

# An Empirical Analysis of Money Demand Function in Nepal

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## Abstract

*This paper analyzes the money demand function for Nepal during the period of the FY 1997/98 to FY 2009/10 using annual data. The empirical results imply that the cointegration tests clearly show the existence of the long-run relationship between real money balances and its determinants, output and interest rate. The vector error correction model has proved the short-run relationship between the real money balances and its determinants. Furthermore, Dynamic OLS estimation of the money demand function indicate that the sign of coefficients of the output and interest rate were found to be consistent with the assumption of the money demand theories.*

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## I. INTRODUCTION

The study of a money demand function is a prime issue since the stable money demand function is prerequisite for the conduct of the effective monetary policy. The demand function for money helps to ascertain the liquidity needs of the economy (Handa, 2009). As a result, it is exigent for the policy makers to understand the factors that determine this function and the existence of a stable long-run relationship between these factors and the money stock. This pivotal role of the money demand function has generated many empirical researches related to the money demand function, including its long-run and short-run stability. Despite the fact that there is a great deal of studies on the money demand in both developed and developing countries, no in-depth study, to our knowledge, has been reported yet on this subject for Nepal. Taking this fact into consideration, this paper tries to fill the gap in the literature by estimating the money demand function for Nepal.

The main objective of this paper is to estimate a theoretically consistent model of the money demand function of Nepal for the period of FY 1997/98 to FY 2009/10 using annual data. Two different definitions of money balances have been employed in the study: narrow money (M1) which includes currency and demand deposits, and broad money (M2) which includes M1 and time deposits. For the model estimation, this paper

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employed the method of cointegration, error correction model (ECM) and Dynamic ordinary least squares (DOLS).

The current monetary policy framework of Nepal has taken broad money as the interim target of the monetary policy (NRB, 2010). Furthermore, several noticeable changes have been occurred in the Nepalese financial system and the economy as a whole after the implementation of the financial sector reform program. In this type of economic milieu, this study bears significance for policy makers, especially Nepal Rastra Bank in its future policy making.

The brief outline of this paper is as follows. Section **II** deals with methodology, which includes models, data features and model estimation technique. Section **III** presents the empirical results of the study and analysis of the results. Section **IV** includes the conclusion and provides the policy implications of the findings.

## **II. MODELS AND DATA**

### *Data and Their Features*

This paper uses annual data of Nepal over the period of FY 1997/98 to FY 2009/10 for empirical analysis. Data include broad money (M1), narrow money (M2), the urban consumer price index (CPI), nominal GDP, the interest rate and real GDP. The sources of data include Nepal Rastra Bank's annual reports and quarterly economic bulletins, and various issues of *Economic Survey of Ministry of Finance*, Nepal. The data source of M1 and M2 are the various issues of the *Quarterly Economic Bulletin* of NRB. The interest rate at the savings deposit at commercial banks has been used as the interest rate for the empirical analysis.<sup>1</sup> Due to the unavailability of the data on weightage rate, this study utilized the interest rate calculated by taking the average of the upper and lower limit of the structure of the interest rate for each year. Data on interest rate were obtained from the various issues of *Quarterly Economic Bulletin* of NRB bulletin. Data on GDP and CPI were obtained from the various issues of *Economic Survey* of Ministry of Finance (MOF), Nepal. The nominal values were deflated by using CPI in order to compute the real values. Logarithm values are used for money supply, price levels and output (GDP). Interest rates are analyzed in two ways, taking a logarithm in one case and not in the other.

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<sup>1</sup> Near money assets such as savings deposits in commercial banks proved to be the closest substitutes for M1, so that their rate of return seems to be the most appropriate variable for the cost of using M1. But, if the broader definition of money were used, the interest rate on medium-term or long-term bonds would become most appropriate (the alternative to holding M2 or M3 is longer term bonds), since savings components of the broad definition of money themselves earn an interest rate close to the short rate of interest (Handa, 2009).

### *Econometric Models*

There are various theories concerning the money demand function. There is generally a consensus among the money demand theories that the main determinants of the quantity of money demand are the scale variable, which can be real income, wealth, or permanent income and opportunity cost variables. For example, Kimbrough (1986a, 1986b) and Faig (1988) came up with the following money demand function as a result of explicitly considering transaction costs:

$$\frac{M_t}{P_t} = L(Y_t, R_t) \quad L_Y > 0, L_R < 0 \dots \dots \dots (1)$$

In this function,  $M_t$  represents nominal money supply for period  $t$ ;  $P_t$  represents the price index for period  $t$ ;  $Y_t$  represents output for period  $t$ ; and  $R_t$  represents the nominal interest rate for period  $t$ . Increase in output lead to increase in money demand, and increase in interest rates lead to decreases in money demand. The function  $L$  is assumed to be increasing in  $Y_t$ , decreasing in those elements of  $R_t$  representing rates of return on alternative assets, and increasing in rates of return associated with assets included in  $M_t$ . Income, GDP in this model, is the choice of the scale variable because of the data limitation on wealth. The opportunity cost of holding money i.e the rate of interest is the second independent variable that determines the money demand function. Therefore, the proposed money demand function for Nepal specified in a log-linear form corresponding to equation (1) in order to conduct an empirical analysis are:

$$\text{Model 1: } \ln(M_t) - \ln(P_t) = \beta_0 + \beta_1 \ln(Y_t) + \beta_2 R_t + \mu_t, \quad \beta_1 > 0, \beta_2 < 0 \dots \dots \dots (2)$$

$$\text{Model 2: } \ln(M_t) - \ln(P_t) = \beta_0 + \beta_1 \ln(Y_t) + \beta_2 \ln(R_t) + \mu_t, \quad \beta_1 > 0, \beta_2 < 0 \dots \dots \dots (3)$$

Where,  $\beta_1$  in both equations (2) and (3) is the income elasticity of money demand, but  $\beta_2$  in (2) is the semi-elasticity of money demand with respect to interest rate and in (3) is the elasticity of money demand with respect to interest rate.<sup>2</sup> The positive sign is expected for income coefficient, while the domestic interest rate coefficient is expected to be negative. Both models 1 and 2 are log linear models, but Model 1 uses the level of interest rates and model 2 uses the logarithm value of interest rates. Model 1 is conventional form of the money demand function mostly used in the empirical research whereas Model 2 is based on the inventory-theoretic approach to money demand pioneered by Allias (1947), Baumel (1952) and Tobin (1956).

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<sup>2</sup> Semi-elasticity used in model 1 shows by how much percent real money demand change in response to a change in the interest rate of 1 percentage point (that is, for instance, the rate rising from 5% to 6%). It can be defined as:

$$\beta_2 = \frac{d \ln M}{dR} = \frac{dM/M}{dR}$$

The elasticity (such as  $\beta_1$  in model 1 and  $\beta_2$  in model 2) shows how the demand for money changes in response to a given percentage point change in the interest rate (say a one percentage point change from 5.0% to 5.05%).

### Model Estimation

As a preliminary analysis, the augmented Dickey-Fuller test is carried out for the logs of real money balances, GDP, and interest rates (Dickey and Fuller, 1979). ADF test is one of the unit root tests to determine whether each data series is non-stationary (that is unit root exist) or stationary (unit root do not exist).<sup>3</sup> This test forms the preamble to the econometric analysis of long-run equilibrium proposed by economic theory. Stationarity of the series is a desirable property for an estimated model. A stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed (Gujarati, 2007). Then, this work uses the widely used method of cointegration and error correction technique in the framework of the linear multivariate vector autoregressive (VAR). A testing procedure suggested by Johansen and Juselius (1990) is conducted to examine possible cointegration among the variables. The Johansen technique provided maximum-likelihood estimates for testing more than one cointegrating vector in a set of time series. This technique is set to account for long-run properties as well as short-run dynamics, in the framework of multivariate vector autoregressive models (Alsaifi, 2009). If the variables that have unit roots are cointegrated, it is appropriate to estimate Vector Error Correction Models (VECM). The VECMs are designed for use with nonstationary series that are cointegrated (Hamilton, 1994). Therefore, this study makes use of VEC models to analyze the money demand.<sup>4</sup> The VECM approach has the

<sup>3</sup> An Augmented Dickey-Fuller test can be specified as:

$$\Delta y_t = \mu + \eta t + \gamma^* y_{t-1} + \sum_{j=1}^{p-1} \phi_j \Delta y_{t-j} + \varepsilon_t$$

Where  $y_t$  is a random variable possibly with non zero mean,  $\mu$  is a constant,  $t$  time trend and  $\varepsilon_t$  is a error correction term with zero mean and a constant variance. The null hypothesis of the unit root ( $\gamma^* = 1$ ) is tested against the alternative of stationarity using critical values provided by MacKinnon distribution (Greene, 2002).

<sup>4</sup> The VECM representation is :

$$\Delta y_t = \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-k} + \mu + \Psi D_t + \varepsilon_t$$

Where,  $\sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-i}$  and  $\Pi y_{t-k}$  are vector autoregressive (VAR) components in the first differences and error correction components in level, respectively.  $Y_t$  is  $p \times 1$  vector of the variables that are integrated of the same order.  $\mu$  is a  $p \times 1$  vector of constants.  $K$  is a lag structure, while  $\varepsilon_t$  is  $p \times 1$  stationary random process with zero mean and constant variance.  $\Gamma_i$  is a  $p \times p$  matrix that represents short-run adjustments among variables.  $\Pi$  is decomposed into  $\beta \alpha$ , where  $\beta$  is an  $r \times p$  matrix of cointegrating vectors and  $\alpha$  is an  $p \times r$  matrix of the speed of adjustments (Alsaifi, 2009).

