Revisiting Money-Price Relationship in Nepal Following a New Methodological Framework

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Abstract

Information on the pattern of money-price relationship is crucial for formulating appropriate monetary policy and implementing it effectively. This paper re-examines the money-price relationship in Nepal following a new methodological framework for time series data analysis. Test results show that money supply significantly affects domestic price in Nepal. Indian inflation is the major factor that has largest impact on the price situation in Nepal. However, exchange rate is not found to be associated with the changes in price level in Nepal. Test results also show that money-price relationship in Nepal has become much stronger in the recent times in terms of the magnitude of impact.

Keywords: Money-price relationship, Inflation determinants, Nepal

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I. INTRODUCTION

1.1 Background

Central banks implement monetary policy with an objective of maintaining price stability so that economic activities can be increased in the economy. To achieve this objective, liquidity, interest rate and credit supply need to be maintained at a desired level through an appropriate level of money supply. Classical and neoclassical economists argue that over-supply of money leads to an increase in price level. Conversely, under-supply of money can lead to economic contraction. Hence, central banks need to keep money supply at an optimal level. In this regard, information on the pattern of money-price relation is crucial for formulating monetary policy and implementing it effectively.

Historical evidences show that constant rise in money growth is directly proportional to the rise in prices. The world's major hyperinflation episodes such as Hungary (August 1945 – July 1946), Zimbabwe (March 2007 – November 2008), Yugoslavia (April 1992 – January 1994), Germany (August 1922 – December 1923) and Greece (May 1941 – December 1945) were primarily associated with excessive supply of money by the government (Hanke and Krus, 2012).

Several studies have analyzed money-price relations in various economies in various time periods. Friedman and Kuttner (1988) show the deterioration in the money price relationship since 1979. A unidirectional causality of money to price was observed in USA during 1870-1975 (Brillembourg and Khan, 1979; Sim, 1972)). In India, Ramachandra (1983, 1986) found a bidirectional relation such that money influenced both real income and prices while nominal income also raised price level. In the similar line, Sharma (1984) also found bidirectional causality between narrow money(M1)as well as broad money(M2) and price level in India. Nonetheless, a unidirectional causality was observed in Pakistan (Husain and Tariq, 1999).

In Nepal also, a number of studies have examined the pattern of money supply and its relation to consumer prices in the past. The empirical studies conducted in early 1980s to present have used varying econometric tools and data ranges. Most of the previous studies have used either simple ordinary least squares (OLS) approach or error correction models (ECM). Against the above background, this study revisits the money-price relationship using a new methodological framework and employing latest time series data. To make the study more comprehensive, other determinants of the price level in Nepal such as exchange rate and Indian inflation also have been included in the empirical test models.

1.2 Theoretical Framework

The most famous quantity theory of money developed by Fisher (1922) expresses the money-price relationship in the following form:

$$MV = PT \qquad \text{……….} (1)$$

where

M denotes money supply.
V refers to velocity of money.
P is the average price level.
T refers to the total volume of transaction of goods and services in an economy.

The modern quantity theory of money believes that the firm specific cost increase cannot be inflationary as long as they are not related to, or accommodated by, increases in the money supply. The relationship can be expressed as:

$$MV = PY \qquad \text{……….} (2)$$

In the above equation, if output of the economy (Y) and the velocity of money (V) are given, then increase in money (M) will proportionately increase price (P).

There are several criticisms against the quantity theory of money. However, this theory is widely used in analyzing the pattern of the money-price relation in an economy due to its distinct advantages.

The rests of the paper is organized as follows. Section 2 reviews the literature on money and prices relationship in Nepal. Section 3 discusses the data and methodology employed in this study. Section 4 presents the empirical results. Finally, Section 5 concludes the paper.

II. LITERATURE SURVEY

Numerous works have studied the pattern of money supply and its relation to consumer prices in Nepal in the past. Most of the previous studies have used annual data and employed common regression methods. Some of the most relevant studies are discussed below.

Neupane (1992) analyzed the impact of money on the inflation in Nepal using OLS methodology with two different models: i) monetarist model and ii) structural model. The monetary model estimated six different coefficients. The model included money supply with two lags, GDP and change in inflation. The first lagged coefficient of narrow money (M1) and opportunity cost of holding money were significant with 0.38 and 0.33 values, respectively. The structural model included four explanatory variables, namely the GDP lagged one year, import price inflation lagged one year, government budget deficit and change in expected cost of holding money. Change in the expected cost of holding money had the substantial contribution (0.42) to inflation followed by import price inflation (0.16). Although the budget deficit variable was also significant, the impact observed was very nominal (0.002).

