Money and Its Role of Income Stabilization: An Econometric Diagnosis

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There is a continuous debate over the transmission mechanism of monetary impulses on economic activities in developed as well as developing countries, and the debate revolves around two broad categories of transmission channels- the Keynesian and the Quantity Theory. Keynesian transmission mechanism examines the effect of money on economic activities by building the structural model. The basic Keynesian view is that the impact of the change in money stock on real income results indirectly through change in the rate of interest rate and thereby investment expenditure. The Quantity Theory of Money, on the other hand, is associated with reduced-form economic model, in which the effect of money on economic activities is examined by looking whether movements in income are tightly linked to movements in money supply. Monetarists analyze the effect of change in money supply on the change in income level as if the economy is a black box in which its working can not be detected. This paper tries to find out the relationship between money and income by using reduced-form models. The empirical results show that there is a strong positive association between money and its role of income stabilization. It is true both for nominal as well as real terms. The lagged response of money supply on income is two years in nominal terms and three years in real terms. There is also the structural shift in the role of money for income stabilization, indicating that money has become more effective during the liberalization period to determine the income level of the economy.

1. INTRODUCTION

Every government has two powerful instruments in its hand -monetary and fiscal policies- to utilize potential economic resources properly for the rapid development of the economy. Monetary policy works through the movement in money supply whereas the fiscal policy uses shifts in tax and expenditure patterns, both attempting to increase economic growth of the economy. Though monetary policy, in the recent years, is focusing its attention on stabilizing the nominal variables such as inflation and exchange rates, its role of income stabilization, as

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yet, cannot be undervalued, especially for the developing countries like Nepal where the economy is below the full employment level. In this regard, the central bank has the responsibility to help achieve the appropriate rate of economic growth with stability, using prudential monetary measures available in its hands. The effectiveness of policy the central bank formulates depends, among other things, on the identification of true relationship between the variables. As such, this paper tries to find out the empirical relationship between money and income.

Nepal Rastra Bank has taken money supply as an intermediate target variable. So far, the money supply is targeted on the basis of expected real output growth, inflation rate and monetization rate. It is expected that the empirical results obtained by this study can be used to target nominal money supply in accordance with the projected nominal money income.

The organization of the study is as follows: the next section throws light on the review of theoretical developments, the third section presents the description of the methods used in the study to get empirical findings. The empirical results and the conclusions are presented in the fourth and fifth sections respectively.

2. SYNOPSIS ON THEORETICAL DEVELOPMENTS

Several theories have been propounded so far to identify the role of money on economic activities. There are basically two groups to discuss over this issue: one group claims 'money matters' and the other, counter claims 'money does not matter'. The different hypotheses range from classical to modern rational expectationists' views as are presented below:

The Classical View

The classical quantity theory of money states that the change in money stock is proportionately related with the change in the price level, assuming that velocity of money and real output remain constant in the short run. The classical quantity theory is expressed as:

(1) $MV = PT$
    Where,
    M = quantity of money in circulation
    V = velocity of money
    P = price level
    T = total real output transacted

Here, the velocity of money (V) is assumed constant because it is determined by structural and institutional factors. The real output transacted (T) is independently determined by real forces such as techniques of production, real sources available in the economy, etc. These variables are constants in the short-run. Thus, the effect of change in money stock is fully reflected to the change in the price level. The classical quantity theorists, therefore, conclude that money determines only the

price level but not the real output of the economy. There exists dichotomy between monetary and real sectors of the economy and the monetary policy has nothing to play any role for income stabilization in the economy.

Traditional Keynesian Concept

Keynes' concept of role of money on economic activities is the revolutionary one against classical concept. Under the assumption of under-employment equilibrium, the basic Keynesian traditional view states that the change in money supply has an indirect effect on real income through changes in the role of interest rate and hence investment expenditure. To establish the link between monetary and real sectors of the economy, Keynes assumes two-asset world (money and bonds) in the portfolio. Therefore, any increase in the quantity of money leads first to the portfolio adjustment in the monetary sector, implying that people invest some of their increased income in bonds. Consequently, there will be a decline in the rate of interest. With given marginal efficiency of capital, the investment demand will increase and hence the national income or real output will increase.

