Research Article

Determinants of Inflation: Evidence from Nepalese Data

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ABSTRACT

This study focuses on the examination of the relationship between the inflation and its major determinants in Nepal namely, GDP at constant price, investment, broad money supply, remittance, exchange rate, interest rate and inflation of India considering their log form using the data from 1980 to 2020 A.D. Augmented Dickey Fuller (ADF) test was adopted to examine whether the variables are stationary or not. The data under the consideration were integrated of different orders I (0) and I (1) so autoregressive distributive lag (ARDL) and bounds test was employed to make the analysis of the data. Vector auto regression (VAR) lag selection criteria was employed for the selection of the optimum lag length. The short run results show that the broad money supply, exchange rate and inflation of India are the significant determinants. Moreover, the results of F-statistic bounds test shows that GDP at constant price, broad money supply, exchange rate and Indian inflation are the major determinants of inflation in the long-run. The negative and significant value of the error correction term (ECT) imply that, the deviation in the long run increment in the inflation is corrected in the succeeding year. In addition, the results of the cumulative sum (CUSUM) and cumulative sum of square (CUSUMSQ) indicate the stability in the coefficients.

Keywords: ARDL; bounds test; inflation; relationship; stability

INTRODUCTION

Inflation is a measure of the value of money. It is defined as the rate at which the prices of goods and services fluctuate in a definite period of time usually a year. Moreover, price

stability has become the major challenges of the countries like Nepal. Inflation is one form of taxation that can be imposed without legislation (Friedman, 1963). Inflation refers to the rising price level which persists for a long period of time, which deteriorates the purchasing power of the consumer (Shapiro, 1966). Accordingly, the phenomenon inflation is complex, multi-dimensional and characterized by the continuous rise in prices (Piao & Zhang, 2004).

Several other indices including consumer price index, gross domestic product (GDP) deflator measure the changes in the price level. Moreover, whichever measure is appropriate, is applied purposely. However, since the consumer price index is widely used in the measurement of the inflation, this study too considers CPI as a measuring tool of inflation. The major categories of the consumer price index in Nepal are food and beverages 43.91 percentage, housing, water, electricity, gas and other fuels 20.30 percentage, education 7.4 percentage, clothing and footwear 7.1 percentage, transport 5.3 percentage, furnishings and housing equipment 4.3 percentage, healthcare 3.5 percentage, communication 2.8 percentage, miscellaneous goods and services 2.8 percentage and recreation and culture 2.5 percentage (NRB, 2022). Besides CPI, GDP at constant price, investment, broad money supply, volume of remittance inflow, interest rate and consumer price index of India are also considered as the variables under analysis.

The main objective of this study is to assess the major determinants of the inflation rate in Nepal examining the relationship with the GDP at constant price, investment, broad money supply, remittance, interest rate and inflation rate of India.

According to the quantity theory of money, introduced by the classical economists, increase in the money stock leads to the proportionate increase in the inflation, velocity of money and quantity of goods remaining constant. Later, the monetarist economists accepted quantity theory of money as their foundation and advocated that inflation is a monetary phenomenon and stated that inflation is the outcome of the too much money chasing too few goods (Friedman, 1963). Theory of demand pull inflation states that, when aggregate demand exceeds the aggregate supply, at the full employment level due to the high government expenditures, increase in the money supply, gives rise to the demand pull inflation. Theory of cost push inflation on the other hand is based upon the assumption that, the increase in the cost of production due to the high price of the factor inputs and fall in the aggregate supply such as rise in the wage rate, profit, corporate taxes, supply shocks and so on leads to the rise in the inflation. Moreover, structural factors such as trade policies, weather conditions, protection of some sectors by the government policies and slow growth of the export in the developing

countries also influence the inflation (Jackman et al. 1981).

Dua and Goel (2021) conducted an analysis on the determinants of inflation in India considering the monthly data from April 1996 to March 2017. The study employed the co-integration method to compute the determining factors of inflation. The results of the study came to conclude that in the long run, there exists the relationship between the inflation and its major determinants namely expected inflation, output gap, growth rate of money supply, rate of exchange, rate of interest, fiscal deficit, minimum support prices, rainfall, international price of oil and food.

Byanjankar (2020) made an analysis regarding the determinants of inflation in Nepal employing the ARDL bounds test considering the data from 1975 to 2018. The study came to conclude that the major determinants of inflation in Nepal in the long run are the Indian inflation, real income and the exchange rate. Whereas, Indian inflation, the exchange rate and government deficit have the significant influence in the short run. Moreover, the error correction term was found to be negative and statistically significant.