ISD (1994) estimated the simple linear regression among the annual series of Nepalese inflation, money supply growth (M1 plus saving deposits), real output and Indian wholesale price; ranging from 1976 to 1993. When the period-end money supply data was considered, the impact of money supply to inflation was 0.54 and the impact of Indian WPI was 0.8. On the other hand, when the average money stock data was used, the coefficient of money supply was 0.8 but the coefficient of Indian WPI was 0.65, like an alteration between two of them. The study also revealed that the highest explanatory power of the equation was attained when money supply was defined as narrow money plus saving deposits.

Mathema (1998) estimated the relationship using OLS on real GDP, narrow money supply (M1), change in imported price (PT),carpenters wage for Kathmandu (MC)and Indian WPI, ranging from 1979-1996. The estimated coefficients of M1, PT and MC (without Indian WPI) were found to be significant with0.27, 0.37, and 0.20 values, respectively. However, when Indian WPI was included (which was not significant though), the impact of M1 was 0.34.

NRB (2001) estimates money-price relationship on quarterly data of CPI, M1, M2 and Indian WPI ranging from 1975Q3–1999Q2 by using Polynomial Distributed Lags (PDLs) model. The log differenced estimates show that the impact of money supply on price was distributed up to the third quarter. With only the M1 and its lag, the estimates show that 10 percent changes in M1 would bring about 4.6 percent changes in prices. Likewise, the PDL models estimates show that coefficient of M1 is 0.45 and that of M2 is 0.66. The augmented model shows the coefficient of Indian WPI as 0.65. Similarly, M1 compared to M2 found to be stronger in explaining money price relationship.

Using OLS approach, Khatiwada (2005) showed that role of money in explaining inflation was reduced substantially but role of exchange rate was even stronger after the implementation of liberalization policies in the country. The impact of broad money on prices remained between two months and six months. The paper further argues that the narrow money is a better policy variable than broad money.

Applying cointegration and error correction model on annual data from 1978 to 2006, NRB (2007) estimated the impact of narrow money supply and Indian inflation (CPII) in Nepal's inflation. The result showed a significant short-run impact of M1 but did not find long-run impact on inflation. The estimates of cointegration equation showed that one percent increase in Indian price level changes Nepal's inflation by 1.09 percent. Likewise, narrow money supply increases inflation by 0.20 in the same year.

IMF (2011) analyses the driving factors of Nepal's food and non-food inflation employing the VAR model with full dataset (2000-2011) and a subset (2007-2011). The study finds that broad money affects non-food inflation significantly compared to food, but the impact fades out quickly (within 5 to 6 months). Besides, the responsiveness of external variables (oil price, exchange rate and Indian inflation) was found gradually increasing in the recent years. The conclusion was that Indian inflation and international oil price determine more than one third of the variability in Nepalese inflation.

Using OLS, IMF (2014) estimates the determinants of Nepalese inflation on the monthly series of Nepal's CPI, broad money, nominal effective exchange rate (NEER) and Indian CPI. The coefficient of broad money was0.12; indicating 1 percent increase in broad money will cause Nepalese inflation to accelerate by 0.12 percent whereas such an increase in Indian CPI will increase Nepal's inflation by 0.45 percent.

Table 1: Summary of Studies on Money-Price Relationship in Nepal

Researcher	Variables	Data Range	Methodology	Estimates of Money
Neupane (1992)	M1, GDP, CPI, Opportunity Costs of Holding Money, C	1971-1988 Annual	OLS with two models: i) monetarist ii) structural	i) Monetarist model: m1 (-1) = 0.38 C = 0.33
ISD (1994)	Inflation, growth rate of m1+saving deposits, Indian WPI	1976-1993 Annual	OLS	Period-end money supply data: 0.54 Average money stock data: 0.8
Mathema (1998)	real GDP, M1, change in imported price (p), carpenters wage for Kathmandu (MC) and Indian WPI	1979-1996 Annual	OLS	***Without Indian WPI*** M1 0.27, P 0.37, C 0.20 ***With Indian WPI*** M1 = 0.34 Indian WPI and GDP were not significant.
NRB (2001)	M1 M2, CPI, Indian WPI (log difference)	1975Q3 – 1999Q2 Quarterly	OLS with Stationarity Considerations, PDLs	M1= 0.45
NRB (2007)	Nepalese CPI, Indian CPI, Narrow Money Supply (M1)	1978-2006 Annual	ECM, OLS	No long-run relation of M1, ECM: 0.20 OLS : M1 0.18
Khatiwada (2005)	Inflation, M1, GDP, Exchange rate, Indian Wholesale inflation,	Annual 1966-1985 1986-2004	OLS	First period, M1 not significant. Second Period, first lag of M1 has negative impact on inflation, 2.19
IMF (2011)	M2, food, non-food and overall inflation, Indian inflation, international oil price and NEER	2000-2011, Monthly	VAR	M2 significant, higher impact on non-food inflation compared to food, but for lesser extent
IMF (2014)	M2, NEER, CPI, Indian CPI	March 2001 to December 2013	OLS, log differenced	M2 = 0.12