Keynes, however, believes the existence of 'liquidity trap' - a situation below which interest rates do not fall down even if money supply is increased- that makes the monetary policy to be less effective on the expansion of aggregate output. Therefore, Keynes' focus is on the importance of fiscal policy rather than on monetary policy. Monetary policy is not sufficient to stabilize the economy and in the depression period, monetary tools become completely ineffective, says Keynes.

Neo-Keynesian Developments

The Keynesian concept had enjoyed greater acceptance and it was piling up day-to-day during 1950s and early 1960s. During this time, modern Keynesians had made significant revisions and extensions in the original or traditional Keynesian analysis and developed various transmission mechanisms of monetary policy. Followings are some of the important ones:

Credit Availability Channel : This channel works through credit rationing- that makes excess loan available for essential sector of the economy. When there exists high degree of positive correlation between loan availability and investment expenditure, the latter will eventually be increased causing the rise in national output of the economy. This channel has been proved to be effective for underdeveloped countries where there is high demand for credit at the prevailing rate of interest in the formal financial sector.

Tobin's 'q' Theory : Tobin (1970) defines 'q' as the ratio of market value of firms to the replacement cost of capital. When money supply increases, the public finds it has more money than it wants and so gets rid of it by spending more on various stocks raising its prices and market value of the firms. This means the value of 'q' is high and the market price of firms is relative higher than replacement cost of capital than the replacement cost of capital, and new plant and capital equipment

will be cheaper to the market value of business firms. Companies can then issue stocks and get a high price for it relative to the cost of the plant and equipment they are buying. Thus, investment spending will rise because firms can buy many new investment goods with only a small issue of stocks and thus ultimately national output will rise.

Wealth Effect Channel : This channel explains that if consumers are assumed to hold bonds as well as other assets in their wealth portfolio, increment in the value of bonds brought about by increase in the monetary impulses will affect net worth of the consumers and they start to make more expenses on various goods and services. Permanent income hypothesis of Milton Friedman (1957) and life cycle hypothesis of Ando and Modigliani (1963) suggest that changes in the net worth of a consumer affect consumption expenditure.

International Trade Channel : This channel explains the effect of changes in money supply on the net export of the country. When domestic interest rates fall (with inflation unchanged) because of increase in money stock, domestic deposits become less attractive relative to deposits denominated in foreign currencies. The result is a fall in the value of domestic deposits relative to foreign currency deposits. This means there is a fall in the exchange rate of domestic currency, which causes a rise in net exports and hence in aggregate output.

There may have been so many other channels of monetary influence on aggregate output, however the particular channel through which changes in the money supply affect national output are diverse and continuously change and it may be too difficult to identify all the transmission mechanisms of monetary policy.

Monetarists' Approach

When Keynesian view was in its peak of popularity among the economists in the 1950s and early 1960s, a small group of economists in the University of Chicago, led by Milton Friedman with some of his disciples- who latter known as monetarists, presented what was then an unfashionable view that money could show strong effect on the economic activities. Monetarists do not describe specific ways; instead, they examine the effect of money on the economic activities by looking is to whether movements in aggregate spending are tightly linked with the movements in money supply. The monetarists argue that when money supply is increased by the monetary authority, the money market is in disequilibrium, the excess money balance is used for purchasing real assets, causing an increase in the quantity of the national real output. However, it is the short run phenomenon according to them. In the long run they believe that growth of real output is independent of the growth of money stock and increased money supply will completely be reflected in the changes of price level.

Hence, the monetarists presented a revolutionary idea, signifying the dominance role of monetary policy on economic activities. Friedman and Schwartz (1963) in their classic book 'A Monetary History of the United States, 1867-1960' had even

showed that the Great Depression was not a period of easy monetary policy; rather the depression could be attributed to the sharp decline in the money supply from 1930 to 1933 resulting from bank panics. They have shown in great detail that the growth rate of money leads business cycles.

