86	59.04	34.00	6.82	0.40	2.21	2.54	0.28	48
GDPG	4.79	4.84	10.22	0.81	2.10	0.10	2.75	0.21	0.90	48
LR	11.59	11.41	15.42	6.99	2.06	-0.28	2.54	1.04	0.59	48
INF	9.01	7.88	26.66	2.53	5.21	1.50	5.43	29.77	0.00	48
FFR	5.13	5.05	16.49	0.09	3.92	0.66	3.10	3.46	0.18	48
ER	46.55	33.86	150.04	8.68	37.01	0.83	2.74	5.64	0.06	48

Source: Authors' calculations

The central tendencies of M2G mean value is 45.66 and median value is 44.86 which are approximately same because both represents the average values of M2G. GDPG's mean value is 4.79 and median value is 4.84. Maximum value of M2G is 59.04 and minimum value is 34.00 and the range is 25.04 which is difference between the maximum value and minimum value. Same as the GDPG's maximum value is 10.22 and its minimum value is 0.81 and range is 9.41 and same will be the case with the other variables like LR, INF, FFR and ER. Standard deviation shows the measure of dispersion from its central value. Measure of dispersion of variable is M2G is 6.82 and GDPG is 2.10. and measure of dispersion of LR, INF, FFR and ER are 2.06, 5.21, 3.92 and 37.01 respectively. The value of skewness of M2G is 0.40 and GDPG is 0.10 that is greater than zero that is the symptoms of positively skewed. According to the criteria M_2G, GDPG, LR and ER are the leptokurtic and INF and FFR are Platykurtic. The p values of JB shows the normality of the variables. According to the criteria INF and ER are not following normal distribution.
Correlation Matrix represents the degree of association between two variables. Table 2 shows the correlation analysis. Correlation among M2G, GDPG, LR and INF is weak and negative. Correlation among the M2G and FFR is moderate and negative. Correlation among M2G and ER is strong and positive. Correlation among M2G with its own value is perfect.

Table 2: Correlation Analysis of Selected Variables (1972-2019)

Correlation	M2G	GDPG	LR	INF	FFR	ER
M2G	1.00					
GDPG	-0.26 (0.07)	1.00				
LR	-0.04 (0.80)	-0.42 (0.00)	1.00			
INF	-0.12 (0.40)	-0.14 (0.36)	0.33 (0.02)	1.00		
FFR	-0.59 (0.00)	0.45 (0.00)	-0.01 (0.93)	0.19 (0.20)	1.00	
ER	0.76 (0.00)	-0.34 (0.02)	-0.05 (0.74)	-0.21 (0.16)	-0.77 (0.00)	1.00

Source: Authors' calculations

Correlation of GDPG with LR, INF, FFR ang ER is weak and negative except FFR. Correlation of LR with INF, FFR and ER is weak and negative except INF which is moderate and positive. Correlation among INF and FFR is weak and positive whereas INF and ER is weak but negative. Correlation among FFR and ER is strong and negative. Correlation among ER with its own value is perfect.

4.2 Unit Root Analysis

Unit Root test is used to examine the stationarity or non-stationarity. The ADF test results are presented in Table 3.

Table 3: Results of ADF Unit Root Test

Unit Root Test on Level							
Variables	**Intercept**	**Lags**	**Intercept and Trend**	**Lags**	**None**	**Lags**	**Conclusion**
M_2G	-1.4285 (0.5604)	0	-4.5707 (0.0034)	1	0.1250 (0.7174)	0	I(1)
GDPG	-5.2157 (0.0001)	0	-5.9021 (0.0001)	0	-1.6300 (0.0966)	0	I(0)
LR	-3.1778 (0.0278)	1	-3.1518 (0.1070)	1	-0.3260 (0.5624)	1	I(1)
INF	-3.2131 (0.0263)	6	-3.1688 (0.1049)	6	-1.4181 (0.1435)	0	I(1)
FFR	-0.7131 (0.8326)	4	-3.9610 (0.0171)	1	-0.9248 (0.3103)	4	I(1)
ER	3.0558 (1.0000)	2	0.6867 (0.9995)	2	3.7964 (0.9999)	2	I(1)

Source: Authors' Calculations

Table 3 explains the results of ADF test for the M_2G and other variables such as GDPG, LR, INF, FFR and ER. Table 3 indicates three equations with intercept, with intercept and trend and without intercept and trend that is none. All the variables are non-stationary except GDPG. In next section, ARDL analysis is applied on the behalf of ADF test.

