MONEY AND PRICE RELATIONSHIP IN NEPAL: A REVISIT

Monetary Division, Research Department, Nepal Rastra Bank

Abstract

This paper examines the money-price relationship in Nepal. The study is a new addition to the studies made on the subject for Nepal in the sense that it estimates the money-price relationship on quarterly data basis. The study makes a short review of literature on money price relationship. Although the theory suggests that money and price have instantaneous relationship, the study shows the delayed impact of money on prices in Nepal. The study shares that the impact of money supply on price is distributed over the third quarter where the Almon lag model is applied to ascertain the sum total effects of money supply on prices over the period. It is found that 10 percent changes in M_1 bring about 4.5 percent changes in prices in Nepal. M_1 compared to M_2 is found to have stronger relationship with prices in Nepal. The empirical results also shows that there is no structural shift in money price relationship during the study period.

I. Introduction

This paper attempts to estimate money-price relationship in Nepal. In the recent days, empirical analysis on money-price relationship has received greater attention, as there is a move to assign the single objective to the central bank. Among likely candidates of monetary policy objective, price stability is the single most important objective. Assignment of price stability as the single objective of monetary policy hinges on the empirical strength of money-price relationship. If empirical results shows a strong and robust relationship between money supply and prices, then the central bank can opt for price stability as its single objective.

The empirical issue of money-price relationship is important for Nepal Rastra Bank on two counts. First, there is a move to introduce new Nepal Rastra Bank (NRB) Act. While redrafting the Act, it is important to set the objective of NRB. If empirical analysis reveal a strong association between money supply and prices, then price stability can be taken as the most important candidate for monetary policy objectives. Second, Nepal has accelerated economic reforms since the early 1990s with outward orientation of the economy; and hence it is important to ascertain the structural shift of money-price relationship during the study period.

The structure of this paper consists of eight sections. After this brief introduction, the second section deals with the theoretical aspect of money-price relationship. The third section enlists the objectives and the fourth section discusses the methodology of the study. Similarly, the fifth section highlights the data sources and limitations. The functional form of the models is discussed in the sixth section. The empirical results are presented in the seventh section. Finally, the eighth section draws the conclusion of the study.

II. A Brief Theoretical Literature Review

This section briefly discusses the theoretical evolution of money and price relationship and begins with the analysis of quantity theory of money. It also discusses the Phillips curve analysis of money and price relationship. The section ends with a brief discussion on rational expectation hypothesis.

II.A. The Quantity Theory of Money

The quantity theory of money postulates a direct and proportional relationship between money supply and price level. The traditional quantity theory of money is encapsulated in the Fisher's equation of exchange given below.

$$MV = PY \quad \text{...............} \ (1)$$

Where, M is money supply, V is the income velocity of money, P is the price level and Y is the income level.

The quantity theory of money assumes full employment in the economy. Velocity also remains stable at least in the short-run. Hence, both Y and V do not change. Among the variables in equation (1), only two variables M and P vary. Equation (1) can be recast as:

$$P = MV/Y \quad \text{.............} \ (2)$$

As V and Y are assumed to be constant, we can rewrite equation (2) as

$$P = f(M) \quad \text{..............} \ (3)$$

II.B. Keynesian Views on Money and Price Relationship

Keynesian views on money and price relationship are encapsulated in the Phillips curve. The Phillips curve envisages that money has effects both on price level and output (unemployment). The Phillips curve posits a trade-off between money wage inflation and unemployment. Keynesians argue that there is a choice for policy makers to make. Increasing money supply helps to increase inflation but also to reduce unemployment. Hence, inflation is the inverse function of unemployment. It must be noted that there is departure in the Keynesian theory of money from the quantity theory of money. Keynesians do not assume full employment. With the increase in money supply, employment opportunities, output and prices increase. Hence, Keynesians assume a direct but not necessarily proportional relationship between money and prices.

II.C. Reformulation of Quantity Theory of Money

Milton Friedman argues that Phillips curve exists only in the short run but not in the long run. This means that the Phillips curve is vertical in the long run which again means there is a direct and proportional relationship between money supply and prices in the long run.