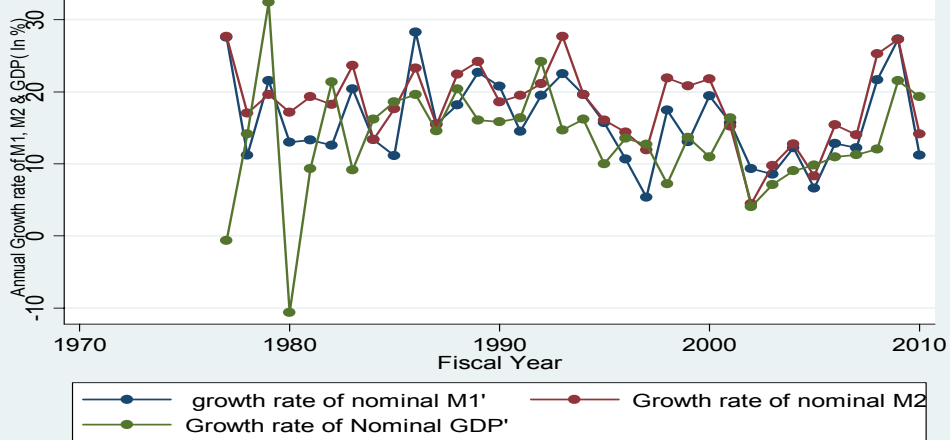
advantage of jointly estimating the long- and short-run components of the demand for money, thus facilitating the task of ensuring that short-run specifications are associated with long-run components with established economic theory (Alsaifi, 2009). Finally, the Dynamic OLS (DOLS) developed by Stock and Watson (1993) has been employed in order to estimate the coefficients of the both models (2) and (3).

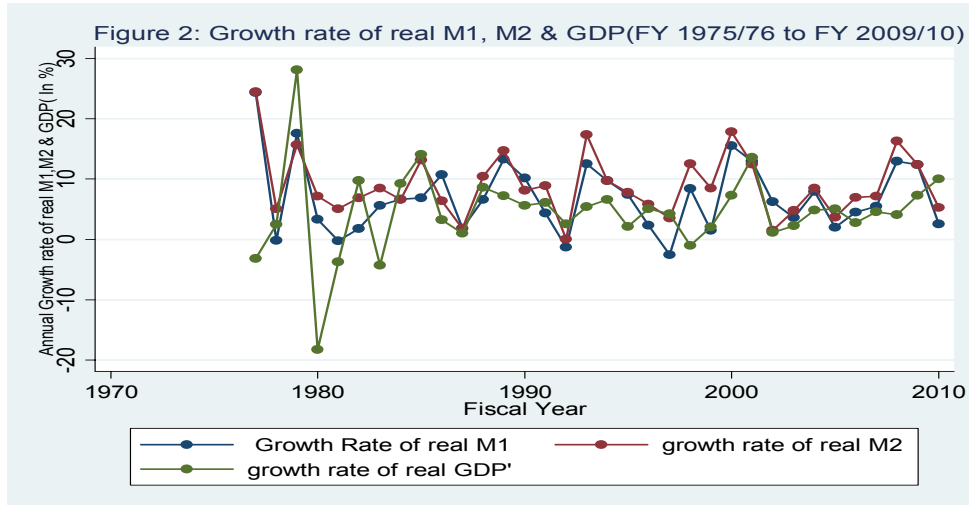
### III. EMPIRICAL RESULTS AND ANALYSIS

#### *Growth and Velocity of Monetary Aggregates*

One of the simple approaches for analyzing the relationship between money and the economy is to examine their graphical relationship and properties. The figures presented show simply the annual growth rates of the money balances and GDP, and income velocity of the money (VM) balances both in nominal and real terms. Figure 1 shows the historical development of the nominal money balances (M1 & M2) and GDP of Nepal during FY 1975/76 to FY 2009/10.