III. DATA AND METHODOLOGY

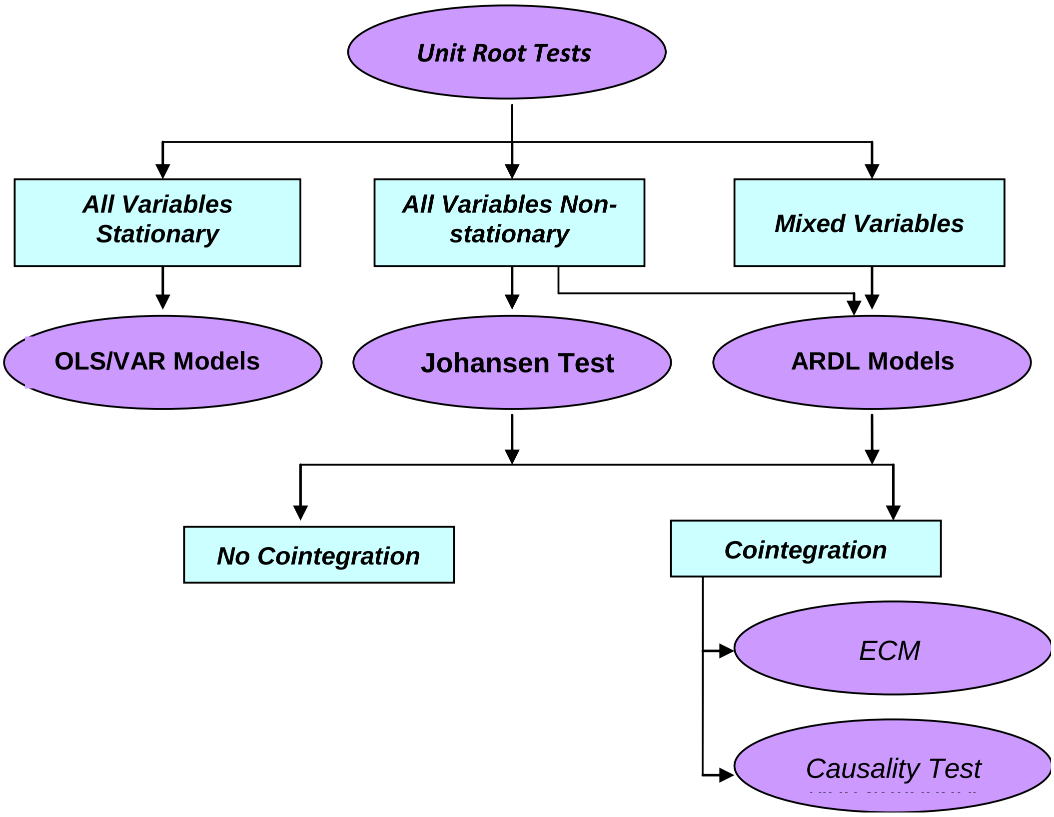
3.1 Data

Price, money supply, exchange rate and Indian inflation are the variables used in the model in this study to analyze money-price relationship in Nepal. Price is proxied by consumer price index (CPI) and money supply by and broad money (M2). Similarly, exchange rate and Indian inflation are represented by nominal effective exchange rate (NEER) and consumer price index of India (CPII), respectively. Monthly data of these variables in log form ranging from 2000M01 to 2017M12 are employed. Two separate regressions are run covering full data set and split data subset ranging from 2008M01 to 2017M12 with a view to examine the relationship in more recent times.

3.2 Method Selection Framework

This study employs time series data to analyze money-price relationship. Selecting appropriate methodology is very crucial in time series analysis as time series data possess unique features. In such a case, models and methods used for other type of data become inappropriate. Wrong specification of the model or using wrong method for analysis leads to biased and unreliable estimates. Hence, we employ the following method selection framework proposed by Shrestha and Bhatta (2018).