Al-Jafari and Altaee (2019) conducted a study on the determinants of inflation sources in Iraq using the annual time series data from 1995 to 2015 employing ARDL model considering the money supply, exchange rate and import as the independent variables. Accordingly, the study came up to conclude that in the long run all the variables under the consideration were the significant determinants of inflation in Iraq. However, in the short-run, the money supply was found to be positive and significant only at 10 percent level of significance, the import was significant at 1 percent and had the positive impact and the exchange rate was found to be insignificant with negative relation. Moreover, the error correction term was significant with the negative sign.

Chaudhary and Xiumin (2018) made an examination regarding the impact of the macroeconomic variables such as broad money supply, real GDP and Indian prices on inflation considering the time series data from the year 1975 to 2016. The results of the analysis conducted using the ordinary least squares regression method came to conclude that the money supply and the Indian prices cause the inflation in the long run.

Alam and Alam (2016) conducted a study regarding the determinants of inflation in India considering the annual time series data from the fiscal year 1989/90 to 2012/13 employing the ARDL bounds test considering wholesale price index as the dependent variable and money supply, exchange rate, world oil price and supply bottlenecks as independent variables. The study came to conclude that both in the long run and short run domestic factors such as

monetary growth and supply bottlenecks dominate the external factors regarding the rise in inflation.

Poudel (2014) made an empirical analysis on the determinants of the inflation in Nepal considering the budget deficit, Indian inflation, broad money supply, exchange rate and real GDP employing the time series annual data from the year 1975 to 2011. Moreover, the data were analyzed using the Wickens-Breusch single equation error correction model and came to conclude that, though, budget deficit, money supply and Indian prices were only significant in short-run, all the variables under the study were significant in the long-run.

Uddin et al., (2014) conducted an investigation regarding the determinants of inflation in Bangladesh using the annual time series data from 1972 to 2012 employing ARDL model. The study came to conclude that gross domestic product, money supply and interest rate of the current year and the real exchange rate and interest rate of the previous year were the major determinants of the inflation in Bangladesh.

Significant number of the international literatures focused on GDP, money supply, exchange rate, interest rate as the major determinants of inflation. Regarding the domestic literatures, most of the literatures have emphasized on the Indian inflation in addition to these variables. However, this study along these variables have incorporated remittance and investment as well employing the time series data of 41 years.

DATA AND METHODS

This study is based upon the quantitative research design. Unit root test, optimum lag selection, ARDL bounds test, error correction model, CUSUM and CUSUMSSQ tests were conducted employing the econometric model. This study considers the annual time series data of consumer price index, GDP at constant price, investment, broad money supply, remittance, interest rate, exchange rate and the consumer price index of India from the year 1980 to 2020. The data series were collected from the annual reports of the World Bank, Nepal Rastra Bank, economic survey, published by ministry of finance, and even from the data used by the other researchers as well.

The data were collected from the secondary sources and analyzed using the eviews 10 statistical tool. In order to examine whether the data were stationary or not, unit root test was conducted, optimum lag selection was conducted to observe the existence of the long run relationship between the variables. Since the series were stationary at level I (0) and first order difference I (1), ARDL bounds test was conducted to examine the long run relationship

of the series. Moreover, error correction model was employed to know about the speed of convergence or divergence of short run disequilibrium to the long run equilibrium of the model. Moreover, CUSUM and CUSUMSQ test were conducted to examine the stability of the parameters.

Under this study, the model is formulated considering the established economic theory, available literatures and previous studies. Accordingly, the variables under considerations are assumed to determine the inflation of Nepal. Consumer price index (CPI) of Nepal represents the dependent variable, whereas, GDP at constant price, investment, broad money supply, remittance, exchange rate, interest rate and consumer price index (CPI) of India represent the independent variables.

The model under the study is based upon the following equation:

$CPI_N = f(GDP, I, M, R, r, E, CPI_I)$ …….. (i)

Where, CPI_N is the inflation of Nepal, GDP is the gross domestic product at constant price, I is the investment, M is the broad money supply, R is the remittance, r is the interest rate, E is the exchange rate and CPI_I is the inflation of India respectively.