II.D. Rational Expectation Hypothesis (REH)

The REH postulates that Phillips curve does not exit even in the short run. So, any increase or decrease in money supply has a direct bearing on prices. The REH assumes that real variables including output are determined independent of monetary factors. Hence, money and prices have a direct and proportional relationship.

III. The Objectives of the Study

The purpose of the study is to gather answers to the following questions.

3.1 What is the state of relationship between money and prices in Nepal?
3.2 Which monetary aggregate better explains prices in Nepal ?
3.3 Has the relationship between money and prices been stable over the period ?
3.4 What is the extent of lead and lag effects of money supply on prices in Nepal ? and
3.5 What influence of Indian prices has been on Nepalese prices.

IV. Methodology

Two price indices exist in Nepal. These are national urban price index and GDP deflator. Data on GDP deflator exist only on annual basis. On the other hand, national urban consumer index has high frequency data. Therefore, to measure price level, national urban price index is used for the study.

Two measures of money supply are available in Nepal. They are narrow money (M_1) and broad money (M_2). M_1 includes currency held by non-bank public and demand deposit held at the monetary sector. M_2 consists of M_1 and time deposits held at commercial banks. Both the measures of money supply are used to see their influences on prices.

Prior to establish the relationships, it is necessary for the time series data to check whether variables on individual basis used for the study are stationary or not. If variables are non-stationary, they produce spurious relationships. To determine stationarity, unit root test is performed on each variable. The relationship between money and prices is obtained by using ordinary least square (OLS) method. The restricted lag method is used to see the lag effect of independent variable on prices. To corroborate the results obtained from OLS method, Granger causality test is also performed on money and prices in order to confirm the cause and effect variables.

V. The Data and the limitation of the Study

The data on money and prices are obtained from various sources. Various issues of International Financial Statistics (IFS), Quarterly Economic Bulletin of NRB, and Economic Survey of HMG are the major sources of data used for the study. Quarterly data are used for the study.

The sample size of the study is from the third quarter of 1975 through the second quarter of 1999. Non availability of quarterly data on prices before the third quarter of 1975 is the main reason for the choice and the limitation of the sample size. Non-availability of quarterly data on GDP has also been another limitation of the study. This constrained to include GDP as a scale variable in the study.

VI. Functional Forms of Estimating Equations

The functional form of the estimating equation is derived from the quantity theory of money. Equation (1) can be recast into the estimating equation of price determination. This is as follows.

$$P_t = a + b_1 M_t + b_2 V_t - b_3 Y_t + u_t \text{ ....(4)}$$

This linear function has however the chance of non-stationarity of the variables and the subsequent empirical estimates way not be robust. Further it is the rate of change in the price level rather than the price level itself, which is important for the policy makers. Hence, equation (4) can be converted into growth rate form. The first difference of log converts data into growth rates. The first difference log transformed equation (4) can be rewritten as:

$$\Delta \log P_t = a + b_1 \Delta \log M_t + b_2 \Delta \log V_t - b_3 \Delta \log Y_t + U_t \text{ ....(5)}$$

In this study, one heroic assumption is made. The assumption is that the money demand function in Nepal is relatively stable. The past empirical studies of Khatiwada (1994) and Paudel (1994) have shown that money demand function in Nepal is relatively stable. Based on this assumption, we can take out both V and Y from the estimating equation. Once we take out V and Y, equation (5) can be written as:

$\Delta\log(P_t) = a + b_1\Delta\log M_t + U_t$ ....(6)

The impact of money supply on prices may not be instantaneous. Studies in other countries have shown the delayed (lagged) effects of money supply on prices. In order to capture delayed effects of money supply, the distributed –lag model of money-price relationship is constructed. Hence, equation (6) can be rewritten as:

$\Delta\log P_t = a + b_1\Delta\log M_t + b_2\Delta\log M_{t-1} + ...b_n\Delta\log M_n + U_t$ ....(7)

The total impact of money supply on prices can be summed as:

$\Delta\text{Log } P_t = a + \sum b_i \Delta\log M_{t-i} + u_t$ .... (8)

The REH states that economic agents look both backward and forward while forming expectations. In their model building, economic agents look backward and establish a link between two variables. For example, economic agents will look backward and see that an increase in money supply causing prices to go up. Hence, economic agents will establish a link between money supply and prices, the former causing the latter. Once this is established, economic agents will exploit every information available to their full advantage. In this case if economic agents come to know likely changes in money supply in the near future, they will form price expectations accordingly. To model price expectations of likely future changes in money supply, one can include expected money supply of one period ahead in the estimating equation. Hence, equation (7) can be written as:

$\Delta\log P_t = a + b_1 \Delta\log M_t + b_2 \Delta \log M_{t-1} .... + b_n \log M_{tn} + b_4 \log M_{t+1} + \mu_t$ .... (9)

In Nepal, an issue of choosing an appropriate intermediate monetary target variable has come up recently. The choice is to be made from the two available monetary measures: narrow money (M_1) and broad money (M_2). Empirical studies conducted in the past had shown M_1 as a better intermediate monetary target variable, for M_1 had shown relatively stronger relationship with other economic variables including prices. However, banking habit of the people has increased over the period. This is reflected in the rising deposits held at the commercial banks. For example, time deposits held at the commercial banks which was 14.7 percent of GDP in July 1985 increased to 30.0 percent of GDP in July 1999. Likewise, the share of time deposits in M_2 has gone up to 66.5 percent in July 1999 from 55.4 percent in July 1985. And a large partion of time deposit has become easily withdrawable. In this context, both the measures of money supply: M_1 and M_2 are used for estimating equation (9).

Nepal is a small open economy with an open border with India. Both people and goods move freely across the border. Compared to Nepal, India is geographical area-wise, population-wise and economy-wise a very big country. Past empirical studies have shown that Indian prices tend to influence Nepalese prices significantly. Hence, to capture the influence of Indian prices, the price model is augmented and equation (9) is expanded. To measure Indian prices, Indian WPI is used for the study . Thus, estimating equation (9) is rewritten as:

$$\Delta \log P_t = a + b_1 \Delta \log M_t + b_2 \Delta \log M_{t-1} + b_n \log M_n + b_4 \log M_{t+1} + \Delta \log \text{ IWPI} + \mu_t \text{ .... (10)}$$

Where IWPI = India's Wholesale Price Index,

VII. Empirical Results of the Study

The first part of this section deals with the stationarity test of the variables used for the study. While the second part presents empirical results of the study.

VII.A. Unit Root Test

In the case of time series analysis, unit root tests are important. Unit root tests help detect the stationarity and non-stationarity of time series data used for the study. A stationary time series has three basic properties. First, it has a finite mean. This means that a stationary series fluctuates around a constant long run mean. Second, a stationary time series has a finite variance. This means that variance is time invariant and third, a stationary time series has a finite (auto) covariance. This reflects that theoretical auto-correlation decay fast as lag length increases. Regressions run on non-stationary time series produce a spurious relationship. Hence, to avoid a spurious relationship, there is a need to perform a unit root test on variables. The Dickey- Fuller (DF) and Augmented Dickey–Fuller (ADF) tests are widely used for performing unit root tests. The ADF test involves the auto-regressive (AR (1)) process. For this, let us consider the following equation.

$$Y_t = \alpha + \rho Y_{t-1} + \xi_t \quad \dots \quad (11)$$

In case ρ carries the value $-1 < \rho < 1$, the variable Y is stationary. If the value of ρ is one, the variable Y is non-stationary. Hence, the unit root null hypothesis is:

$$Ho = \rho = 1$$

While testing the null hyposesis of unit root, the following equation is used.

$$\Delta(Yt) = \alpha + \gamma Y_{t-1} + \xi_t \quad \text{............} \quad (12)$$

Where, $\gamma = \rho$ -1 and Δ(Y) is the first difference of the series Y. The unit root hypothesis is:

$$Ho = \gamma = 0$$

If the variable is stationary at level, the variable is said to be integrated of order zero, I(0). If the variable is non-stationary at level, the ADF test can be utilized and the first difference of the variable can be used for testing a unit root. In this case, the variable is said to be co-integrated of order one, i.e, I (1). Likewise, one can test for the higher order of co-integration of the variables. It must be noted that a larger negative t-statistic suggests rejection of the hypothesis of a unit root and implies that the series is stationary.