Figure 1: Growth rate of Nominal M1, M2 & GDP( FY 1975/76 to FY 2009/10)

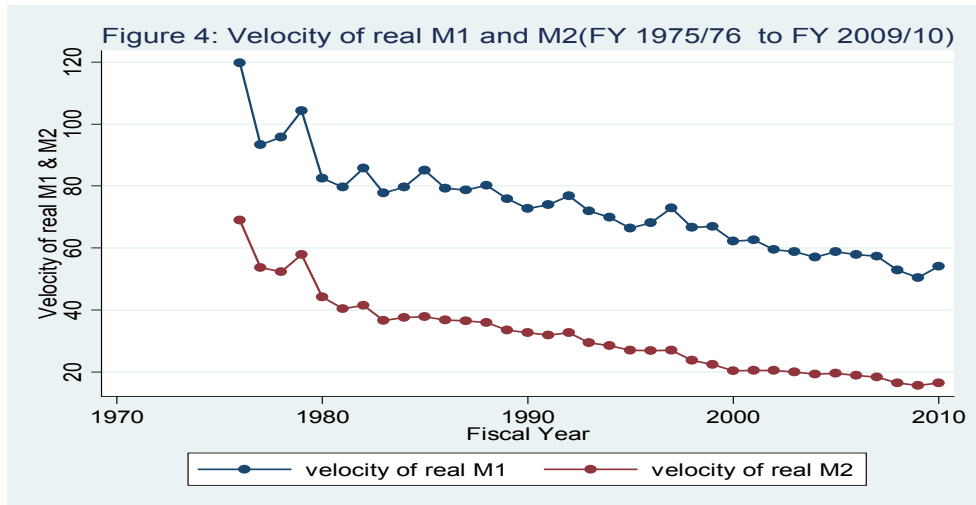
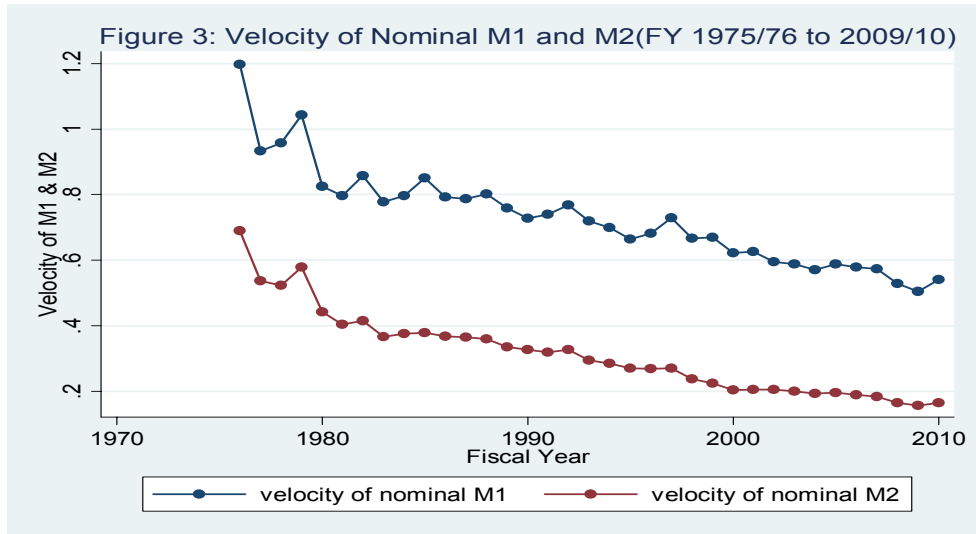




Similarly, Figure 2 shows the growth of the real GDP, M1 and M2. The figures clearly show that the changes in the nominal money balances have been closely associated with the changes in economic activity as represented by GDP. During the study period, the growth rates in both nominal (Figure 1) and real terms (Figure 2) money supply have also fluctuated and nearly captured the major up (for example, FY 1985/86) and downswings (for example, FY 1995/96) of the economy.

The income velocity of money (VM) also plays the important role in ensuring the effectiveness of the monetary policy since when VM is unpredictable, money demand function is also unstable.<sup>5</sup> Figure 3 and 4 show the income velocity of money for both M1 and M2 of Nepal for the period of FY 1975/76 to FY 2009/10. The velocity of both M1 and M2 in nominal and real terms has been declining gradually, but along with the fluctuation in few years. The velocity of the M1 has been more fluctuating than the M2 in the study period. The velocity of M1 became more stable after FY 1999/00 whereas it fluctuated continuously before this time period. It is clear from the figures presented above that the VM of M2 seem to be relatively more stable than the VM of M1 in both real and nominal terms.

<sup>5</sup> VM is defined as the average number of times that a national currency is spent in a year. Hence, it can be defined as the ratio of GDP to money supply i.e  $VM = \frac{Y}{M}$ , where Y stands for GDP and M stands for money supply.



The declining value of VM of Nepal implies the increase in the degree of the monetization of the economy. Furthermore, the decline in VM has partly offset the inflationary potential of the growth in the money supply.

**Unit Root Test Results**

Before embarking upon the cointegration analysis, the time series properties of the variables need to be examined. For this, this study makes use of the Augmented Dickey-Fuller (ADF) test in a regression with a drift, but no trend to analyze the time series

properties of the data. Table 1 presents the estimated test statistics for all variables on the level and first difference using ADF.