Rational Expectationists' View

The failure of pre-existing theories to explain the dismal economic performance during the seventies and eighties of the economies practically all over the world gave rise to the theory of 'Rational Expectations'-called the theory of 'Ratex'. Rational expectationists believe that public can predict about the level or rate of change of some economic variables based on the use of the best model and all the information available thereof. Therefore, they maintain that monetary policy has negligible systematic effects on output unless they come as a surprise to the public. The actual rate of monetary expansion, according to them, can be divided into anticipated and unanticipated ones and they concluded that anticipated variation in the rate of growth of money supply could lead directly to variations in inflation rate and unanticipated variation is reflected only to real income and eventually to inflation rate fluctuation. The monetarists have accepted long run neutrality of monetary policy over real economic variables such as output and employment, but, according to rational expectationists, it is true even in the short run as well.

3. METHODOLOGY

This paper is related with macro-economic variables, so the secondary data used on the sources such as economic surveys (HMG/N), quarterly economic bulletin (NRB), etc are used. For the purpose of processing and analyzing the data, different statistical and econometric tools are used to work out empirical results.

Unit Root Test

At the outset, the unit root test is used to check whether the variables used are stationary or not. In time series analysis, the empirical results with non-stationary data lead to spurious results. The Dicky-Fuller (DF) and Augmented Dicky-Fuller (ADF) tests are normally used to perform unit root tests. To test the stationarity, let us consider the general relationship as:

(2) $\qquad Y_t = \alpha + \rho\, Y_{t-1} + \varepsilon_t$

If $|\alpha| < 1$, y is stationary and if y=1, y is non-stationary and contains unit root. So, the null hypothesis of unit root is given by;

$\qquad H_0: \rho = 1$

For testing this null hypothesis, the equation (1) is converted into as:

$\qquad \Delta\, y_t = \alpha + \gamma\, y_{t-1} + \varepsilon_t$

$\qquad$ Where, $\gamma = \rho - 1$

In this case, the null hypothesis of unit root is $\gamma=0$

Co-integration Test

The co-integration test is used to test the existence of long-run equilibrium relationship between the variables, though they might have individually shown the non-stationary phenomena in the short-run. When the series are co-integrated, the ordinary least square method is supposed to be super consistent to estimate the regression parameters. Of the many methods available for co-integration test, the data are tested by using the method suggested by Engle and Granger (1987). As per this method, firstly the regression is run between non-stationary variables and obtain residuals. Then, the unit root test is used for the residuals thus obtained. If the residuals do not contain unit roots, the given variables are said to be co-integrated with the notion of that the variables have equilibrium relationship in the long-run.

Specification of the Model

To know the exact relationship between the variables, we should set the model that best describes the true relationship. Mainly there are two types of widely used models- (i) reduced form, and (ii) structural models, to describe the money-income relationship. The economists who follow Keynesian type of transmission mechanism are mostly biased towards large-scale structural model, and followers of monetarists proposition are biased towards reduced-form single equation model. Structural model examines whether one variable affects another by using data to build a model that explains the channels through which one variable affects the other; whereas reduced-form model examines whether one variable has an effect on another simply by looking directly at the relationship between the two variables. The selection of the model is basically depends on the factors such as objective of the researcher, the reliability of the model, structure of the economy, data availability, cost factors, etc. All of these factors have help to select the reduced-form model. Thus, the general functional form of the estimating equations on the reduced-form models is as follows:

(3) $Y_t = a_0 + a_1 M_t + u_t$
         Here, Y is the income variable and M, the money supply variable.
   The empirical results are also obtained in real terms as well. The variables concerned are converted into the real terms by using the GDP deflator. The income variable (Y) is separated in agricultural income (Y_{ag}) and non-agricultural income (Y_{nag}) to find the sectoral response of monetary shocks. As monetary variables, both monetary aggregates are used to find the empirical results.