The specific econometric model under this analysis in the log form:

$lninf = b_0 + b_1 lngdp + b_2 lninv + b_3 lnbms + b_4 lnrem + b_5 lnint + b_6 lnexch + b_7 lniinf + et$…..(ii)

RSESULTS AND DISCUSSION

Unit Root Tests

Unit root test is generally a non-stationary process and is conducted to examine whether the variables are stationary or not. This study employed the Augmented Dickey Fuller test to check the integration order of the variables under analysis considering their log form.

Table 1

Results of Augmented Dickey Fuller Test

Variable	At Level		At First Difference		
	t-statistics	p-value	t-statistics	p-value	Order of Integration
Lninf	-4.29	0.00			I(0)
Lngdp	0.09	0.96	-6.24	0.00	I(1)
Lninv	-0.23	0.93	-5.63	0.00	I(1)
Lnbms	-0.46	0.89	-4.40	0.00	I(1)
Lnexch	-2.61	0.10	-5.04	0.00	I(1)
Lnint	-1.70	0.43	-4.61	0.00	I(1)

Lnrem	-0.46	0.89	-7.10	0.00	I(1)
Lniinf	-2.88	0.06	-7.79	0.00	I(1)

Source: Calculation using Eviews 10

According to the results of the table 1, inflation of Nepal is stationary at level. However, the other variables GDP at constant price, investment, broad money supply, remittance, exchange rate, interest rate and inflation rate of India, are stationary at first difference.

Optimum Lag Selection

Optimum lag selection is a process to examine the existence of the long run relationship between and among the variables under consideration. Accordingly, Akaike information criterion (AIC) was adopted to select the optimum lag for the analysis.

Table 2

Results of the Selection of Optimum Lag Length

Lag	Logl	LR	FPE	AIC	SC	HQ
0	-63.55	NA	5.97e-09	3.77	4.11	3.89
1	225.17	440.67*	4.69e-14*	-8.06	-4.96*	-6.96*
2	287.18	68.54	8.34e-14	-7.96	-2.10	-5.87
3	389.87	70.26	5.15e-14	-9.99*	-1.37	-6.93

*Indicates lag order selected by the criterion

LR: Sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Source: calculation using eviews 10

In the table 2, the results of the standard VAR model considering the Akaike Information Criterion (AIC) shows the optimum lag of 3. Thus, this analysis is conducted employing 3 lags.

ARDL Regression Result

After examining whether the variables under consideration are stationary or not and selecting the optimum lag length for the ARDL model, the optimum lags of the variables under analysis is given as ARDL (2, 2, 0, 1, 2, 0, 0, 0).

Table 3

Result of the Estimated ARDL Model

Dependent Variable: LNINF

Method: ARDL

Sample (adjusted): 1982 2020

Included Observations: 39 after adjustments

Maximum dependent lags: 3 (Automatic selection)

Model selection method: Akaike info criterion (AIC)

Dynamic regressors (3 lags, automatic): LNGDP LNINV LNBMS LNEXCH LNINT LNREM LNIINF

Fixed regressors: C

Number of models evaluated: 49152

Selected Model: ARDL (2, 2, 0, 1, 0, 0, 2, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNINF(-1)	-0.17	0.14	-1.19	0.24
LNINF(-2)	-0.25	0.14	-1.77	0.09
LNGDP	0.23	0.52	0.45	0.66
LNGDP(-1)	0.50	0.56	0.89	0.38
LNGDP(-2)	0.47	0.45	1.05	0.31
LNINV	0.21	0.69	0.31	0.76
LNBMS	4.04	1.76	2.30	0.03
LNBMS(-1)	-6.15	1.96	-3.14	0.00
LNEXCH	1.52	0.68	2.23	0.04
LNINT	0.36	0.43	0.85	0.41
LNREM	-0.02	0.31	-0.05	0.96
LNREM(-1)	0.16	0.37	0.43	0.67
LNREM(-2)	0.54	0.33	1.65	0.11
LNIINF	0.84	0.20	4.21	0.00
C	-1.19	2.75	-0.43	0.67
R-squared	0.72	Mean dependent var		1.95
Adjusted R-squared	0.55	S.D. dependent var		0.55
S.E. of regression	0.37	Akaike info criterion		1.11
Sum squared resid	3.21	Schwarz criterion		1.75
Log likelihood	-6.63	Hannan-Quinn criter.		1.34
F-statistic	4.32	Durbin-Watson stat		2.24
Prob (F-statistic)	0.00			

Source: Calculation using Eviews 10

Table 3 shows the short-run results of the ARDL model. Accordingly, the variables broad money supply, exchange rate and inflation of India seem to be significant at 5 percent

level of significance since the p value is less than 0.05 ($p<0.05$). However, the p value of GDP, investment, remittance and the interest rate is greater than 0.05 ($p>0.05$), thus were found to be insignificant.