Figure 1: **Method Selection Framework for Time Series Data Analysis**



OLS: Ordinary Least Squares; VAR: Vector Autoregressive;
ARDL: Autoregressive Distributed Lags; ECM: Error Correction Models

Starting point in time series data analysis is to conduct unit root test to determine the stationarity of the time series. If all the time series being used in the model are nonstationary or I(1), then cointegration test can be run following Johansen (1988) or ARDL models. We apply autoregressive distributed lag (ARDL) model for the estimation. ARDL model is an ordinary least square (OLS) based model which is applicable for both non-stationary time series as well as for times series with mixed order of integration (i.e., some time series non-stationary and others stationary). This model takes sufficient numbers of lags to capture the data generating process in a general-to-specific modeling framework. Likewise, it can capture both short-run and long-run information and takes into consideration the loss of information which occurs while taking the difference. Since there is a chance of occurring more than one co-integrating vector, the ARDL approach is relatively better over the ECM (Nkoro and Uko, 2016).

To illustrate the ARDL modeling approach, the following simple model can be considered:

$$y_t = \alpha + \beta x_t + \delta z_t + e_t \qquad \text{……… (3)}$$

The error correction version of the ARDL model is given by:

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{i=1}^{p} \delta_i \Delta x_{t-i} + \sum_{i=1}^{p} \varepsilon_i \Delta z_{t-i} + \lambda_1 y_{t-1} + \lambda_2 x_{t-1} + \lambda_3 z_{t-1} + u_t \qquad \text{……… (4)}$$

The first part of the equation with β, δ and ε represents short run dynamics of the model. The second part with λs represents long run relationship. The null hypothesis in the equation is λ1+λ2+λ3 = 0, which means non-existence of long run relationship.

IV. EMPIRICAL ANALYSIS

4.1 Data Properties

The unit root test is conducted on monthly series of CPI, M2, NEER and CPII at level and log-transformed data to examine their stationarity. Further, the tests are also conducted by including intercept, trend and both in the two popular test methods: augmented dickey fuller (ADF) and Philips-Perron (PP). The unit root test results are presented below in Table 2 and Table 3.

Table 2: ADF Tests Results

Variable	*Intercept*				*Trend and Intercept*			
	Level		*First Difference*		*Level*		*First Difference*	
	t-stat	*p-value*	*t-stat*	*p-value*	*t-stat*	*p-value*	*t-stat*	*p-value*
CPI	2.223	1.000	-2.119	0.237	-1.691	0.752	-3.761	0.021
log(CPI)	0.884	0.995	-3.151	0.024	-2.649	0.259	-3.343	0.062
M2	2.449	1.000	-0.488	0.889	1.307	1.000	-2.991	0.137
log(M2)	0.886	0.995	-3.288	0.018	-2.445	0.355	-3.502	0.042
NEER	-1.790	0.385	-19.369	0.000	-2.336	0.412	-19.352	0.000
log(NEER)	-1.843	0.359	-19.421	0.000	-2.405	0.376	-19.401	0.000
CPII	2.324	1.000	-2.173	0.217	-2.502	0.327	-10.560	0.000
log(CPII)	0.639	0.990	-11.222	0.000	-1.916	0.642	-11.257	0.000

The ADF tests show that all the four variables are non-stationary at the level as well as at log transformation at 5 percent level of significance. The level series of CPI, M2 and CPII become stationary at first difference only after taking log. Likewise, none of the series is trend stationary since all of them were still non-stationary after the inclusion of time trend in the ADF test equation.

Table 3: Philips-Perron Tests Results

Variable	***Intercept***				***Trend and Intercept***			
	Level		***First Difference***		***Level***		***First Difference***	
	t-stat	***p-value***	***t-stat***	***p-value***	***t-stat***	***p-value***	***t-stat***	***p-value***
CPI	2.986	1.000	-10.606	0.000	-1.326	0.879	-11.091	0.000
log(CPI)	1.632	0.999	-10.988	0.000	-2.536	0.311	-11.091	0.000
M2	9.386	1.000	-14.086	0.000	1.888	1.000	-16.486	0.000
log (M2)	1.481	0.999	-15.851	0.000	-1.841	0.681	-16.183	0.000
NEER	-2.048	0.266	-19.709	0.000	-2.576	0.293	-19.777	0.000
log (NEER)	-2.113	0.239	-19.879	0.000	-2.682	0.245	-20.057	0.000
CPII	2.689	1.000	-9.974	0.000	-1.876	0.663	-10.587	0.000
log (CPII)	0.793	0.994	-11.222	0.000	-1.975	0.611	-11.257	0.000

As a complementary in the unit root test, The Philips-Perron (PP) test is also conducted. The PP test results also show that all the variables are non-stationary at the level as well as at log transformation. However, all the variables are stationary at the first difference (Table 3). Thus, all the series, whether we take a log or not, are I(1). The unit root test results are consistent with ADF test, specifically when taking log.