Table 1: Unit Root Test

		Mackinnon Critical Value		
Variable	**ADF Test Statistic**	**1%**	**5%**	**10%**
Log(CPIN)	9.05	-2.59	-1.94	-1.62
Log(CPIN)with C and trend	-2.49	-4.06	-3.46	-3.15
Δlog(CPIN) ,,	-3.22	-2.59	-1.94	-1.62
Log(M1)	10.56	-2.59	-1.94	-1.62
Log(M1) with C and trend	-1.18	-4.06	-3.46	-3.15
Δlog(M1)	-2.96	-2.59	-1.94	-1.62
Log(M2)	7.89	-2.59	-1.94	-1.62
Log(M2) with C and trend	-1.84	-4.06	-3.46	-3.15
Δlog(M2)	-1.36	-2.59	-1.94	-1.62
Log (IWPI)	6.62	-2.59	-1.94	-1.62
Log (IWPI) with C and trend	-1.77	-4.06	-3.46	-3.15
Δlog (IWPI)	-2.34	-2.59	-1.94	-1.62

Table 1 presents unit root test statistics for variables used for the study. The results obtained from unit root tests have the following features. First, the results show that all the variables in the log level forms contain unit roots. This means that they are non-stationary in log levels. Second, the unit root tests also suggest that the variables are trended. Third, among the variables, consumer price index of Nepal (CPIN) and narrow money (M_1) are integrated of order one, I (1). That is, the first difference log CPIN and log M_1 are stationary at 1 percent. Fourth, the first difference log IWPI is stationary at 5 percent. Fifth, however, the first difference log M_2 is not stationary even at 10 percent.

VII.B. Co-integration Test

Individual economic time series may not be stationary, but there may be cases of linear combination among them. This means that non-stationary economic time series may produce stationary relationships if they are cointegrated. For this, unit root tests are applied for residuals obtained from the regression results. If residuals do not contain unit roots, econometric relationship among variables could be co-integrating. The procedure used is the Engle-Granger cointegration regression technique. For example, if there are two variables, Y (consumption expenditure) and X (disposable income), the following equation can be considered for co-integration test.

$\mu = Y - \alpha - \beta X$ ……………………….(13)

Where, μ is the error term, residual. Thus μ is also termed as the linear combination of Y and X.

If μ, the residual does not contain unit root, and is stationary, the series Y and X are said to be co-integrated. The following table shows the result of co-integrating relationship of variables used for the study. Log(CPIN) and log(M1) are co-integrated of order zero I(0). The co-integration vector is significant at one percent. Similarly log(CPIN) and log(M2) are also co-integrated of order zero I(0). In this case also co-integration vector is significant at one percent. Log(CPIN) and log(IWPI) are co-integrated with constant and zero trend terms of order I(0). However the co-integration vector is significant at ten percent only.

Co-integration Test

Variables				Order of	Dickey
Dependent	Independent	Constant	Trend	Co-integration	Fuller Test
Log CPIN	Log M1	No.	No.	I(0)	-6.7*
Log CPIN	Log M2	No.	No.	I(0)	-5.8*
Log CPIN	Log IWPI	Yes	Yes	I(0)	-3.8**

*Significant at one percent.
** Significant at ten percent.

VII.C. Selection of Lag Length

Monetarists hold the view that inflation is essentially a monetary phenomenon. It is argued that a sustained increase in the general level of prices is possible only when money supply increases far in excess of desired level of money demand. However, this link between money supply and prices is not instantaneous. Empirical studies have demonstrated that the response of prices to an increase in money supply spreads over a long period of time. It is an accepted fact that distributed–lag models play useful role in explaining relationship of economic variables. In the distributed lag model, problem of specification of the optimum length of the lag arises. In the literature, one finds a number of approaches to the selection of the lag length. One of the approaches is the ad hoc (arbitrarily) estimation of distributed–lag model. Alt and Tinbergen popularized this approach. In this approach, sequential procedure is adopted. For instance, in the case of money- price model, first current price is regressed on current money, then money is to be lagged by one period, two period and so on until the coefficient of lagged variable becomes statistically insignificant and the sign of the variable changes. There are a number of problems in the ad hoc estimation of distributed lag models. It is argued that there exists a priori guide as regards the maximum length of the lag. Apart from this, this approach is criticized on the ground that there exist fewer degrees of freedom and problem of multi-collinearity and data mining.

