AN ECONOMETRIC ANALYSIS OF DEFICIT BUDGET, MONEY SUPPLY AND INFLATION IN NEPAL

Tara Prasad Bhusal[*]

ABSTRACT

High money supply (M2) and high budget deficits (BD) both are equally responsible for higher rate of inflation. Moreover, inflationary pressure gets more momentum when money supply and budget deficits both increase together. The empirical evidence of Nepal also supports this hypothesis. Present paper re-examines this issue in the context of Nepal by using econometric analysis. The empirical results reveal that long run inflation is not only related with higher money supply but also to budget deficit. On the one hand, there is unidirectional causal relationship between money supply with inflation and similarly budget deficit with inflation. On the other, the supply of money has no causal connection with budget deficit. Hence the finding implies that both monetary and fiscal policies are important to control inflation in Nepal.

Key words: Budget deficit, inflation, money supply, cointegration, causal relation, unit root, CPI.

INTRODUCTION

The conventional approach of money supply believes that is that high money supply (M_2) and high budget deficits (BD) both encourage higher rate of inflation (CPI). In general, the long-run inflation is primarily a monetary phenomenon. Nepalese experience is not different in this context. Inflation is generally associated with monetary expansion. Therefore, a rise in the general price level can most often be traced to higher money supply. However, the impacts of fiscal sector are also considered to be an important factor in explaining price fluctuations.

The overall inflation in Nepal during the 1980s averaged 10.62 percent per annum. In the 1990s, it increased to an average of around 16.30 percent per annum. This inflationary acceleration was attributable with several determinants such as heavy devaluation of rupee, a sharp rise in the oil prices and large monetary expansion (with an average annual increase of 19.5 percent). The economy experienced a rate of inflation averaged at 13.7 percent per annum during 2000s. During study period (1975-2009) the average annual rate of inflation was 8.3%. Similarly, monetary assets also witnessed a sharp average annual rise of 18.57 percent and the average rate of budget deficit was also increased with a sky rocketing rate of 19.19 percentages during the study period. That is why during last decades, a critical task faced by Nepal Rastra Bank was to maintain inflation within targeted level for ensuring macroeconomic stability. Despite different measures adopted by the Central Bank, the inflation was an

[*] Mr. Bhusal is an Associate Professor at Central Department of Economics T.U., Kirtipur, Nepal.

average of 8.29 percent during the period 2000-2009, whereas the average annual growth rate of money supply was 18.56 percent. In Nepal, it is generally asserted that the main cause behind a higher rate of inflation could be large monetary expansion, fiscal imbalances, and deficit financing.

The main objectives of this article are to examine the long-run relationship among inflation, supply of money and budget deficit in Nepal and to detect the direction of causality among these variables.

LITERATURE REVIEW

In economic literature, numerous models have been developed to analyze the long-run relationship among inflation, money supply and budget deficit. However, evidence from the empirical literature is mixed, Akcay (1996). De Haan and Zelhorst (1990) analyze the relationship between government budget deficit and money growth in developing countries. The overall conclusion of this study does not support the hypothesis that government budget deficit causes monetary expansion and, therefore, leads to inflation. Similarly, Vieira (2010) investigates the relationship between fiscal deficit and inflation in case of six major European economies. The results provide little support for the proposition that budget deficit has been an important contributing factor to inflation in these economies over last 45 years. Durevall and Ndung'u (2001), using a dynamic error correction model of inflation for Kenya, reveals that money supply affects prices only in the short-run. However, the study by Catao and Terrones (2003) shows a strong positive relationship between budget deficits and inflation among developing countries as well as countries characterized by high inflation, but not among advanced economies with low-inflation.

