The Demand for Money in Nepal: An Analysis Using Vector Error Correction Model

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ABSTRACT

This paper examines the demand for money in Nepal. Accordingly, time series techniques such as Unit Root Test, Co-integration test approach were conducted considering the annual data from 1975 to 2019. The results of the unit root test indicate that the variables are stationary at the first order difference. Moreover, the co-integration test state that there is co-integration among the real broad money supply, real GDP at producer price, inflation and the interest rate, after taking the logs of real broad money supply, real GDP and interest rate and taking the first difference of all the considered variables, which makes the series normal and stationary respectively. Besides the results of the CUSUM test indicate the stability of the model. The results of the VECM show that there exists the long-run causality of the determinants on the money demand function whereas, out of the considered variables, none has the short-run causality on the money demand function. Moreover, ordinary least square method was also conducted to compute the coefficient of parameters which showed that though only one, real GDP, out of three, was found to be significant, the model was found to be good fit with the value of R-squared 0.9933 stating that the 99.33 percent variation in the dependent variable is explained by the explanatory variables.

KEYWORDS: Money demand, refinance rate, CUSUM test, VECM test, good fit

INTRODUCTION

Money demand function is an essential component in formulating the monetary policy. It helps the monetary authorities to influence the expected changes in the macroeconomic variables such as income and interest rate by making the appropriate changes in the monetary policy (Iftekhar et.al, 2016). Moreover, money demand function is affected by numerous macroeconomic variables and the stability of the money demand relies in the ability of the monetary authorities to estimate the impact of the monetary policy on the economic activities and to enable them to endorse the policy actions with greater confidence and efficiency (Hassan et.al, 2016). Though there has been the sufficient literature regarding the money demand function and determinants of money demand in case of developed and developing economies, much less study has been conducted in case of the countries like Nepal. As such, this study may help to bridge such gap of literature by estimating the demand function and determining the major determinants of the money demand in case of Nepal.

The specific objectives of this study are to examine the relationship among the real broad money supply, real GDP at producer price, the inflation rate and the refinance

rate and to determine the appropriate variable/variables for the policy formulation considering the annual data from 1995 to 2019.

Regarding the organization of the study, this study is composed of Literature Review in section 2, which comprises the theoretical review and review of related studies. Accordingly, section 3 comprises Methodology consisting models, data and model estimation technique. Similarly, section 4 comprises the empirical results of the study and analysis. Section 5 comprises the conclusion.

LITERATURE REVIEW
Theoretical Review

There are three dominant views, namely the classical, the Keynesian and the Post-Keynesian view as discussed in Telyukova (2008) and Gaurisankar and Kwie-Jurgens (2012).Accordingly, the view of classical economists regarding money demand rests upon the quantity theory of money, which is based upon the concept that money is only the medium of exchange and emphasized on the transaction demand for money in terms of the velocity of the circulation of the money. Moreover, classical theory of money demand rests upon the Fisher Equation of Exchange MV=PT.

Where MV represents the total money supply composed of M: Total quantity of money and V: Velocity of money in circulation. On the other hand, PT represents the money demand which is composed of P: price level and T: Total amount of goods and services exchanged for money. Thus, Md=PT represents the money demand function of the classical theory.

Keynesian Theory of money demand is based upon the concept that money is demanded mainly for three major purposes, namely, transaction demand, precautionary demand and speculative demand for money. Sahadudheen (2012) indicate that the first two purposes of money demand proportionally depend on income. Accordingly, an increase in income translates into more money being reserved for transaction and precautionary measures. This reflects the medium of exchange function of money. Thus, there exists a positive correlation between money demand and income. Speculative demand for money has been found to have a negative relation with interest rate.

Mathematically, $M_d=f(Y,r)$

The Post-Keynesian Theory of Money demand views that money is also a type of assets and its demand is also affected by the same factors influencing the demand for the other assets. However, post-Keynesian approach of money demand rests upon the fact that incentives to hold the money does not have much change and thus the impact of interest on the demand for money is very low.

Review of Related Study

Adhikari (2018) examined the long run and short run dynamic relationship between broad money, consumption expenditure, capital stock and interest rate in Nepal using the period of 1975 to 2017 employing the Auto regressive Distributive Lag (ARDL) testing and came to conclude that there exists long-run co-integration among the variables when the demand for money variable is considered as a dependent. Moreover, the long-run estimation of the ARDL framework shows that the final consumption expenditure and interest rate were found to be significant for money demand in the long-run.