4.2 Autoregressive Distributed Lag (ARDL) Model Estimations

As described in section 3.1, we include all the potential determinants of inflation in the model while estimating the money-price relationship in Nepal. The variables included in the model are consumer price index (CPI), broad money supply (M2), nominal effective exchange rate (NEER) and Indian CPI (CPII). The model using the log form data is as follows:

$$LNCPI_t = \alpha + \beta LNM2_t + \chi LNNEER_t + \delta LNCPII_t + e_t \qquad \text{……….} (5)$$

The error correction version of the above model is as follows:

$$\begin{aligned}\Delta LNCPI_t = {} & \varepsilon_0 + \sum_{i=1}^{p} \phi_i \Delta LNCPI_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta LNM2_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta LNNEER_{t-i} + \sum_{i=1}^{p} \eta_i \Delta CPII_{t-i} \\ & + \lambda_1 LNCPI_{t-1} + \lambda_2 LNCPI_{t-2} + \lambda_3 LNM2_t + \lambda_4 LNM2_{t-1} + \lambda_5 LNM2_{t-2} \\ & + \lambda_6 LNNEER_t + \lambda_7 LNCPII_{t-1} + \lambda_8 LNCPII_{t-1} + \lambda_9 LNCPII_{t-2} + u_t \qquad \text{………} (6)\end{aligned}$$

Above equation can be rewritten as:

$$\Delta LNCPI_t = \varepsilon_0 + \sum_{i=1}^{p} \phi_i \Delta LNCPI_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta LNM2_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta LNNEER_{t-i} + \sum_{i=1}^{p} \eta_i \Delta CPII_{t-i} + \lambda(ecm) - 1 + u_t$$

……… (7)

Whole Data Set and Subsets

To observe the influence of money on the price at different time horizon, we estimate equations (5) and (7) with whole data set and a subset with data from 2008M01 to 2017M12 separately. We split the samples based on the logic that due to the political unrest, the price situation might have been influenced more by supply-side factors before 2008. Similarly, the successful transition toward political stability and changing economic atmosphere might have changed the pattern of relationship between major economic variables in the later period.

(a) Estimates for Whole Data Set

The ARDL model is estimated using Microfit 5.0 software. For the purpose of selecting the optimal leg length, Akaike Information Criterion (AIC)is used. This selected (2,2,0,2) model for LNCPI, LNM2, LNNEER and LNCPII, respectively for estimation as given in the equation (5) and (6). The ARDL model test results are presented in Table 4 and Table 5.

Table 4: Long-run Estimates (2000M01 to 2017M12)

Coefficient	*Estimates*	*t-stats*	*p-value*
α (Constant)	-0.322	-0.84019	0.402
β (LNM2)	0.188**	3.8078	0.000
χ (LNNEER)	-0.094	-1.2901	0.198
δ (LNCPII)	0.609**	5.397	0.000

** Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level.*

The long-run estimates show that CPII and M2 are the significant determinants of inflation in Nepal. The estimates ofβ and δ indicate that one percent change in money supply (M2) brings a change of about 0.19 percent in inflation while one percent change in Indian inflation leads to a change in Nepal's inflation of 0.61 percent. However, the impact of exchange rate does not seem to affect inflation as the coefficient of χ is not statistically significant.

Table 5: Error Correction Representations

Coefficient	*Estimates*	*t-stats*	*p-value*
ecm(-1)	-0.191***	-4.680	0.000
$\phi\Delta$LNCPI	0.215***	3.361	0.001
$\varphi_1\Delta$LNM2	-0.024	-0.640	0.523
$\varphi_2\Delta$LNM2(-1)	0.072*	1.904	0.058
γ ΔLNNEER	-0.018	-1.256	0.211
$\eta_1\Delta$LNCPII	0.441***	4.454	0.000
$\eta_2\Delta$LNCPII(-1)	0.363***	3.354	0.001
$\bar{R}^2$: 0.38 F-Stat: 19.8251 (0.000) DW Stat: 1.9575			

** Significant at 10% level, ** Significant at 5% level, *** Significant at 1% level.*

The error correction representation of the ARDL model shows a cointegration relationship of the included variable as indicated by the significant value of ecm(-1).The 0.19 absolute value of ecm(-1) shows that disequilibrium in the Nepalese inflation is adjusted by about 19 percent every months to maintain the equilibrium with other cointegrated variables. Indian CPI has both first and second lag positive impact in the equilibrium price level while second lag of money supply has also a nominal impact.