4.3 Linear ARDL

ARDL approach is very useful to explain the long-run and short-run results in the single equation at a time. Under ARDL cointegration technique, the results are efficient and unbiased. ARDL does not care about the small sample size and provides best results when sample size is small as compared to the Johansen-Juselius cointegration approach which deals with large sample size (Sheikh and Chaudhry, 2013; Narayan and Narayan,2008; Pesaran and Shin, 2001).

4.3.1 Bounds Test Analysis (for Linear ARDL)

Before estimating the long-run relations and ECM model, it is very important to test the existence of long-run relations among variables, whether the long-run relation among variables exists or not. Table 4 the upper segment shows the value of F statistic and Lower segment of Table 4 shows the critical values of bounds at different level of significance.

Table 4: Bounds Test

Test Statistic	**Value**	**K**
F-statistic	6.297136	5
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Authors' calculations

According to Table 4 the value of F-Statistic's lies above the I1 bound at different level of significance. that shows the existence of long-run relationship among the variables. After diagnosing the existence of the long-run relationship among the variable the next step is long-run and Error Correction estimation for the linear ARDL.

4.3.2 Long Run and Error Correction Analysis (for Linear ARDL)

This section explains the long-run and error correction results that are estimated by the ARDL approach to analyze the impact of exchange rate on the money demand. Error correction analysis is estimated for the short-run results. So, Table 5 explains both long-run and short-run results.

Table 5: Long run and EC Results

DV= M2G				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Long Run Results				
C	22.534	5.996	3.757	0.000
GDPG	2.993	0.839	3.567	0.001
LR	0.809	0.347	2.329	0.027
INF	-0.099	0.194	-0.510	0.613
FFR	-1.131	0.469	-2.409	0.023
ER	0.113	0.031	3.641	0.001
Error correction Results				
D(M2G(-1))	0.458	0.161	2.839	0.008
D(M2G(-2))	0.256	0.157	1.626	0.115
D(GDPG)	0.281	0.245	1.146	0.261
D(GDPG(-1))	-0.818	0.237	-3.441	0.001
D(GDPG(-2))	-0.682	0.234	-2.910	0.007
D(LR)	0.589	0.260	2.264	0.031
D(INF)	-0.352	0.127	-2.767	0.010
D(INF)	-0.481	0.139	-3.449	0.001
D(INF)	0.242	0.107	2.262	0.031
D(FFR)	-0.356	0.289	-1.231	0.228
D(FFR(-1))	0.249	0.424	0.587	0.561
D(FFR(-2))	0.318	0.240	1.323	0.196
D(ER)	0.082	0.034	2.392	0.024
CointEq(-1)	-0.728	0.152	-4.769	0.000

Source: Authors' calculations

GDPG has meaningful and positive impact on money demand. The reasons behind the positive relation among GDPG and money demand are as follows: Firstly, as GDP increases it leads to increase transactions demand for money that is the part of total money demand so, demand for money increases. Secondly, due to increase in GDP, people become more wealthier and want to hold more assets in their portfolio so, demand for money increases. The positive relation among GDPG and money demand is explained by various theories of demand for money including Classical, Cambridge approach, Keynes' liquidity preference theory, Friedman's modern quantity theory of money[3] advocated the positive relation of income level with demand for money. It is also empirically justifiable in many studies like Marquez,1987; Mousa, 2010; Magibany and Nourzad,1995; Bahmani-Oskooee and Malixi,1991. Lending Rate is also significant and

[3]See Friedman (1995).

positively related to the demand for money. Interest rate is positively related to the demand for money if individuals has interest-bearing portfolio that found the most important part of monetary aggregate Doornik et al. (1998). Many studies have presented the positive relation among the interest rate and demand for money see for example Qayyum, 2001, 2005; Arestis and Demetriades, 1991; Leeper and Gordon, 1992.