Mohamed and Nageye (2018) examined the money demand function in Somalia considering the time series data from 1970–2010 using the Vector Error Correction

Model (VECM) considering the real money supply as the dependent variable and GDP, Inflation, Exchange rate, Purchasing power and Foreign interest rate as the explanatory variables. The study concluded the variables were co-integrated indicating the long run relationship between the variables and five out of the six variables in the model were statistically significant to explain the model.

Faridi and Akhtar (2013) made an attempt to estimate the factors that determine the real money demand function in Pakistan employing the bound testing approach to co-integration for estimating the money demand function through an ARDL framework considering the annual time series data from 1972 to 2011. Accordingly, the finding of the study showed that income elasticity is positive while the interest elasticity is negative. Moreover, the study shows that variables like financial innovation and population influence money demand function positively while exchange rate affects the real demand for money negatively. The analysis also concludes that short-run elasticity are less elastic than that of long- run elasticity.

Bhatta (2013) examined the long-run co-integration relationship among the demand for real money balances and its determinants considering the annual data set of 1975-2009 of Nepal using the ARDL modeling and came to conclude that there exists the long run co-integrating relationship among the real money balances, real GDP and interest rate. Moreover, the Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMSQ) test have confirmed the stability of the long-run money demand functions.

Budha (2011) examined the money demand function for Nepal considering the annual data between the FY 1997/98 to FY 2009/10 using the VECM. Accordingly, the results show that there exists the co-integration and exists the long-run relationship between real money demand and its determinants, output and interest rate. Moreover, the vector error correction (VECM) has proved the short-run relationship between the real money demand and its determinants.

METHODOLOGY
Framework and Model Specification:

Though there are several theories regarding the money demand function, most of the theories concentrate on the scale variables such as real income level, permanent income level, interest rate and inflation rate. Accordingly, this study, considering the theoretical basis follows the following basic model:

$$Dln\ M_t = b_0 + b_1 DlnY_t + b_2 DCPI_t + b_3 DlnR_t + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.1)$$

Where, M_t is the monetary aggregates in real term. Accordingly, under the money demand function, assuming the clear money market, money demand is equal to the money supply, usually issued by the central monetary authority.

In the Nepalese context, Nepal Rastra Bank releases two major types of monetary aggregates narrow money supply (M_1) which comprises currency in circulation and demand deposits in the commercial banks. On the other hand, broad money supply (M_2) comprises the time deposits along with the M_1. This study analyzes the broad money supply (M_2) to estimate the money demand function in Nepal.

Accordingly, Y_t is the real GDP at producers price, CPI_t is the consumer price index (Inflation Rate), R_t is the interest rate, et is the error term, D is the first derivative, ln is the natural log, b0 is the intercept, b_1, b_2 and b_3 are the elasticity coefficient of GDP, CPI and Interest Rate respectively

It is better to specify the model on the basis of the Classical, Keynesian and Post-Keynesian money demand theories. Accordingly, income elasticity coefficient (b_1)

is expected to have positive where as inflation elasticity coefficient (b_2) and the interest elasticity coefficient (b_3) is expected to be negative.

Moreover, in order to examine the long-term and short-term impacts the money demand function, broad money equations is transformed into a VECM specification as:

VECM Model Specification:
DLRBMS = b_0 + b_1DLRGDP + b_2DInflation + b_3DInterest + e_t………...................(3.2)

Data and Data Sources

This study covers the annual time-series data from the year 1975 to 2019, considering the variables real broad money supply, real GDP at producer's price, inflation rate and the interest rate. The data series were collected from the various issues of the economic survey published by Ministry of Finance, Annual Reports of Nepal Rastra Bank, Central Bureau of Statistics and the various publications of World Bank and International Monetary Fund.

RESULTS AND DISCUSSION

Vector Error Correction Model (VECM) has been used to analyze the short-run and long-run relationship between the money demand and its determinants using the R Program. In order to test the long-run relationship between the money demand and its determinants, the stationary properties of the variables was conducted using Augmented Dickey Fuller (ADF) Test. Since all the variables were found to be non-stationary, the first order differentiation was conducted to make the data stationary.