The Almon Approach to Distributed Lag Models

It is a priori postulation that the effects of changes in explanatory variables on dependent variable may spread for several time periods and in this case distributed lag models are suggested to apply for policy evaluation. There are various methods available to estimate the equations with lagged variables, a more sophisticated and frequently used method has been presented by S. Almon. The mathematical form of the model with finite number of parameters and only one independent variable is:

$$(4) \quad Y_t = \alpha + \sum_{i=0}^{k} a_i X_{t-i} + u_t$$

Instead of attempting to estimate directly all the a's by applying OLS to the above model, they are approximated by some function that may be given by m^{th} degree polynomial in i. Therefore,

$$(5) \quad a_i = \beta + \beta_i + \beta_2 i^2 + \dots + \beta_m i^m$$

Here, β's are obtained by using OLS method. Getting the values of β's, we can easily find the values of a's. One thing to be considered is that while using Almon's technique the degree of polynomial (m) should be necessarily less than the length of lag (k). Although there are various techniques used for selecting the degree of polynomial, yet it is usually assumed low, i.e., 3 or 4 (Koutsoyiannis, 1996, pp. 300). The selection of lags, on the other hand, depends on the significance and sign of the estimated parameters associated with the lagged values of the variables. The selection of degree of polynomial and the lags, however, should be performed on a priori ground while estimating lagged model from Almon technique.

Method of Estimation

The relationship between the variables is obtained by using Ordinary Least Square (OLS) method for all the models.

Stability Test

If we use linear regression models to represent an economic relationship, the question often arises as to whether the relationship remains stable in various periods of time or not. Here, the whole study period has been separated into two sub-sample periods viz. 1975-1989 and 1990-2002. The former represents the less liberalized economy and the latter, the liberalized economy. The basis for such separation of the whole period is on the postulation that the liberalization policy started during mid 1980s and intensified at the beginning of 1990s, following the policy changes such as deregulation in interest rates, establishment of joint venture

banks, initiation on full convertibility in current account, etc. In this regard, we realized the necessity of stability test to know the effectiveness of liberalization policy. Several statistical tests are available for the stability test of the regression equation and of the parameters. One of the popular methods of testing the stability of the parameters can be performed with the help of Chow-test statistics. The null of the coefficients of two sub-sample periods do not differ significantly is given by;

$H_0 : a_1 = a_2$

To test this hypothesis, the calculated F-ratio is given by,

$$(6) \qquad F^* = \frac{[\Sigma e_o^2 - (\Sigma e_1^2 + \Sigma e_2^2)]/K}{[\Sigma e_1^2 + \Sigma e_2^2]/(n_1 + n_2 - 2K)}$$

Where,

Σe_p^2 = Residual sum of squares of the regression estimates
n = Number of observations
K = Number of estimated parameters

Subscripts p, 1 and 2 stand for pooled, sample 1 and sample 2 periods respectively.

4. EMPIRICAL FINDINGS

Unit Root Test Results

The following table exhibits the unit root test results. The results show that all the variables in log-transformed form are non-stationary. For the case of first difference log-transformed variables, no variables possess unit root except for the non-agricultural GDP.

Unit Root Results

Variables	log							
	Y	Yag	Ynag	M_1	M_2	RY	RM_1	RM_2
ADF Statistic	-0.53	-1.18	-1.42	0.10	-1.24	0.55	-0.97	-1.02

Variables	Δlog							
	Y	Yag	Ynag	M1	M2	RY	RM1	RM2
ADF Statistic	-3.04	-3.07	-5.40	-4.62	-2.47	-5.04	-5.73	-5.75

The MacKinnon's statistics in 1%, 5% and 10% for log-transformed variables are -3.71, -2.98 and -2.63 , and that for difference of log-transformed variables are -3.72, -2.99 and -2.63 respectively.

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[*] As suggested by Chow, we have two types of test statistics to test the structural change- breakpoint test and forecast test. This formula is for breakpoint test.

Co-integration Test

The co-integration test results as shown below exhibit that all the variables in the corresponding relationships are integrated of order zero. The co-integration vectors for the set of variables log (Y) and log (M1), log (RY) and log (RM2), and log (Ynag) and log (M1) are significant at 5% level, whereas the remaining models are significant at 1% level. The results in the co-integration tests suggest that one can also run the regressions in the log-transformed variables, even if they are individually non-stationary as shown by unit root test results.