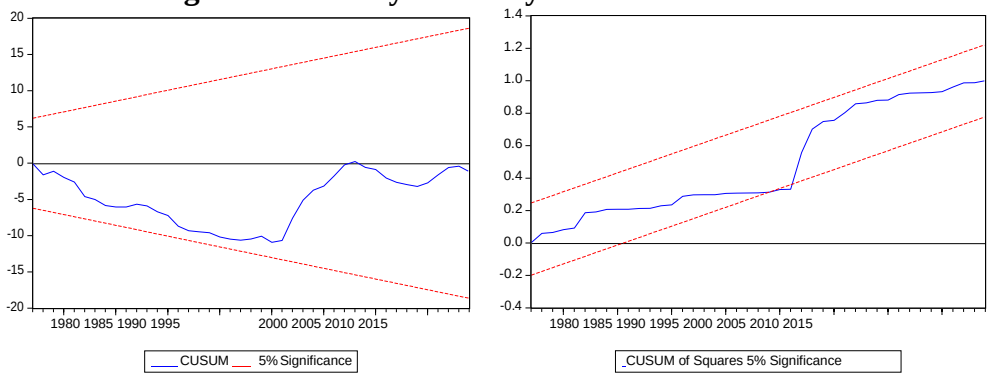
Table 5 shows negative impact of inflation on money demand. The reason behind the negative relation among the inflation rate on the demand for money is if inflation increases, it decreases the in the real value of money and in this situation, people do not want to hold money in their portfolio so demand for money decreases. Qayyum, 2001, 2005 found the negative association between inflation and money demand. Federal Fund Rate represents the negative but significant impact on money demand. It reflects that an increase in the foreign interest rate leads to decrease in the demand for money. The reason behind the negative relation among them is that when the Federal Fund Rate increases, foreign currency become more profitable so, demand for foreign currency increases and demand for domestic currency decreases. The results are verified by Mousa, 2010.

Exchange rate has also significant and positive impact on money demand. The reason behind the positive relation between exchange rate and money demand is that if there is excess supply of money, this excess supply results in form of deficit in the balance of payments. Then there will be an automatic depreciation of the nation's currency. It will lead to increase the prices and thus demand for money will also increase. To absorb the excess supply of money, the demand for money increases sufficiently to absorb this excess supply. According to the monetary approach of exchange rate, exchange rate has positive impact on the demand for money. Empirical studies also confirm the positive relation among ER and M2G including Megibany and Nourzad, 1995; McNown and Wallace,1992; Bahmani-Oskooee,1991; Bahmani-Oskooee et al.,1996. Error correction results describes the speed of adjustment and short-run results. the coefficient value of error correction term is -0.728 which is significant and indicates that seven months are required for the adjustment process in short run to restore equilibrium.

4.3.3 Stability Tests (for Linear ARDL)

Stability test investigates about the stability of the model. To examine the stability of the model, CUSUM and CUSUM of Squares have used with 5 % level of significance. The model is stable if the values lie within the bands and if the values crosses the bands means data have large variations and model is not stable.

Figure 1: Stability of Money demand Balances



According to Figure 1, the model is stable in the first figure of CUSUM at 5% level of significance, because the values lies between the upper and lower bands from 1980 to 2015. The second figure of the CUSUM of squares shows that model is stable because the values fluctuate between the upper and lower bands from 1980 to 2015. In year 2003, negligible instability is observed but overall model is stable.

4.4 Non-Linear ARDL Analysis

Granger and Yoon (2002) presented the concept of hidden cointegration in time series. Hidden cointegration means two time are cointegrated with their negative and positive aspect. Standard linear form of cointegration (symmetric) is the special case of the hidden cointegration and hidden cointegration shows the asymmetric or non-linear cointegration. After that Schorderet (2003) introduced the bivariate asymmetric cointegration regression to examine the hidden cointegration. Furthermore, in recent research, Shin et al. (2011) presented the asymmetric ARDL used negative and

positive partial sum to diagnose the asymmetric impact in long and short run.