Table 6: Diagnostic Test Statistics

A: Serial Correlation	χ^2 (12) = 48.524 (0.000)
B: Functional Form	χ^2 (1) = 4.220 (.040)
C: Normality	χ^2 (2) = 1460.3 (0.000)
D: Heteroscedasticity	χ^2 (1)= 0.786 (0.375)

A: Lagrange multiplier test of residual serial correlation
B: Ramsey's RESET test using the square of the fitted values
C: Based on a test of skewness and kurtosis of residuals
D: Based on the regression of squared residuals on squared fitted values

The diagnostic tests for the ARDL estimates confirm homoskedasticity and normality. However, the test results indicate a serial correlation (Table 6). The ARDL model is found to be robust against residual autocorrelation and presence of it does not affect the estimates (Laurenceson and Chai 2003, p.30).

(b) Estimation for Data Subset

Same models of equation (5) and (7)were estimated employing data subset ranging from 2008M01 to 2017M12. The lag lengths were chosen based on the optimal leg lengths given by Akaike Information Criterion (AIC), which selected a model of (2,2,3,2) for

LNCPI, LNM2, LNNEER and LNCPII, respectively. The estimated results are given in Table 7.

Table 7: Long-run Estimates (2008M01 to 2017M12)

Coefficient	*Estimates*	*t-stats*	*p-value*
α (Constant)	-1.436*	-1.769	0.080
β (LNM2)	0.271***	5.829	0.000
χ (LNNEER)	0.029	0.235	0.815
δ (LNCPII)	0.486***	5.426	0.000

: Significant at 10% level, **: Significant at 5% level, *: Significant at 1% level.*

The split data subset estimates show that the money-price relationship has become much stronger in the recent times. The coefficient of β for split data subset is 0.27 compared to that of 0.19 for the whole data set. On the other hand, impact of Indian inflation on prices in Nepal has declined in the recent times as shown by the coefficients of δ of 0.61 for whole data set to 0.49 for split data subset. Furthermore, there has been a huge shift in the intercept as the value of α has jumped from -0.32 to -1.44 and become statistically significant at 10 percent level. However, nominal effective exchange rate has no significant impact on price as test results are not statistically significant in both data sets (Table 7).

The error correction representation shows a cointegration relationship, similar to that of whole data set. Comparatively higher value of ecm(-0.22 vs -0.19) indicates a quicker adjustment to equilibrium with other cointegrated variables (Table 8).

Table 8: Error Correction Representations(2008M01 to 2017M12)

Coefficient	*Estimates*	*t-stats*	*p-value*
ecm(-1)	-0.219***	-3.664	0.000
$\phi_1\Delta$LNCPI	0.160	1.964	0.052
$\varphi_1\Delta$LNM2	0.052	1.081	0.282
$\varphi_2\Delta$LNM2(-1)	0.115	2.459	0.015
$\gamma\ \Delta$LNNEER	-0.003	-0.080	0.936
$\eta_1\Delta$LNCPII	0.349	3.574	0.001
$\eta_2\Delta$LNCPII(-1)	.34088	3.1025	0.002
$\bar{R}^2$: 0.484 F-Stat:13.748 (0.000) DW Stat: 1.94			

: Significant at 10% level, **: Significant at 5% level, *: Significant at 1% level.*

The diagnostic tests of the estimates indicate homoskedasticity and normality. There is a serial correlation at 5 percent level of significance (Table 9). However, this is not a serious issue in the ARDL model as mentioned above.

Table 9: Diagnostic Test Statistics (2008M01 to 2017M12)

A: Serial Correlation	$\chi^2(12) = 25.2670$ (.014)
B: Functional Form	$\chi^2(1) = 5.6053$ (.018)
C: Normality	$\chi^2(2) = 25.2823$ (.000)
D: Heteroscedasticity	$\chi^2(1) = .012609$ (.911)

Values in ( ) are p-values.