The Koyck approach can also be applied to estimate the distributed lag model. However, the Koyck approach also suffers from many drawbacks. Autoregressiveness, serial correlation, violation of Durbin-Watson d-test and non-linearity of parameter estimation are some of the criticisms leveled against this approach.

Shirley Almon has also developed polynomial distributed lag model. However, the Almon approach involves the selection of the maximum lag length in advance, which in itself is the problem. Hence, the Almon approach also does not provide solution to the problem.

Schwarz and Akaike have developed formal test of lag length, which are popularly known as Schwarz Criterion and Akaike Information Criterion respectively. According to these criteria, the maximum lag length is selected based on the least value of the lag.

Both Schwarz criterion and Akaike information criterion is used to determine the optimum length of the lag. But it did not provide the consistent result. Therefore, it was necessary to adopt the ad hoc approach to lag length selection. The ad hoc approach showed that the coefficient of money supply lagged beyond third quarter carried negative sign. Hence, it is decided to restrict the lag length upto the third quarter.

VII.D. Empirical results

This section includes five sub-sections. The first part reports regression results where CPIN is regressed on M_1. The second part shows the results where CPIN is regressed on M_2. The third part shows the results of Polynomial Distributed Lag model. The fourth part augments the model with Indian WPI as an additional independent variable. The fifth part introduces a structural break and discusses whether there has been structural shift in money price relationship.

VII.D.1. CPIN regressed on M_1

ΔLog (CPIN)=0.008 –0.204Δlog(M_1)+0.106Δlog($M_{1(-1)}$)+0.345Δlog($M_{1(-2)}$)+0.159Δlog($M_{1(-3)}$)
.(0.36) (0.01) (0.14) (0.00) (0.03)
Adj.R^2 0.49 DW 1.94 (Sample period 1975.3 1999.2) (14)

Figures in bracket indicate p-values.

Equation (14) which is the empirical results of equation (7) show that coefficients of money supply lagged by period two and three have a priori signs and they are significant at less than 5 percent. Coefficient of current M_1 has a theoretically opposite sign but statistically significant at one percent. Although, M_1 lagged by one period has an appropriate sign but the coefficient is not statistically significant.

Two tests are applied for checking whether the model is correctly specified or not. These are Wald coefficient test and redundant variable test.

The Redundant Test: The null hypothesis is that the model (14) has two redundant variables, current M_1 and one period lagged M_1 ($M_{1(-1)}$). When the redundant test is applied to the model (14), the null hypothesis stands rejected. It is clear from F-statistic and Log likelihood ratio, which suggest that both these variables are not redundant.

Redundant Variables: DLOG(M1) DLOG(M1(-1))

F-statistic	6.859093	Probability	0.001714
Log likelihood ratio	13.47048	Probability	0.001188

Wald Coefficient Restriction Test: The adjusted R^2 shows that current M_1 and lagged M_1 explain roughly half (i.e., 49 percent) of the changes in CPIN. Whereas the quantity theory of money supply suggests that money supply and prices have a direct and proportional relationship. This prompted to apply Wald Coefficient Restriction test to the model. Consider the following equation.

C(1)+c(2)+c(3)+c(4) =1 ....(15)

Equation (15) is the null hypothesis. The left-hand side elements of equation (15) represent coefficients of M_1, $M_{1(-1)}$, $M_{1(-2)}$, and $M_1(_{-3})$ respectively. The null hypothesis is that the summation of these coefficients is one. Both the F-statistic and Chi-square statistic of Wald Coefficient Test suggest the rejection of null hypothesis. This means that money (M_1) and prices are not proportionally related in Nepal.

Equation (15)

Null Hypothesis:	C(1)+C(2)+C(3)+C(4)=1		
F-statistic	22.20281	Probability	0.000009
Chi-square	22.20281	Probability	0.000002

Although Redundant Variables Test does not suggest the dropping of M_1 and $M_1(_{-1}))$ from the model (14), however attempt has been made to re-estimate equation (14) by dropping both of them. The objective of doing so is to see whether their dropping from the equation helps improve the results, or not,

$$\Delta\log(\text{CPIN}) = 0.002{=}{+}0.461\Delta\log(M_1(_{-2})) + 0.107\Delta\log(M_1(_{-3}))$$
(0.71) (0.00) (0.06)

Adj.R^2 0.42 DW 2.19 (Sample period 1975.3 1999.2) (16)

Figures in bracket indicate p-values.