The value of R-squared is 0.72, indicating the good fit of the model implying that 72 percentage variation in dependent variable inflation is explained by the explanatory variables.

ARDL Bounds Test for Co-Integration

In case when the series are in different order of integration, auto regressive distributive lag (ARDL) co-integration technique is used to determine the long run relationship between the series. (Pesaran and Shin, 1995 & Pesaran et al, 2001).

Accordingly, ARDL co-integration approach has three major advantages over the other previous co-integration approaches. ARDL does not need all the variables to be integrated of same order, ARDL test is comparatively more efficient in case of small and finite size of the data and application of the ARDL technique gives unbiased estimates of long-run model (Harris & Sollis, 2003).

Thus, since the data under analysis are integrated of order I (0) and I (1), ARDL bounds test was employed to attain efficient and unbiased estimates of the long-run model.

Table 4

Results of ARDL Co-Integration Test

Test Statistics	Value	Significance	I(0)	I(1)
		Asymptotic n=1000		
F-statistic	7.92	10%	1.92	2.89
K	7	5%	2.17	3.21
		2.50%	2.43	3.51
		1%	2.73	3.90

Source: Calculation using Eviews 10

The table 4 shows, the value of F-statistic is 7.92, which is greater than the value of upper bounds 3.21 at 5% level of significance, which is widely accepted cut-off value regarding the confidence in the rejection of null hypothesis. Thus, the null hypothesis is rejected which indicates that there exists the co-integration.

ARDL Co-Integration and Long –run Effects

Log-run co-integration relationship between the dependent and the independent variables is conducted by employing ARDL (2, 2, 0, 1, 0, 0, 2, 0) bound test.

Table 5

ARDL Long Run Form and Bounds Test Results

Dependent Variable: D (LNINF)

Selected Model: ARDL (2, 2, 0, 1, 0, 0, 2, 0)

Case 2: Restricted Constant and No Trend

Sample: 1980 2020

Included Observations: 39

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	0.85	0.29	2.96	0.01
LNINV	0.15	0.48	0.31	0.76
LNBMS	-1.48	0.70	-2.12	0.04
LNEXCH	1.07	0.49	2.20	0.04
LNINT	0.25	0.30	0.84	0.41
LNREM	0.49	0.25	1.98	0.06
LNIINF	0.59	0.15	4.10	0.00
C	-0.84	1.93	-0.43	0.67

EC=LNINF-(0.85*LNGDP+0.15*LNINV-1.48*LNBMS+1.07*LNEXCH+
0.25* LNINT+0.49*LNREM+0.59*LNINF-0.84)

Source: Calculation using Eviews 10

Table 5 shows that, the variables, LNGDP, LNBMS, LNEXCH and LNIINF are significant at 5 percent level of significance, as p value is less than 0.05 ie ($p<0.05$). However, considering the 5 percent level of significance, LNREM, LNINV and LNINT were found to be insignificant as the p value is greater than 0.05 ie ($p>0.05$). Moreover, LNGDP, LNINV, LNEXCH, LNINT, LNREM and LNINF were found to have the positive coefficients but LNBMS was found to have the negative coefficient.

Thus, the results reveal that, 1 percent increase in the LNGDP, LNEXCH and LNIINF leads to the increase in the LNINF by 85, 107 and 59 percent respectively. On the other hand, 1 percent increase in the LNBMS leads to the decrease in the LNINF by 148 percent. However, LNINV and LNINT are insignificant with positive relation with LNINF in the long run.

Error Correction Model (ECM) Regression Results

Error correction model integrates the short run dynamics along with the long run equilibrium without deterioting the long run information. Accordingly, error correction term refers to the speed of adjustment by restoring the equilibrium in dynamic model where, the value of error correction term should be statistically significant and negative as well (Banerjee et al., 1998).