A: Lagrange multiplier test of residual serial correlation
B: Ramsey's RESET test using the square of the fitted values
C: Based on a test of skewness and kurtosis of residuals
D: Based on the regression of squared residuals on squared fitted values

The money-price relation shown by the ARDL model is significantly different compared to that reported by the previous studies. This might be due to the following three reasons. First, most of the previous studies used M1 instead of M2 for money supply. Secondly, previous studies employed data of different time period with lower frequency and horizon. And thirdly, most of the previous studies reviewed in this paper employ OLS or VAR methods, and some of them modify the time series by taking difference to make stationary. As mentioned earlier, long-run information is lost when time series is differenced. Hence, the estimates given by ARDL model seem to be more robust and reliable.

4.3 Granger Causality Tests

Granger causality analysis shows the causal relationship between variables pair-wise. It helps in examining the validity of the variables incorporated in the model. This statistical measure confirms uni-directional, bi-directional or no relationship between two variables. To validate the inclusion of variables in the model, co-integration relation and the direction of the relationship, Granger causality test has been conducted using the whole data set. The summary results of the Granger causality test with 2 lags based on Granger (1969) are presented in Table 10.

Table 10: Granger Causality Tests

Pair	*Null Hypothesis*	*F-Stat/ (P-value)*	*Explanations*
1	CPII does not Granger Cause CPI	31.778 (0.000)	Only first hypothesis is rejected. It shows that Indian Inflation has a unidirectional relationship with Nepal's inflation.
	CPI does not Granger Cause CPII	0.355(0.702)	
2	NEER does not Granger Cause CPI	3.684(0.027)	Both the hypotheses are rejected. This indicates that there exists a bidirectional relationship of NEER with CPI. The impact of CPI to NEER is stronger than the other way.
	CPI does not Granger Cause NEER	10.008(0.000)	
3	M2 does not Granger Cause CPI	23.902(0.000)	Only the first hypothesis is rejected. It means that there is a unidirectional relationship of M2 with CPI.
	CPI does not Granger Cause M2	2.752(0.066)	
4	NEER does not Granger Cause CPII	2.436 (0.066)	Only the second hypothesis rejected. This shows that is a unidirectional relationship of CPII with NEER. This is justifiable in the sense that Nepal's exchange rate is pegged with India and the country has substantial trade dependence with India.
	CPII does not Granger Cause NEER	4.456(0.005)	
5	M2 does not Granger Cause CPII	0.642(0.527)	As both hypotheses are not rejected, we can infer that M2 and CPII are independent from each other.
	CPII does not Granger Cause M2	1.894(0.153)	
6	M2 does not Granger Cause NEER	2.128(0.122)	As both hypotheses are not rejected, we can infer that M2 and NEER are independent from each other.
	NEER does not Granger Cause M2	1.661 (0.192)	

Values in ( ) are p-values.

In a nutshell, the Granger causality test confirms that all the variables (CPII, NEER and M2) included in the model influence the CPI. These relationships are also theoretically valid and other problems such as endogeneity are not observed.

V. CONCLUSION

Main objective of the monetary policy is to maintain price stability as it is a prerequisite for economic growth and development. Several internal and external factors affect price level in an economy. Money supply is the major internal factor affecting price level as over-supply of money can lead to an increase in price level. Information on the pattern of money-price relationship is crucial to maintain the money supply at an optimal level. Several studies on money and prices in various economies in the world have shown both unidirectional as well as bidirectional causality between money and prices. Money influences both real income and prices while nominal income also raises price level. Previous studies in Nepalese context find that money supply alone has limited power to explain Nepalese price level compared to external factors such as Indian inflation. However, the empirical methods followed by most of these studies were not strong enough as they employed ordinary least squares (OLS) method or error correction models (ECM) on low frequency data.

This paper revisits money and price relationship in Nepal by applying step-wise econometric framework and employing monthly time series data spanning from January 2000 (2000M01) to December 2017 (2017M12). To make the regression model complete and comprehensive, other relevant variables also have been included. Considering the properties of time series data, the autoregressive distributed lag (ARDL) model has been employed to analyze the cointegration relationships. To validate the model and model results, Granger causality tests also have been conducted. Empirical tests are conducted employing whole data set and a split data subset ranging from 2008M01 to 2017M12 separately to examine the pattern of shift occurred in the recent times.