The regression result of equation (16) shows that by dropping current M_1 and lagged M_1 by one period, the value of coefficient of M_1 lagged by two period improves. But the explanatory power of the model is less than that of model (14).

VII.D.2. CPIN Regressed on M_2

$$\Delta\log(\text{CPIN}){=}{-}0.003{-}0.416\Delta\log(M2){+}0.182\Delta\log(M2_{(-1)}){+}0.696\Delta\log(M2_{(-2)}) + 0.129\Delta\log(M2_{(-3)})$$
-(0.84) (0.00) (0.20) (0.00) (0.36)

Adj.R^2 0.34 DW 1.98 (Sample period 1975.3 1999.2) (17)

Figures in bracket indicate p-values.

The results of CPIN regressed on M_2 are more or less similar to that of CPIN regressed on M_1. However, there are some differences. First, the explanatory power as suggested by adjusted R^2 at 0.34 is less than that CPIN regressed on M_1 at 0.49. Second, the coefficient of intercept has appropriate sign in the case of CPIN regressed on M_1 and wrong sign in the case of CPIN regressed on M_2. Third, coefficient of the third period lagged money supply is statistically significant at less than 5 percent in the case of CPIN regressed on M_1 and not statistically significant in the case of CPIN regressed on M_2. While second period lagged money supply is highly significant in both cases.

Wald coefficient tests applied for equation (17) have more or less the same results as found in equation (14).

VII.D.3. Polynomial Distributed Lags (PDLs)

The PDLs model (also referred to Almon Lag Model) is also run in order to ascertain the sum total effects of money on prices in Nepal. This model simply helps to smooth the lag effects and gives the total effects of independent variables. Based on the empirical results discussed in previous sections, three distributed lags with second degree polynomial is used for this analysis. Followings are the model and result of the PDLs.

a. Model: LS Δlog(CPIN) C PDL(Δlog(M_1),3,2)

Lag Distribution	Coefficients	t Statistics
0	-0.24	-3.47
1	0.17	2.61
2	0.32	4.96
3	0.21	3.04
Sum of lags	0.45	1.95
Adj R^2 = 0.51 D-W statistics 1.86		

b. Model: LS Δlog(CPIN) C PDL(Δlog(M_2),3,2)

Lag Distribution	Coefficients	t Statistics
0	-0.51	-3.49
1	0.35	2.93
2	0.60	4.97
3	0.22	1.51
Sum of lags	0.66	1.69
Adj R^2 = 0.35 D-W statistics 1.92		

The empirical result shows that there is a positive sign of all individual lags of M_1 and M_2, which is in line with the hypothesis of money and price. Considering the total effect on price, the sum of Almon lags of M2 is recorded higher than that of M1 but goodness of fit is relatively weak than that of M1.

VII.D.4. The Model Augmented with Indian WPI

This section reports the results of the monetary model augmented to capture the impact of Indian prices on Nepalese prices. To measure Indian prices, Indian WPI is used. The following are the results of augmented model:

$$\Delta\log(\text{CPIN}) = \underset{(0.58)}{0.004} \underset{(0.01)}{-0.174}\underset{(0.48)}{\Delta\log(M_1)} + \underset{(0.01)}{0.048}\Delta\log(M_{1(-1)}) + \underset{(0.12)}{0.191}\Delta\log(M_{1(-2)}) + 0.103\Delta\log(M_{1(-3)}) + \underset{(0.00)}{0.646}\Delta\log(\text{IWPI})$$

Adj.R^2 0.57 DW 1.68 (Sample period 1975.3 1999.2) (18)

Figures in bracket indicate p-values.

The model augmented with Indian prices explains better as adjusted R^2 is higher (0.57). The coefficient on Δlog (IWPI) is also statistically significant. The result shows that 10 percent increase in Indian WPI causes 6 percent rise in Nepalese prices.