**Table 1: Augmented Dickey-Fuller (ADF) Test**

Variables	Augmented Dickey Fuller(ADF)	
	Levels	First Difference
LRGDP	-0.288	-2.897**
LRM1	-1.320	-3.036*
LRM2	-0.629	-3.374*
LP	-0.134	-2.344**
R	-0.134	-1.177

Notes: 1.LRGDP, LRM1, LRM2, LP and R are the log of the real GDP, real M1, real M2, CPI and nominal interest rate respectively.

2. \*/\*\* stand for significant at 1% and 5%, respectively.

3. Critical values were used of Mackinnon (1991). The critical values are -2.99 and -1.89 at the 1% and 5% level of significance respectively.

The statistics under ADF tests implies that all levels of the natural logarithms of the mentioned time series variables have unit roots at the 5 per cent level of significance. Furthermore, the ADF statistics show that the unit root hypotheses are rejected at the 5 per cent level of significance for the first difference of the natural logarithms of the variables except R. As a result, the ADF test conducted implies that the level of each variable was found to have a unit root, whereas the first difference of each variable was found not to have a unit root except R. Thus, all variables are found to be non-stationary at levels and stationary at their first differences except R. All variables are best modeled as I (1) with drift. Since almost variables are integrated of the order I(1) with drift, then one can expect that these series may be cointegrated as well.

### *Cointegration Analysis*

This paper has used the Johansen and Juselius(1990) methodology to test the presence of a stable long-run relationship between real money balances and their determinants. Johansen and Juselius (1990) use both trace eigenvalue statistics( $\lambda_{trace}$ ) and maximum eigenvalue statistics( $\lambda_{max}$ ) which are employed to determine the cointegration vectors. The optimal lag length of VAR is determined by the Sequential Likelihood Ratio (LR), the Final Prediction Error (FPE), and the Akaike Information Criterion (AIC). Table 2 presents the results of the rank tests of the M1. The result reported from the trace and maximum eigenvalue statistics show that the null hypothesis of the cointegrating vector linking real M1 and its determinants is rejected at the 5% level of significance for both  $\lambda_{max}$  and  $\lambda_{trace}$  statistics for both models 1 and 2 since  $\lambda_{max}$  and  $\lambda_{trace}$  exceed their corresponding 5% critical values. In model 1, however, for  $\lambda_{max}$ , the null hypothesis of the, at most, one cointegrating vector cannot be rejected at the 5% significance level. It is obvious that both statistics yield different results. But Johansen and Juselius(1990) suggest the use of  $\lambda_{trace}$  statistics in the situation of the conflict between the two statistics. As a result, we can conclude that there exist more than one cointegrating vectors for this M1 at the 5% significance level if we consider model 1. In model 2, the null hypothesis of



the zero cointegration is strongly rejected by the data at the 5% level of significance for both  $\lambda_{\max}$  and  $\lambda_{\text{trace}}$ . However, the null hypothesis of the, at most, one cointegrating vector cannot be rejected as both trace and maximum eigenvalue statistics are smaller than the critical values reported for each. Thus, it can be concluded that there exists a unique cointegrating vector for the model 2 for M1 at the 5% level of significance.

**Table 2: Johansen Cointegration Tests for Models (1 &2), M1**

Model	Hypothesized	Test Statistics	5% Critical Values			
	no of CE(S)		Eigenvalue	$\lambda_{\max}$	$\lambda_{\text{trace}}$	$\lambda_{\max}$
Model 1	H <sub>0</sub>					
	0		23.738*	40.94*	20.97	29.68
	At most 1	0.844	11.084	17.21*	14.07	15.41
	At most 2	0.634	6.119*	6.12*	3.76	3.76
Model 2	H <sub>0</sub>					
	0		22.823*	36.135*	20.97	29.68
	At most 1	0.874	10.938	13.312	14.07	15.41
	At most 2	0.63	2.37	2.373	3.76	3.76

Note: \*denotes the rejection of the null hypothesis at the 5% significance level. Critical values are from Source: Osterwald-Lenum(1992).

**Table 3: Johansen Cointegration Tests for Models (1 &2), M2**

Model	Hypothesized	Test statistics	5% Critical Values			
	no of CE(S)		Eigenvalue	$\lambda_{\max}$	$\lambda_{\text{trace}}$	$\lambda_{\max}$
Model 1	H <sub>0</sub>					
	0	-	34.932*	49.272*	20.97	29.68
	At most 1	0.958	10.72	14.339	14.07	15.41
	At most 2	0.623	3.62	3.618	3.76	3.76
Model 2	H <sub>0</sub>					
	0	-	24.324*	39.013*	20.97	26.68
	At most 1	0.874	13.481	14.706	14.07	15.41
	At most 2	0.63	1.226	1.23	3.76	3.76

Table 3 shows the rank test for M2 for both hypothesized models 1 and 2. From the reported result, the null hypothesis of the zero cointegrating vectors is strongly rejected by the data in both models at the 5% significance level for both  $\lambda_{\max}$  and  $\lambda_{\text{trac}}$  as both  $\lambda_{\max}$  and  $\lambda_{\text{trac}}$  are greater than their corresponding 5% critical values. But, the null hypothesis of the, at most, one cointegrating vector is not rejected by both trace and maximum eigenvalue statistics because both trace and maximum eigen value statistics are smaller than the critical values reported for each. Therefore, we can conclude that there is a unique cointegrating vector for M2 at the 5% significance level.