The estimated coefficients of ARDL models for whole data set show that there is a significant relationship between money and price in Nepal as one percent change in money supply induces a change of 0.19 percent in the consumer price index. Indian consumer price index has the largest impact on Nepal's price level shown by a coefficient of Indian consumer price index of 0.61. Estimated coefficients for the split data subset show that money-price relationship in Nepal has become much stronger in the recent times with a coefficient of 0.27 compared to that of 0.19 for whole data set. Conversely, the estimates show that impact of Indian inflation on Nepal's inflation has declined in recent times. The coefficient of Indian consumer price index is 0.49 for split data subset compared to 0.61 for whole data set. However, nominal effective exchange rate does not seem to affect price level in Nepal as test results are not statistically significant in both data sets. The Granger causality test results show a unidirectional causality from money into prices in Nepal. Based on the model fitness statistics, we can argue that these estimates obtained employing the step-wise econometric framework and using monthly time series data are robust and reliable compared to the estimates reported by previous studies.

REFERENCES

Brillembourg, A., and M. S. Khan. (1979). The Relationship between Money, and Prices: Has Money Mattered Historically? Journal of Money, Credit Banking 358-365.

Fisher, Irving. (1922). The Purchasing Power of Money-Its Determination and Relation to Credit, Interest, and Crises. New York: The Macmillan Co.

Friedman, B. M., and K. N. Kuttner. (1988). "Money, In- come and Prices after the 1980s" mimeo., NBER.

Granger, C. W. J. (1969). "Investigating Causal Relations by Econometric Models and Cross-spectral Methods. "Econometrica, Vol. 37, No. 3.:424-438

Hanke, S.H. and N. Krus. (2012). World Hyperinflations. CATO Working Paper No. 8, August 15 2012. Washington DC: Cato Institute. Retrieved February 20 from https://object.cato.org/sites/cato.org/files/pubs/pdf/workingpaper-8.pdf

Husain, F and Tariq Mahmood. (1999). Causality between Money and Prices: Evidence from Pakistan. The Pakistan Development Review, Vol. 37, No. 4. Stable URL: http://www.jstor.org/stable/41261104. Accessed: 09-03-2017 04:29 UTC

IMF. (2011). "Nepal: Selected Issues."IMF Country Report No. 11/319. Washington DC: International Monetary Fund.

_______. (2014)."Nepal: 2014 Article IV Consultation—Staff Report."IMF Country Report No. 14/214. Washington, D.C. : International Monetary Fund

ISD. (1994). "Inflation in Nepal." NRB Economic Review. Vol. 7: 99-108. Institute for Sustainable Development. Kathmandu

Khatiwada, Y. R. (2005). "Monetary Policy". NRB in 50 Years: Golden Jubilee Publication: 279-295. Nepal Rastra Bank, Kathmandu.

Laurenceson J. and J. Chai. (2003). Financial Reform and Economic Development in China. Cheltenham, UK, Edward Elgar.

Mathema, Sushil Ram. (1998). "Determinants of Inflation with Special Reference to Wages in Nepal. "NRB Economic Review, Vol. 10: 1-18.

Neupane, Guru Prasad. (1992). "Causes of Inflation in Nepal: A Quantitative Analysis. "NRB Economic Review, Vol 6: 33-49

Nkoro, E. and A. Uko. (2016). Autoregressive Distributed Lag (ARDL) cointegration technique: application and interpretation. Journal of Statistical and Econometric Methods, vol.5, no.4, 2016, 63-91 ISSN: 1792-6939, Scienpress Ltd, 2016. Retrieved February 10 from http://www.scienpress.com/Upload/JSEM/Vol%205_4_3.pdf

NRB. (2001). "Money and Price Relationship in Nepal: A Revisit." NRB Economic Review, Vol. 13, Research Department, Nepal Rastra Bank

NRB. (2007). Inflation in Nepal. Nepal Rastra Bank, Research Department, Kathmandu.

Ramachandra, V. S. (1983). “Direction of Causality between Monetary and Real Variables in India-An empirical Result” Indian Economic Journal, 31, 65–76.

______. (1986). “Direction of Causality between Monetary and Real Variables in India-An extended Result”, Indian Economic Journal, 34, 98–102.

Sharma, R. (1984). “Causality between Money and Price Level in India”, Indian Economic Review, 19(2), 213-21.

Shrestha, Min B. and Guna R. Bhatta. (2018). “Selecting Appropriate Methodological Framework for Time Series Data Analysis”, Journal of Finance and Data Science. https://doi.org/10.1010/j.jfds.2017.11.001. Preliminary version of this paper was published as NRB Working Paper No. 36 (March 2017).

Sims, C. (1972). “Money, Income, and Causality”, American Economic Review, 62(4), 540-552.