VII.D.5. Structural Shift in Money and Price Relationship

Nepal has been adopting liberal economic policies since mid 1980s. But as the multiparty democracy was restored in 1990, economic reform process accelerated. It is expected that structural shift in money and price might have also taken place with the break in economic regime since 1990. Hence, in order to see whether structural shift in money and price has taken place or not, first, the sample period is divided into two sub-sample periods (i) 1975.3 to 1989.4 and (ii) 1990.1 to 1999.2. Regression results are reported and analyzed accordingly. Second, Chow tests are applied for checking the structural shift in money and price relationship.

Sample Period 1975.3 to 1989.4

$$\Delta\log(\text{CPIN}) = 0.007 - 0.160\Delta\log(M_1) + 0.093\Delta\log(M_{1(-1)}) + 0.340\Delta\log(M_{1(-2)}) + 0.162\Delta\log(M_{1(-3)})$$

.(0.57) (0.08) (0.31) (0.00) (0.08)

Adj.R^2 0.56 DW 2.0 (Sample period 1975.3 1989.4) (19)

Figures in bracket indicate p-values.

Sample period 1990.1 to 1999.2

$$\Delta\log(\text{CPIN}) = 0.007 - 0.369\Delta\log(M_1) + 0.187\Delta\log(M_{1(-1)}) + 0.429\Delta\log(M_{1(-2)}) + 0.182\Delta\log(M_{1(-3)})$$

(0.59) (0.01)(0.18) (0.00) (0.16)

Adj.R^2 0.38 DW 1.80 (20)

Figures in bracket indicate p-values.

The regression results of sample period portioned into two sub-periods, 1975.3 to 1989.4 and 1990.1 to 1999.2, show that coefficients are not statistically different between the two sub sample periods. This suggests that there is no structural shift in money-price relationship during the study period. The null hypothesis that there is no structural shift is corroborated by the chow test as given below.

Chow Test

Chow Breakpoint Test: 1990:1

F-statistic	0.833541	Probability	0.529612
Log likelihood ratio	4.561015	Probability	0.471762

Chow Forecast Test: Forecast from 1990:1 to 1999:2

F-statistic	1.282824	Probability	0.204345
Log likelihood ratio	63.53203	Probability	0.005821

Granger Causality Test

In the regression analysis, we regress dependent variable on independent variables. By doing so, we obtain a statistical relationship between the dependent variable and independent variables. But the statistical relationship thus obtained does not imply the causation. Therefore, before regressing dependent variable on independent variables, we must establish a direction of causality. The monetary theory has it that money causes price and not the other way round. But many studies have also revealed a strong feedback. This must be tested. For this, we utilize the Granger causality test. The Granger approach to causality uses the past information of both the variables. To test the causality, two regression equations are set. Before the equations are regressed, the selection of optimum lag length is made. In the case of money- price relationship for Nepal, we have used 3 lags as discussed in section 7.3. To conduct the causality test between money and price, we used the following two equations both for narrow money as well as broad money.

LS dlog(cpin) c dlog(cpin) dlog(cpin($_{-1}$)) dlog(cpin($_{-2}$)) dlog(cpin($_{-3}$)) dlog(M_1) dlog(M_1($_{-1}$)) dlog(M_1($_{-2}$)) dlog(M_1($_{-3}$)) ………..(21)

LS dlog(M_1) c dlog(M_1) dlog(M_1($_{-1}$)) dlog(M_1($_{-2}$)) dlog(M_1($_{-3}$)) dlog(cpin) dlog(cpin($_{-1}$)) dlog(cpin($_{-2}$)) dlog(cpin($_{-3}$)) ………..(22)

The null hypotheses are as follows:

Null Hypothesis:	Obs	F-Statistic	Probability
DLOG(M1) does not Granger Cause DlOG(CPIN)	92	11.2870	0.00037
DLOG(CPIN) does not Granger Cause DLOG(M1)		6.78495	0.00037

The above test does not establish a clear-cut causality between narrow money (M1) and consumer price index (CPIN) in Nepal. The result shows that both M_1 and CPIN Granger cause each other.

Similarly, in the case of causality between for M_2 and prices in Nepal, both the variables have a role in the determination of the other. The results are given below.

Null Hypothesis:	Obs	F-Statistic	Probability
DLOG(M2) does not Granger Cause DlOG(CPIN)	92	6.75194	0.00039
DLOG(CPIN) does not Granger Cause DLOG(M2)		5.63111	0.00144

VIII. Conclusions

Following conclusions can be drawn from this study. First, it must be noted that money supply has impact on prices after some time lags if relationship is estimated on quarterly data. The regression results show that money supply generates impact on prices only after six months time lag. The lag impact lasts up to the third quarter and beyond the third quarter the effect does not exist. The Almon Lag analysis also supports this argument for M1 and M2.