Co-integration Test Results

Dependent Variable	Explained by	Constant	Trend	Co-integration Order	Dicky-Fuller Test Statistic
$\log Y$	$\log M_1$	-	-	I(0)	-3.89
$\log Y$	$\log M_2$	-	-	I(0)	-2.65
$\log RY$	$\log RM_1$	-	-	I(0)	-3.55
$\log RY$	$\log RM_2$	-	-	I(0)	-2.60
$\log Y_{ag}$	$\log M_1$	-	-	I(0)	-4.65
$\log Y_{nag}$	$\log M_2$	-	-	I(0)	-2.59

The MacKinnon's statistics for 1%, 5% and 10% are -2.66, -1.96 and -1.62 respectively.

Results in Nominal Income on Nominal Money Supply

The regression results in nominal terms exhibit that both definitions of money supply are the significant determinants of money income. Despite low DW test statistics indicating positive autocorrelation, all other test statistics are highly significant for both the estimated equations. The elasticity coefficient of narrow money supply is greater than that of broad money supply, which may be because of relatively more exogenous characteristics of M_1 than M_2. The currency, a major part of the M_1, is exogenously determined by the monetary authority, but the time deposits, a part of broad money supply, basically depend on endogenous variables like income level, interest rates, etc.

Dependent Variable	Explained by	Constant	Coefficient	Test Statistics		
				Adj. R^2	DW	p- value for F
log (Y)	$\log (M_1)$	3.35 (0.00)	0.86 (0.00)	0.996	0.68	0.00
	$\log (M_2)$	3.69 (0.00)	0.75 (0.00)	0.99	0.50	0.00

Bracket figures indicate p-values

Results in Real Incomes on Real Money Supply

With a view to knowing the impact of real money supply on real output of the economy, the following two equations have been estimated as shown below. The real money stock has a significant effect on real aggregate income level. The elasticity coefficient o.65 for M_1 indicates that one percent change in real money balance is able to change in real GDP by 0.66 percent. For broad money, this coefficient is 0.50, lower than that of narrow money, again indicating M_1 as a better predictor of income level of the economy. When compared these coefficients with the coefficients in nominal terms, indicating that the real money supply has comparatively lower impact on real output in comparison with nominal terms.

Dependent Variables	Explained by	Constant	Coefficient	Test Statistics		
				Adj. R^2	DW	p- value for F
log (RY)	log (RM_1)	4.86 (0.00)	0.65 (0.00)	0.98	0.70	0.00
	log (RM_2)	5.78 (0.00)	0.50 (0.00)	0.97	0.56	0.00

Bracket figures indicate p-values for t-statistics

The Results on Sectoral Response

Expecting the impacts of money on sectoral incomes of the economy are diverse, an attempt has also been made in nominal terms only to find out the effectiveness of money separately on agricultural and non-agricultural income in the economy. As the previous results have shown that narrowly defined money is a better explanatory variable to determine income level, only this monetary aggregate (M_1) is used from now on in estimating regression equations. As shown by results, money supply is able to explain significant changes on agricultural as well as non-agricultural income. The lower coefficient for agricultural income may be attributed to heavily weather-dependent agricultural income and a large part of this income is basically non-monetized. The non-agricultural income, on the contrary, is more money-influencial. The goodness of fit for both models is highly significant. The DW statistics, however, poses some problem, showing positive autocorrelation between the error terms.

Dependent Variables	Explained by	Constant	Coefficient	Test Statistics		
				Adj. R^2	DW	p- value for F
log (Y_{ag})	log (M_1)	3.95 (0.00)	0.72 (0.00)	0.99	0.81	0.00
log (Y_{nag})	log (M_1)	1.25 (0.00)	1.01 (0.00)	0.997	0.99	0.00

Bracket figures indicate p-values for t-statistics

Results in Polynomial Distributed Lag Models

It is expected that the effects of changes in money supply on money income are spread over a period of some time. As per the expectation, the following results have also shown that the nominal money stock has a positive effect on changes on nominal income up to two years lag, whereas there are dampening effects on changes in nominal income beyond three years lagged changes in money stock. The coefficients are also decreasing over the increase in lags and becoming insignificant beyond two years.