### ***Vector Error Correction Model (VECM) Results***

As the variables in both models tested above are found to be cointegrated, a better way to explain the dynamic relationship between them is to use VECM. Thus, this study employed the VECM to tie the short-run behavior of each money demand to its long-run

equilibrium values. Under this method, the simultaneous effect of all the variables in the model on each other is estimated.

The short-run error correction model for money demand for Model 1 using M1 is given by the equation (4). Here, t-statistic and p-values are in round brackets and in squared brackets respectively. The coefficients of both (output and interest rate) have the expected sign, and are statistically significant. In the short-run, both variables output and interest rate have significant effect on the narrow money (M1). Although the error-correction term is significantly different than zero, it does not have the expected sign. This implies that the dynamic adjustment to an excess money supply by economic agents would be through increasing their demand for money, which would cause the dynamic stability in the demand for money.

$$\Delta \ln RM1_t = 0.006 + 0.742 \Delta \ln RM1_{t-1} + 0.0433 \Delta \ln Y_{t-1} - 1.354 \Delta R_{t-1} + 0.1235 EC_{t-1} \quad (4)$$

(0.0308)	(0.0184)	(0.29763)	(0.492)
[2.401]	[2.811]	[-4.488]	[0.251]

R<sup>2</sup>=0.31      F-stastic=0.658      LM(2)=7.17      LM(5)=5.31  
 (0.73)      (0.81)

Portmanteau test(1) Adj Q-stat=10.11      Jarque-Bera Normality test=9.79  
 (0.34)

(0.99)

Residual Heteroskedasticity Test  $\chi^2=40.76$   
 (0.098)

Equation (5) reports the short-run error correction model for money demand of Model 2 using M1, where t-statistic and p-values are in round brackets and in squared brackets respectively. The estimated results show that the coefficients of both GDP and interest rate have the sign that confirm to the money demand theory along with their statistical significance. Therefore, the short-run demand for M1 seems to be influenced by the lags of M1, GDP and interest rate. But, the error-correction term does not have expected sign.

$$\Delta \ln RM1_t = 0.0071 + 0.741 \Delta \ln RM1_{t-1} + 0.0432 \Delta \ln Y_{t-1} - 0.249 \Delta \ln R_{t-1} + 0.0022 EC_{t-1} \quad (5)$$

(0.524)	(0.0318)	(0.0161)	(0.595)
[2.393]	[2.691]	[-4.193]	[0.0042]

R<sup>2</sup>=0.33      F-stastic=0.983      LM(2)=4.685      LM(5)=5.44  
 (0.86)      (0.79)

Portmanteau test(1) Adj Q-stat=6.867      Jarque-Bera Normality test=9.695  
 (0.65)      (0.99)

Residual Heteroskedasticity Test  $\chi^2=39.5$   
 (0.118)

Equation (6) is the error correction model of money demand for Model 1 using M2. The results obtained here are also very similar to those of M1. Here, both output and interest rate coefficients are statistically significant and have the expected sign. The coefficient of the GDP is positive i.e 0.04 and the coefficient of the interest rate is negative i.e. -1.335. This implies that the short-run demand for M2 is also influenced by lag of the both output and interest rate.

$$\Delta \ln RM2_t = 0.0082 + 0.885 \Delta \ln RM2_{t-1} + 0.0434 \Delta \ln Y_{t-1} - 1.335 \Delta R_{t-1} + 0.537 EC_{t-1} \quad (6)$$

(0.0258)	(0.0081)	(0.312)	(0.2645)
[3.429]	[5.321]	[-4.293]	[2.03]

R <sup>2</sup> =0.35	F-stastic=2.049	LM(2)=7.96 (0.54)	LM(5)=8.62 (0.473)
Portmanteau test(1)	Adj Q-stat=5.69 (0.72)	Jarque-Bera Normality test=10.22	(0.99)
Residual Heteroskedasticity Test $\chi^2=40.46$ (0.096)			

$$\Delta \ln RM2_t = 0.0083 + 0.884 \Delta \ln RM2_{t-1} + 0.0434 \Delta \ln Y_{t-1} - 0.249 \Delta \ln R_{t-1} + 0.556 EC_{t-1} \quad (7)$$