The Unit Root Test shows that all the variables under the analysis real broad money supply (RBMS), real gross domestic product (RGDP) at producer's price, inflation rate and the interest rate are stationary at the first difference.

Unit Root Test

For the co-integration analysis, the properties of the time series data, Augmented Dickey Fuller Test was conducted to examine whether the variables were stationary or not. Accordingly, the variables at levels were found to have unit root that is to be non-stationary. But, the first difference of all the variables seems to have removed the unit root that is to make the series stationary.

Table 4.1
Results of Unit Root Test, Augmented Dickey Fuller Test

Panel		Variable	Augmented Dickey Fuller Test Result	Probability Value	Remarks
Panel I Level	Intercept	LRBMS	-2.3564	0.4325	
		LRGDP	-2.2664	0.4682	
		Inflation	-2.2664	0.1893	p-value>0.05 Non-Stationary
		LInterest	-2.37	0.4271	
Panel II First Difference	Intercept	LRBMS	-4.8764	0.01	
		LRGDP	-4.5011	0.01	
		Inflation	-4.8718	0.01	p-value<0.05 Stationary
		LInterest	-3.7756	0.03	

Note: LRBMS, LRGDP, and LInterest are log of real broad money supply (M2), real GDP at producer price and refinance rate of interest respectively.

The Augmented Dickey Fuller test shows that the natural logarithms of all the time series variables along with the inflation without natural logarithm face the problem of unit root at the 5% level of significance. However, the first difference of the natural logarithm of all the variables including the inflation without natural logarithm was found not to have the unit root.

Co-Integration Test

This study employs Johansen (1990) test, applied in the time series data to examine the existence of the long-run relationship among the money demand and its determinants under consideration.

Table 4.2
Co-integration Test of the Model

Maximum Rank	Test Statistics	Critical Values at 5 Percent	Result	Remarks
0	67.36	27.14	Test Statistics> Critical Value at 5 Percent	
At Most 1	26.06	21.07	Test Statistics> Critical Value at 5 Percent	Co-Integration
At Most 2	19.10	14.90	Test Statistics> Critical Value at 5 Percent	
At Most 3	11.74	8.18	Test Statistics> Critical Value at 5 Percent	

Accordingly, in the above table, considering the trace study, the null hypothesis was rejected accepting the alternative hypothesis indicating that there is co integration between the variables since the test statistics 67.36, 26.06, 19.10 and 11.74 are greater than the critical values 27.14, 21.07, 19.10 and 11.74 at 5 percent significance level under the rank of 0, 1, 2 and 3 respectively.

Vector Error Correction Model (VECM) Test and Results

In case when the variables in a model are found to be co-integrated, VECM is considered as the effective way of explaining the relationships of the variables as it links the short run behavior to the long-run. Accordingly, the error correction co-integration equation of the study is given by:

Table 4.3.1
Vector Error Correction Co-integration Model

Variables	DLRBMS	DLRGDP	DInflation	DLInterest
r_1	1	-4.024161	-0.07174969	-0.07174969

DLRBMS= - 4.024161 DLRGDP - 0.07174969 DInflation + 0.3695942 DLInterest…….. (4.1)

Equation 4.1 shows the vector error correlation equation. The result of the VECM model indicates that, DLRGDP and DInflation has the negative relation with the DLRBMS whereas, DL Interest has the positive relationship with the DLRBMS. Against the expected outcome, there exists the indirect relationship between the real GDP and real broad money supply and positive relationship between the interest rate and the real

Broad Money supply. However, the relationship between the inflation rate and real broad money was negative as per the expectation.

Table 4.3.2
Vector Error Correction Short Run and Long Run Causal Relation

Variables		ECT Value	Value of First Lag	Value of Second Lag
Dependent	DLRBMS	-0.1825(0.0753)*	-0.7244(0.1760)***	-0.1659(0.1990)
Independent	DLRGDP		-0.3725(0.2308)	-0.1776(0.1579)
	DInflation		-0.0074(0.0042).	-0.0027(0.0024)
	DLInterest		0.0905(0.0539)	0.0193(0.0554)

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

In the above table, the significant and negative value of error correction term (ECT) of the dependent variable indicates that there is long term causality among the variables. The value 0.1825 indicates that there is 18.25 percent long term causality.