Nominal Terms:

Dependent Variable: log (Y)	Explained by					Sum
	$\log (M_1)$	$\log (M_1)_{t-1}$	$\log (M_1)_{t-2}$	$\log (M_1)_{t-3}$	$\log (M_1)_{t-4}$	
Coefficients	0.543	0.293	0.110	-0.007	-0.056	0.88
t-Statistics	3.17	3.47	0.76	-0.08	-0.33	99.65

For the case of real terms, the coefficient for one year lag is the highest and thereafter it started to decline having with positive signs. The t-value for current year is insignificant, but for one to three year lags, it is significant.

Real Terms:

Dependent Variable: log (RY)	Explained by					Sum
	$\log (RM_1)$	$\log (RM_1)_{t-1}$	$\log (RM_1)_{t-2}$	$\log (RM_1)_{t-3}$	$\log (RM_1)_{t-4}$	
Coefficients	0.193	0.217	0.194	0.122	0.002	0.73
t-Statistics	1.60	4.57	2.24	1.99	0.03	49.99

Results in Stability Test

With a view to knowing whether or not there is the stability in the relationships between money and income in different economic regimes, the whole sample period is divided in two sub-sample periods- 1975 to 1989 (less liberalized economic regime) and 1990 to 2002 (liberalized economic regime), assuming the year 1990 as a breakthrough, especially because of restoration of democracy and intense beginning of economic and financial liberalization from this particular year. The results as shown below are against the null hypothesis of no effect of structural change for both nominal as well as real terms. The coefficients are greater in liberalization period, indicating that liberalization period is more effective to cause change in income level by the change in money supply. The goodness of fit and the DW statistics have also been improved for the liberalization period.

Nominal Terms:

Sample Period	Dependent Variable	Explained by	Constant	Coefficient	Test Statistics		
					Adj. R^2	DW	p- value for F
1975-1989	log (Y)	log (M_1)	3.87 (0.00)	0.79 (0.00)	0.98	0.80	0.00
1990-2002	log (Y)	log (M_1)	3.53 (0.00)	0.84 (0.00)	0.99	0.95	0.00

F(Chow) = 4.03 (p-value:0.03)

Bracket figures indicate p-values for t-statistics

Real Terms:

Sample Period	Dependent Variable	Explained by	Constant	Coefficient	Test Statistics		
					Adj. R^2	DW	p- value for F
1975-1989	log (RY)	log (RM_1)	5.96 (0.00)	0.51 (0.00)	0.91	0.94	0.00
1990-2002	log (RY)	log (RM_1)	4.96 (0.00)	0.65 (0.00)	0.95	0.96	0.00

F(Chow) = 8.27 (p-value:0.002)

Bracket figures indicate p-values for t-statistics

5. CONCLUSIONS

The empirical results associated with the relationship between money and income exhibit that money supply can be used as an effective variant for income stabilization in Nepal. It is valid both for nominal and real terms. Compared to broad money, the larger coefficient of narrow money indicates that narrow money can be used as an appropriate policy variable for income stabilization.

Regarding the results between money supply and the two definitions of sectoral incomes-agricultural and non-agricultural, the coefficient for agricultural income is larger than for non-agricultural income, indicating that former is more money influential than the latter. This strongly supports the priori postulation that non-agricultural income is better explained by the monetary variable. The agricultural income is largely weather dependent but non-agricultural sector of the economy is monetized sector and it is more money-sensitive.

The regression results on the lagged response of money on income have shown that the full adjustment of monetary shock on income level is completed within two year lag period for nominal income stabilization and three year for real income stabilization. So, the adoption of monetary control measures to stabilize output of the economy should be taken as per this lagged response of money on income level.

Regarding the efficiency of liberalization policy, the stability test proves that there is a significant effect of change in policy regimes for income stabilization. The coefficients have been increased for both nominal and real terms in the liberalization period than that of less liberalized period indicating liberalization policy more effective to determine income level in Nepal.

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