(0.0259)	(0.0082)	(0.0629)	(0.278)
[3.413]	[5.289]	[-3.966]	[2.019]

R <sup>2</sup> =0.361	F-stastic=2.036	LM(2)=5.67 (0.73)	LM(5)=10.24 (0.33)
Portmanteau test(1)	Adj Q-stat=6.22 (0.72)	Jarque-Bera Normality test=9.795	(0.99)
Residual Heteroskedasticity Test $\chi^2=36.28$ (0.198)			

From VECM, the estimated money demand function for M2 for Model 2 is given by equation (7). This equation also reports the same results as earlier. The coefficients of the output and interest are both statistically significant and have the expected sign. But the error correction term does not have the expected sign.

**Dynamic OLS Results**

As the existence of the cointegration relation was supported by the Johansen cointegration tests, the money demand function can be estimated by using the Dynamic OLS (Stock and Watson, 1993). The Stock-Watson approach is a robust single equation approach which corrects for regressor endogeneity by the inclusion of the leads and lags

of first differences of the regressors, and for serially correlated errors by GLS procedures.<sup>6</sup> In this study, the number of leads and lags is chosen arbitrarily to be 1. Table 4 presents the estimation results obtained from DOLS with respect to Model 1 for M1. From this table, it is clearly observed that the coefficient of GDP is significantly estimated to be positive i.e 2.19 and the interest rate coefficient is estimated to be negative i.e -0.071.

**Table 4: Dynamic OLS (M1, Model 1)**

$$\ln M1_t - \ln P_t = \beta_0 + \beta_1 \ln y_t + \beta_2 R + \sum_{i=-k}^k \gamma_{yi} \Delta \ln y_t + \sum_{i=-k}^k \gamma_{ri} \Delta R_t + u_t$$

Variables	Coefficients	SE	t-stastic	P-value	R <sup>2</sup>
Constant	-16.82	18.22	1.29	0.525	0.99
lnY	2.19	1.70	0.59	0.42	
lnR	-0.071	.12	-0.92	0.66	

**Table 5: Dynamic OLS (M1, Model 2)**

$$\ln M1_t - \ln P_t = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln R + \sum_{i=-k}^k \gamma_{yi} \Delta \ln y_t + \sum_{i=-k}^k \gamma_{ri} \Delta \ln R_t + u_t$$

Variables	Coefficients	SE	t-stastic	P-value	R <sup>2</sup>
Constant	-22.33	5.189	-4.3	0.145	0.98
lnY	2.68	0.479	5.61	0.112	
lnR	-0.035	0.144	2.46	0.246	

Table 5 shows the DOLS results of Model 2 for M1. This table also clearly shows that the output coefficient is 2.68 and the interest rate coefficient is -0.035. Thus, the sign condition of the money demand (M1) holds for both of the cases. In this way, it becomes apparent that not only the cointegrating relation was supported, but also the existence of the money demand function with respect to the M1 was statistically supported. Next, we take the money demand function using M2 component. In the case of M2 also, as the existence of the cointegration was supported, the DOLS has been used to estimate the money demand function.

<sup>6</sup> The DOLS estimators is based on the following augmented cointegrating regression, which includes the past, present and future values of the change in Xt,

$$Y_t = \beta_0 + \beta_1 X_t + \sum_{i=-k}^k \gamma_{ii} \Delta X_t + u_t$$

Where k represents the leads and lags of the variable,  $\beta_0$  and  $\beta_1$  are the parameters needs to be estimated.  $Y_t$  and  $X_t$  are the cointegrated variables.

**Table 6: Dynamic OLS (M2, Model 1)**

$$\ln M2_t - \ln P_t = \beta_0 + \beta_1 \ln y_t + \beta_2 R + \sum_{i=-k}^k \gamma_{yi} \Delta \ln y_t + \sum_{i=-k}^k \gamma_{ri} \Delta R_t + u_t$$

Variables	Coefficients	SE	t-stastic	P-value	R <sup>2</sup>
Constant	-21.51	18.22	1.29	0.525	0.99
lnY	2.73	1.701	0.59	0.420	
lnR	-0.0031	0.121	-0.92	0.661	

**Table 7: Dynamic OLS (M2, Model 2)**

$$\ln M2_t - \ln P_t = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln R + \sum_{i=-k}^k \gamma_{yi} \Delta \ln y_t + \sum_{i=-k}^k \gamma_{ri} \Delta \ln R_t + u_t$$

Variables	Coefficients	SE	t-stastic	P-value	R <sup>2</sup>
Constant	-20.95	2.5	-8.38	0.076	0.99
lnY	2.675	0.231	11.57	0.055	
lnR	-0.0019	0.694	2.87	0.214	

Table 6 shows the estimation results of Model 1 for M2. It is evident from the table that the sign of the output coefficient is positive (2.73) and the sign of the interest rate coefficient is significantly negative (-0.0031). Table 7 shows the DOLS estimation outcome for the M2 with respect to Model 2. In this table also, the output coefficient was significantly estimated positive values of 2.675 and the interest rate coefficient was significantly estimated negative values of -0.0019. From this we can conclude that along with the existence of the cointegration relation, the existence of the money demand function with respect to M2 was statistically supported.