Asymmetric ARDL like symmetric ARDL have same assumptions such as, ARDL gave accurate result in small sample size as compared to the other econometric technique, ARDL can't apply if any variable have I(2), ARDL can apply when variables are I(0) or I(1), and even mixture of I(0) and I(1), appropriate lag length, serially uncorrelated error term and model must be stable (Katrakilidis and Trachanas, 2012).

4.4.1 Bounds Test Analysis (For Non-Linear ARDL)

It is very important to test the existence of long-run relations among variables, whether the long-run relation among variables exists or not. Bounds test is used to diagnose the existence of the long-run relation among variables. Bound test is same for linear and non-linear ARDL.

Table 6: Bounds Test (Non-Linear ARDL)

Test Statistic	**Value**	**K**
F-statistic	3.513672	10
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	1.83	2.94
5%	2.06	3.24
2.5%	2.28	3.5
1%	2.54	3.86

Source: Authors' Calculations

Table 6 explain the detection of long-run relationship existence. According to the table, the long-run relationship among variables exists as F statistics is greater than the upper bound.

4.4.2 Long Run and Error Correction Analysis (For Non-Linear ARDL)

This section explains long-run and error correction results of non-linear ARDL approach. Table 7 explains the long-run and short-run results of non-ARDL. Both a 1% positive and a 1% negative shock to GDPG have positive and significant impact on the demand for money. It means that when 1 percent positive shock is given to GDPG, demand for money rises by 9.5 percent and while 1 percent negative shock to GDPG increases the demand for money by 3.6 percent. That clearly explains that the magnitude of coefficient of positive shock in GDPG is greater as compared to the negative one.

Lending rate also shows the positive and negative asymmetric impacts on demand for money. A 1 percent positive shock in LR enhances 7.3 percent increase in demand for money while a 1percent negative shock in LR decreases the demand for money increases 5.9 percent that shows the inverse relationship among the negative shock in LR and demand for money. Positive shock in the LR describes the larger contribution in the demand for money as compared to the negative shock in the LR and both are statistically significant. A 1 percent positive shock in inflation rate increases demand for money by 0.5 percent whereas the 1 percent negative shock in inflation rate decreases the demand for money by 0.2 percent. The value of the coefficients expresses that the positive shock has larger contribution in the demand for money than the negative shock in inflation.

Both a 1% positive and a 1% negative shock to FFR have negative impact on demand for money. It exhibits that when 1 percent positive shock is given to FFR, demand for money falls by 8.9 percent and while 1 percent negative shock to FFR decreases the demand for money by 0.5 percent. It explains that magnitude of coefficient of positive shock in FFR is greater as compared to the negative one.

Lastly, we explain the exchange rate positive and negative shocks. A 1% positive shock in ER leads to the 2.4 percent decrease in demand for money while a 1 percent negative shock in exchange rate increases 2% demand for money. Positive shock in exchange rate have larger contribution in the demand for money than the negative shock in the exchange rate in the demand for money.

Table 7: Long run and EC Results (for Non-Linear ARDL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long Run Results				
GDPG_POS	9.528	3.287	2.898	0.012
GDPG_NEG	3.646	1.351	2.697	0.018
LR_POS	7.301	2.074	3.520	0.003
LR_NEG	-5.980	2.079	-2.876	0.013
INF_POS	0.518	0.647	0.800	0.437
INF_NEG	-0.228	0.542	-0.421	0.680
FFR_POS	-8.993	3.312	-2.714	0.017
FFR_NEG	-0.522	0.793	-0.659	0.521
ER_POS	-2.412	0.723	-3.333	0.005
ER_NEG	2.019	1.855	1.088	0.296
C	17.448	13.555	1.287	0.220
Error Correction Results				
D(GDPG_POS)	1.642	0.508	3.227	0.006
D(GDPG_POS(-1))	-0.010	0.389	-0.027	0.978
D(GDPG_POS(-2))	-2.053	0.530	-3.868	0.001
D(GDPG_NEG)	-0.672	0.376	-1.786	0.097
D(GDPG_NEG(-1))	-1.330	0.380	-3.494	0.004
D(LR_POS)	2.847	0.822	3.461	0.004
D(LR_POS(-1))	2.704	0.987	2.740	0.016
D(LR_POS(-2))	-3.688	0.978	-3.768	0.002
D(LR_NEG)	-3.092	0.934	-3.307	0.005
D(INF_POS)	-0.703	0.232	-3.020	0.009
D(INF_POS(-1))	-0.906	0.245	-3.689	0.002
D(INF_NEG)	0.032	0.299	0.108	0.915
D(FFR_POS)	-4.344	1.035	-4.197	0.001
D(FFR_POS(-1))	2.106	0.746	2.823	0.014
D(FFR_NEG)	0.272	0.652	0.417	0.682
D(FFR_NEG(-1))	-0.245	0.506	-0.485	0.635
D(FFR_NEG(-2))	0.599	0.348	1.720	0.109
D(ER_POS)	0.189	0.115	1.635	0.125
D(ER_POS(-1))	0.020	0.235	0.085	0.932
D(ER_POS(-2))	0.573	0.263	2.177	0.048
D(ER_NEG)	1.043	0.988	1.056	0.310
CointEq(-1)	-0.517	0.162	-3.183	0.007