Accordingly, considering the lags of the variables, one out of two lags of the dependent variable DLRBMS and independent variable DInflation were significant, indicating weak short run causality. Moreover, since both the lag values of two independent variables DLRGDP and DLInterest were insignificant, in the results of VECM, indicates that none of the variables establish the strong short-run causality.

Estimation of the coefficients of the Parameters

Ordinary least square (OLS) method is adopted to estimate the unknown parameters in the linear regression analysis and to examine whether the variables under study are significant and the model is nicely fitted or not.

Table 4.4
Estimation of the Coefficients of the Parameters

Variable	Coefficient	Standard Error	t-Statistics	Probability	R^2	F-Statistics
Constant	-10.430542	0.467467	-22.313	<2e-16 ***	0.9933	< 2.2e-16***
LRGDP	1.994150	0.044920	44.393	<2e-16 ***		
Inflation	-0.003128	0.003542	-0.883	0.382		
LInterest	0.044695	0.057901	0.772	0.445		

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

From the above computation of the OLS, it was found that only one real GDP was found to be significant at 5 percent level of significance. On the other hand, two variable Inflation and Interest Rate out of three were found to be insignificant. However, even though the two out of three variables were found to be insignificant, the model seem to be nicely fitted as R-Squared value is 0.9933 which indicates that 99.33 percent variation in the dependent variables is explained by the explanatory variables.

Stability Test

The cumulative sum (CUSUM) test prescribed by Brown, Durbin and Evans (1975) was conducted to test the stability of the parameters. The CUSUM test considers the cumulative sum of recursive residuals based on the first set of the n observations and is updated recursively and plotted against break points. In case, the plot of the CUSUM statistics lies within the critical bounds of 5 percent level of significance represented by a pair of straight lines drawn at the 5 percent level of significance, the null hypothesis that all the coefficients in the error correction model are stable and cannot be rejected. In case the lines cross each other, the null hypothesis of the consistency of the coefficient is rejected at 5 percent significance level.

Figure 4.1
CUSUM Plot of Cumulative Sum of Squares
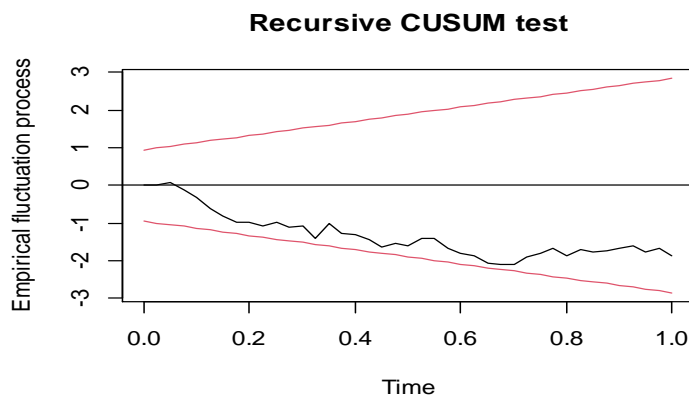
In the above diagram, since the black curve (irregular curve) lies within the boundary of two red (regular upward and downward sloping) lines, ie the CUSUM statistics lie within the 5 percent band indicating the model is said to be stable.

CONCLUSION

This paper is an empirical analysis of the money demand function of Nepal considering the annual time series data from the year 1975 to 2019. The major objective of this study was to examine the short-run and long run relationship among the money demand and its determinants such as real GDP, inflation rate and interest rate. Accordingly, similar to the results of the other researchers under consideration, the results of the Johansen co-integration test in this study also indicated that there exists the long-run equilibrium relationship among the variables under the study. Moreover, the CUSUM test proved the stability of the long run money demand function. On the other hand, using the VECM, the study though confirmed the long run causal relationship among the variables like other researchers, however, could not establish short run causal relationship among the variables like other researchers under considerations. Besides, this study establishes the negative relationship between the income level represented by real GDP and money demand and positive relationship between the interest rate and the money demand which is against the established theories. However, the negative relationship between the inflation rate and the money demand supports the existed theories. Finally, the outcome of the ordinary least square estimation, the value of R-squared proved that the model is good fit though two out of three explanatory variables are not significant.

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