Table 6

Results of ARDL Error Correction Regression

ARDL Error Correction Regression

Dependent Variable: D (LNINF)

Selected Model: ARDL (2, 2, 0, 1, 0, 0, 2, 0)

Case 2: Restricted Constant and No Trend

Sample 1980 2020

Included Observations: 39

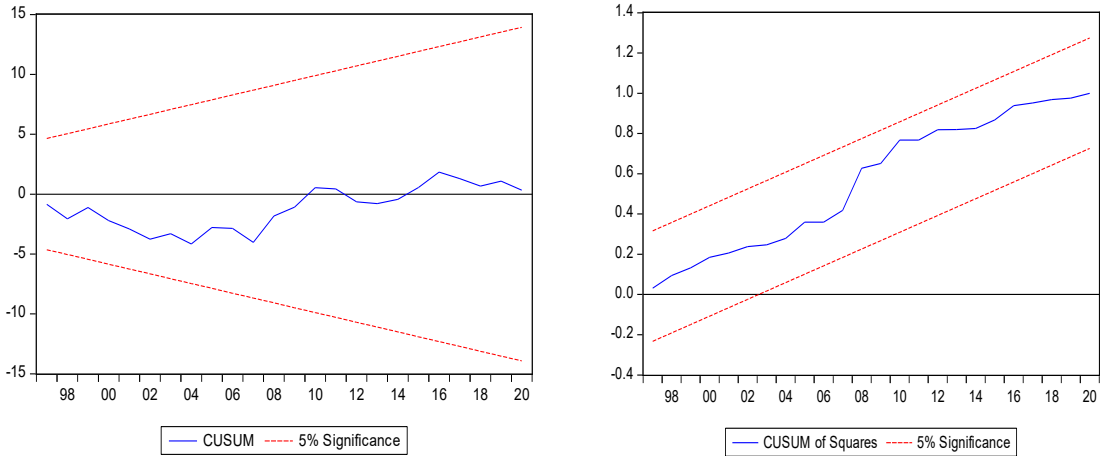
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNINF(-1))	0.25	0.10	2.46	0.02
D(LNGDP)	0.23	0.35	0.66	0.51
D(LNGDP(-1))	-0.47	0.34	-1.38	0.18
D(LNBMS)	4.04	0.64	6.36	0.00
D(LNREM)	-0.02	0.22	-0.07	0.94
D(LNREM(-1))	-0.54	0.21	-2.62	0.01
CointEq(-1)*	-1.42	0.15	-9.75	0.00
R-squared	0.78	Mean dependent var		-0.02
Adjusted R-squared	0.74	S.D. dependent var		0.62
S.E. of regression	0.32	Akaike info criterion		0.70
Sum squared resid	3.21	Schwarz criterion		1.00
Log likelihood	-6.63	Hannan-Quinn criter		0.81
Durbin-Watson stat	2.24			

Source: Calculation using Eviews 10

In the table 6, error correction term (CointEq(-1)) is negative and statistically significant as well, which implies that the equilibrium is convergent. Moreover, the value -1.420763 indicates that the deviation in the long run increment in the inflation is corrected by 142 percentages in the next year.

Stability Tests

Cumulative sum (CUSUM) and cumulative sum of square (CUSUMSQ) are conducted in order to assess the stability of the parameters (Pesaran & Pesaran, 1997). Accordingly, the CUSUM test detects the systematic changes in the regression coefficients, whereas, CUSUMSQ test identifies the deviation from the consistency of the regression coefficients. The result of the CUSUM and CUSUMSQ is presented in the figure 1.



Source: Calculation using Eviews 10

Figure 1 : Results of CUSUM and CUSUMSQ Test

According to figure 1, since the plots of the CUSUM and CUSUMSQ statistics lie within the critical band of the 5 percentage level of confidence, indicates the absence of instability of the coefficients. Thus, we can conclude the existence of the stability in the coefficients during the period of analysis in case of Nepal.

CONCLUSIONS

This paper makes an analysis regarding the determinants of inflation in Nepal considering the annual time series data from the year 1980 to 2020 employing ARDL model. The major objective of the study was to compute the relationship between the inflation and its determinants namely GDP at constant price, investment, broad money supply, remittance, exchange rate, interest rate and Indian inflation considering their log form. Accordingly, in the short run, the broad money supply, exchange rate and inflation of India were found to have the significant effect on the inflation. However, in the long run, broad money supply, exchange rate and inflation of India along with the GDP at constant price, were found to have the significant effect on the inflation. Moreover, only the broad money supply was found to have the negative effect, except which, all the other variables under consideration were found to have the positive effect in the long run. The negative and significant value of the error correction term indicates the quick convergence of the short-run disequilibrium to the long-run equilibrium. In addition, the results of the CUSUM and CUSUMSQ test shows the stability of the long run inflation function.

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