In the connection of Nepal, studies have been conducted to examine the role of fiscal deficit as a major determinant of inflation have also provided mixed results. Bilquees (1988) finds no relationship between budget deficit and inflation. Neyapti's (1998) empirical analysis based on the data set for 44 developing and less developed countries indicates that positive association between budget deficits and inflation is not statistically significant for a number of countries including Nepal. However, in contrast to these studies, Shabbir and Ahmed (1994) find a positive relationship between budget deficits and inflation in Nepal. According to their findings, a one percent increase in budget deficit leads to 6 to 7 percent increase in the general price level. The findings of Chaudhary and Ahmad (1995) suggest that domestic financing of the budget deficit, particularly from the banking system, is inflationary in the long-run. The results point to a positive relationship between budget deficit and inflation during acute inflation periods of the 1970s. The authors also find that money supply is not exogenous; rather, it depends on the position of international reserves and fiscal deficit. Khan and Qasim (1996) reveal that the expansionary fiscal policy stance has been reflected in a deteriorating balance of payments position and has induced repeated downward adjustment in the rupee, which has caused the price level to increase. In a more recent study, Agha and Khan (2006) examine the long-run relationship between inflation and fiscal indicators in Nepal for the period 1973-2003. The empirical results, using Johansen cointegration analysis, indicate that in the long-run inflation is not only related to fiscal imbalances but

also to the sources of fiscal deficit financing. The authors conclude that inflation in Nepal is strongly affected by government's bank borrowing for budgetary support as well as fiscal deficits and, consequently, that fiscal policy is an important factor in explaining price movements.

The empirical works have been carried out to examine the relationship between inflation and budget deficit in Nepal; the findings have, however, remained mixed. Rationalise a need to re-examine the issue. The availability of a relatively long quarterly data series might provide more reliable evidences with regard to the nature of the relationship among inflation, money supply and budget deficit.

ANALYTICAL FRAMEWORK

ADF UNIT ROOT TEST

Many macroeconomic time series contain unit roots dominated by stochastic trends, as developed by Nelson and Plosser (1982). Unit root tests are important to examine the stationary of a time series because a non-stationary regression invalidates many standard empirical results and thus requires special treatment. Granger and Newbold (1974) have found by simulation that the F-statistic calculated from the regression involving the non- stationary time-series data does not follow the standard distribution. This nonstandard distribution has a substantial rightward shift under the null hypothesis of no causality. Thus the significance of the test is overstated and a spurious result is obtained, Bhusal (2009). The presence of a stochastic trend is determined by testing the presence of unit roots in time- series data. Non-stationarity or the presence of a unit root can be tested using the Dickey and Fuller (1981) tests.The test is the t statistic on ϕ in the following regression:

$$\Delta Y_t = \alpha_0 + \alpha_1 .t + \phi Y_{t-1} + \sum \psi_i \Delta y_{t-i} + \varepsilon_t \quad \ldots \quad (1)$$

where Y is the variable under consideration, Δ is the first difference operator, t captures time trend, ε_t is a random error. The optimal lag length is identified so as to ensure that the error term is white noise. α_0, α_1, ϕ and ψ are the parameters to be estimated. If we cannot reject the null hypothesis $\phi=0$, then we conclude that the series under consideration has a unit root and is therefore non-stationary.

TESTS OF COINTEGRATION

The cointegration test is based in the methodology developed by Johansen (1991), and Johansen and Juselius (1993). Johansen's method is to test the restrictions imposed by cointegration on the unrestricted variance autoregressive, involving the series.

$$Z_t = K_1 Z_{t-1} + K_2 Z_{t-2} + K_3 Z_{t-3} + \ldots\ldots\ldots\ldots + K_{k-1} Z_{t-k} + \mu + v_t \quad \ldots \quad (2)$$

where, Z = (*CPI, M* 2, *BD*) is a 3×1 vector of variables. *CPI*, *M2* and BD are consumer price index, money supply and budget deficit, respectively. The variables are potentially I (1). K_i is 3×3 matrices of parameters, μ is a vector of constant and v_t is a vector of normally and independently distributed error term. Equation (2) can be reformulated in a vector error correction model (VECM),

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \Gamma_3 \Delta Z_{t-3} + \ldots\ldots\ldots\ldots + \Gamma_{k-1} \Delta Z_{t-k-1} + \Pi Z_{t-1} + \mu + v_t \quad \ldots \quad (3)$$

where, $\Gamma_i = (I - A_1 - A_2 \ldots\ldots - A_i)$,(i= 1,2,3…..k-1) and $\Pi = -(I - A_1 - A_2 - A_3 \ldots - A_i)$.