Second, the results show that M1 has relatively stronger relationship than that of M2 with prices in Nepal. Third, there is no structural shift in money-price relationship. Fourth, Granger Causality tests do no establish a clear-cut unilateral causality flowing from money to prices. Fifth, unit root tests show that M1 and consumer price index are stationary whereas M2 is non-stationary. Sixth, although money supply and measured inflation have a positive relationship, the relationship is not strong and robust.

In the light of weak relationship between money supply and inflation in Nepal, it implies that measurement of core inflation is necessary to ascertain the actual degree of relation between money and price.

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Annex

log (CPIN) = 3.743 + 0.024 trend + 0.707 Ar(1)
(0.00) (0.00) (0.00)
Adj.R^2 : 0.99 DW 1.72 (Sample period 1975.3 1999.2)
Figures in bracket indicate p-values.

d (CPIN) = 1.303 - 0.004 d(M_1) + 0.002 d($M_{1(-1)}$) + 0.006 d($M_{1(-2)}$) + 0.003 d($M_{1(-2)}$)
(0.08) (0.00) (0.01) (0.00) (0.00)
Adj.R^2 : 0..58 DW 2.0 (Sample period 1975.3 1999.2)

log (CPIN) = - 0.586 + 0.096 log(M_1) + 0.037 log($M_{1(-1)}$) + 0.480 log($M_{1(-2)}$)
(0.00) (0.26) (0.75) (0.00)
Adj.R^2 : 0..99 DW 0.50 (Sample period 1975.3 1999.2)

log (CPIN) = 0.887 + 0.005 log(M_1) + 0.024 log($M_{1(-1)}$) + 0.377 log($M_{1(-2)}$) +0.008 trend
(0.04) (0.95) (0.83) (0.00) (0.00)
Adj.R^2 : 0..99 DW 0.52 (Sample period 1975.3 1999.2)

dlog (CPIN) = 0.008 –0.204 dlog(M_1) + 0.106 dlog($M_{1(-1)}$) + 0.345 dlog($M_{1(-2)}$) +0.159 dlog($M_{1(-3)}$
(0.36) (0.01) (0.14) (0.00) (0.03)
Adj.R^2 : 0..51 DW 1.92 (Sample period 1975.3 1999.2)

log (CPIN) = - 0.396 - 0.012 log(M_2) + 0.169 log($M_{2(-1)}$) + 0.388 log($M_{2(-2)}$)
(0.00) (0.95) (0.52) (0.04)
Adj.R^2 : 0..99 DW 0.59 (Sample period 1975.3 1999.2)

log (CPIN) = - 0.383 - 0.345 log(M_2) + 0.170 log($M_{2(-1)}$) + 0.722 log($M_{2(-2)}$) + 0.759 Ar(1)
(0.00) (0.00) (0.16) (0.00) (0.00)
Adj.R^2 : 0..99 DW 0.59 (Sample period 1975.3 1999.2)

log (CPIN) = - 0.462 - 0.011 log(M_2) + 0.153 log($M_{2(-1)}$) + 0.304 log($M_{2(-2)}$) + 0.171 log(wpi)
(0.00) (0.95) (0.55) (0.12) (0.08)
Adj.R^2 : 0..99 DW 0.56 (Sample period 1975.3 1999.2)

log (CPIN) = - 0.461 + 0.162 log($M_{2(-1)}$) + 0.304 log($M_{2(-2)}$) + 0.171 log(wpi)
(0.00) (0.37) (0.11) (0.07)
Adj.R^2 : 0..99 DW 0.56 (Sample period 1975.3 1999.2)

d (CPIN) = 2.218 - 0.003 d(M_2) + 0.001 d($M_{2(-1)}$) + 0.004 d($M_{2(-2)}$) + 0.001 d($M_{2(-2)}$)
(0.01) (0.00) (0.54) (0.00) (0.16)
Adj.R^2 : 0.38 DW 1.7 (Sample period 1975.3 1999.2)

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