#### IV. CONCLUDING REMARKS

This paper empirically analyzed the money demand function for Nepal using annual data for the period of FY 1997/98 to FY 2009/10. The empirical results obtained from the cointegration analysis indicate that the real money balances M1 and M2 are cointegrated with the output as represented by GDP and interest rate, implying that a long-run relationship between the real monetary aggregates and independent variables (GDP and R) is established. The VECM<sub>s</sub> were employed to show the short-run dynamic relationship among monetary aggregates and scale variables. The cointegration and error correction results clearly show that there exist a long-run and short-run dynamic equilibrium between monetary aggregates (M1 & M2) and scale variables, GDP and interest rate. Furthermore, estimated results from Dynamic OLS also implied the statistical support for the existence of the money demand function with respect to both M1 and M2 under both

models. The declining value of velocity of money observed in this paper clearly reflects the growing monetization of the economy. As velocity of M2 was observed relatively stable than M1, it simply indicates the superiority of broad money over narrow money for policy purpose.

These derived empirical results from this paper imply that NRB can focus on both M1 and M2 control in order to achieve these goals. Future research on the money demand function may include different interest rates from money market in explaining money demand in short and long-run. In addition, the stability of the Nepal's money demand function, taking into account the currency substitution issue, may be the another issue for the researchers in order to suggest the ways for the effective formulation and implementation of the monetary policy of Nepal.

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**Appendix 1: Data set used in the estimation of the Money Demand Function**

Fiscal Year	GDP (Rs. In millions)	CPI	M1 Mid july (Rs. In millions)	M2 Mid july (Rs. In millions)	R Mid july
1975/76	1739.40	15.40	1452.50	2524.00	
1976/77	1728.00	15.80	1852.90	3223.00	
1977/78	1972.70	17.60	2060.60	3772.10	
1978/79	2612.80	18.20	2504.90	4511.40	
1979/80	2335.10	19.90	2830.40	5285.30	
1980/81	2553.00	22.60	3207.80	6307.70	
1981/82	3098.80	25.00	3611.50	7458.00	
1982/83	3382.10	28.50	4348.90	9222.40	
1983/84	3929.00	30.30	4931.50	10455.20	
1984/85	4658.70	31.50	5480.00	12296.60	
1985/86	5573.40	36.50	7029.30	15159.00	
1986/87	6386.40	41.40	8120.20	17498.20	
1987/88	7690.60	45.90	9596.60	21422.60	
1988/89	8927.00	49.70	11775.40	26605.10	
1989/90	10341.60	54.50	14223.00	31552.40	
1990/91	12037.00	59.80	16283.60	37712.50	
1991/92	14948.70	72.40	19457.70	45670.50	
1992/93	17149.20	78.80	23833.00	58322.50	
1993/94	19927.20	85.90	28510.40	69777.10	
1994/95	21917.50	92.50	32985.40	80984.70	
1995/96	24891.30	100.00	36498.00	92652.20	
1996/97	28051.30	108.10	38460.30	103720.60	
1997/98	30084.50	117.10	45163.80	126462.60	6.5-8.8
1998/99	34203.60	130.40	51062.50	152800.20	5.75-8.0
1999/00	37948.80	134.80	60979.70	186120.80	4.0-6.5
2000/01	44151.90	138.10	70577.00	214454.20	3.5-6.5
2001/02	45944.28	142.10	77156.20	223988.30	2.5-6.25
2002/03	49223.13	148.90	83754.10	245911.20	2.5-6.0
2003/04	53674.89	154.80	93973.70	277310.10	2.0-5.0
2004/05	58941.16	161.80	100205.80	300440.00	1.75-5.0
2005/06	65408.40	174.70	113060.80	346824.10	2.0-5.0
2006/07	72782.70	185.90	126888.00	395518.20	2.0-5.0
2007/08	81566.32	200.20	154343.90	495377.10	2.0-6.5
2008/09	99131.61	226.70	196459.40	630521.20	2.0-7.5
2009/10	118268.01	245.80	218519.00	719599.10	2.0-12.0

GDP: Gross Domestic Product, CPI: Urban Consumer Price Index, M1: Narrow Money, M2: Broad Money, R: Interest rate structure of the Commercial Banks at Savings Deposit.