Source: Authors' Calculations

4.4.3 Presence of Asymmetry based on Wald Test

This section investigates the presence of Asymmetries of variables based on Wald test. Table 8 examines the asymmetries of independent variables GDPG, LR, INF, FFR and ER for the non-linear ARDL.

Table 8: Wald Test

Null Hypothesis	F-Statistic	Prob.
GDPG_POS = GDPG_NEG = 0	9.6259	0.006
LR_POS = LR_NEG = 0	0.4727	0.628
INF_POS = INF_NEG = 0	5.069	0.023
FFR_POS = FFR_NEG= 0	9.597	0.002
ER_POS = ER_NEG = 0	2.049	0.168

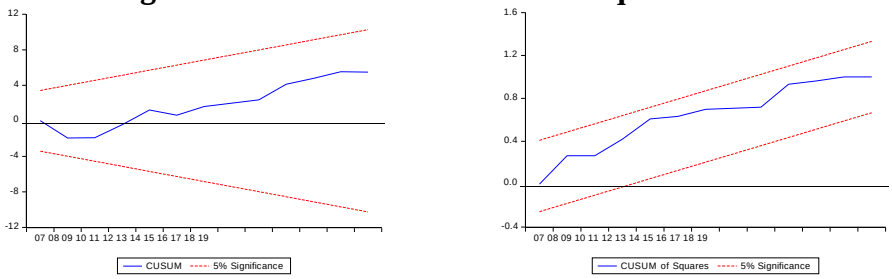
Source: Authors' Calculations

Table 8 presents the results of Wald Test to diagnose the presence of asymmetric effects on dependent variable. GDPG, INF are FFR are asymmetric because we have rejected the H_o which shows that there is no asymmetry while for LR and ER we have found symmetric effects because we are unable to reject the null hypothesis.

4.4.4 Stability Tests (For Non-linear ARDL)

Stability Test for non-linear ARDL explains that the model is stable or not. For this purpose, CUSUM and CUSUM of Squares tests are used.

Figure 2: CUSUM and CUSUM of Squares Tests



According to CUSUM and CUSUM of Squares tests, the model is stable at 5% level of significance because the values lie between the upper and lower bands.

5. Conclusion

This paper investigates the determinants of demand for money in Pakistan by using time series data from 1972 to 2019. The study has applied linear and non-linear ARDL techniques to explore the impact of exchange rate, GDPG, lending rate, foreign interest rate and inflation rate on money demand. Long-run results extracted from linear ARDL technique show that the impact of GDPG, lending rate and exchange rate are significant and have positive impact on money demand whereas the inflation is insignificant and have negative impact on the demand for money. Moreover, foreign interest rate is significant and have negative impact on money demand. The results divulge that the money demand function is stable in Pakistan and exchange rate changes have positive and strong impacts on demand for money. Results of the NARDL exhibit that positive shocks in exchange rates decrease the money demand while the negative shocks tend to augment the demand for money. Furthermore, the asymmetric test shows that exchange rate changes have symmetric effects on money demand.

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