The 3×3 coefficient matrix Π provides information about the long-run relationships among the variables. Π can be factored into $\alpha\beta'$ where α will include the speed of adjustment to the equilibrium while β' will be the long-run matrix of coefficients. The presence of *r* cointegrating vectors between the elements of *Z* implies that Π is of the rank r (0< r < 3). To determine the number of cointegrating vectors, Johansen developed two likelihood ratio tests: trace test (λ_{trace}) and maximum eigenvalue test (λmax). If there is any divergence of results between these two tests, it is advisable to rely on the evidence based on test because it is more reliable in small samples the λmax (Dutta and Ahmed, 1997; Odhiambo, 2005).

ERROR CORRECTION MODELING (ECM)

The existence of co-integration relationships indicates that there are long-run relationships among the variables, and thereby Granger causality among them in at least one direction. The ECM was introduced by Sargan (1964), and later popularized by Engle and Granger (1987). It is used for correcting disequilibrium and testing for long and short- run causality among co-integrated variables. The ECM, in this paper is specified as follows:

$$\Delta CPI_t = a_0 + \sum_{i=1}^{m} a_{1i}\Delta CPI_{t-i} + \sum_{i=1}^{n} a_{2i}\Delta M2_{t-i} + \sum_{i=1}^{l} a_{3i}\Delta BD_{t-i} + \lambda ECM_{t-1} + u_t \quad \ldots (5)$$

$$\Delta M2_t = b_0 + \sum_{i=1}^{m} b_{1i}\Delta CPI_{t-i} + \sum_{i=1}^{n} b_{2i}\Delta M2_{t-i} + \sum_{i=1}^{l} b_{3i}\Delta BD_{t-i} + \theta ECM_{t-1} + v_t \quad \ldots. (6)$$

$$\Delta BD_t = c_0 + \sum_{i=1}^{m} c_{1i}\Delta CPI_{t-i} + \sum_{i=1}^{n} c_{2i}\Delta M2_{t-i} + \sum_{i=1}^{l} c_{3i}\Delta BD_{t-i} + \psi ECM_{t-1} + \varepsilon_t \quad \ldots (7)$$

where, Δ is the difference operator, m and n are the numbers of lags, a's, b's and c's are parameters to be estimated and, λ, θ and ψ are the error correction term, which is derived from the long run co-integration relationship. In each equation, change in the endogenous variable is caused not only by their lags, but also by the previous period's disequilibrium in level. Given such a specification, the presence of short and long-run causality could be tested (Shiu and Lam, 2010:50).

DATA ESTIMATION AND INTERPRETATION OF RESULTS

This study uses yearly observations for the period 1975-2009 for three variables: the consumer price index (CPI), money supply (M2) and government budget deficit (BD) in order to analyze the possibility of cointegration and causality relationship among them. Despite the fact that CPI has limited coverage, it is the most reliable measure of inflation and is commonly used in empirical studies (Metin, 1998; Solomon and De Wet 2004; Agha and Khan 2006). Therefore, following the standard practice, inflation is proxied by CPI. The data, seasonally unadjusted and expressed in nominal terms, have been collected from annual reports by Nepal Rastra

Bank of Nepal and from Economic Survey (2009-10) published by the Government of Nepal. The following calculation has been done through ADF Unit Root Test:

Table 1: Augmented Dickey Fuller (ADF) Unit Root Tests

Variables	Level	First Difference	Mackinnon Critical Values for Rejection of Hypothesis of Unit Root			Decision	Order of Integration
			1 Percent	5 Percent	10 Percent		
LCPI	-0.7586	-4.4598	-4.2528	-3.5484	-3.2096	Non-stationary in level but stationary in first differences	I(1)
LM2	-2.9682	-4.4598	-4.2528	-3.5484	-3.2096	Non-stationary in level but stationary in first differences	I(1)
LBD	-2.2574	-5.4058	-4.2528	-3.5484	-3.2096	Non-stationary in level but stationary in first differences	I(1)

Source: Authors' calculations.

The first step in cointegration analysis is to test the unit roots in each variable. Consequently, we apply augmented Dickey-Fuller (ADF) unit root tests on logarithms of CPI, M2 and BD (LCPI, LM_2 and LBD). From the results of ADF test, all series are stationary in first differences (Table 1). This implies that all the series are integrated of order one [i.e. I(1)]. Multivariate cointegration analysis is sensitive to lag length selection. In order to determine optimal lag length we use the automatic based on SIC, maximum length=8. The cointegration test is carried out assuming an intercept in the cointegrating equation.

Table 2: Cointegration Test Based on Johansen's Maximum Likelihood Method

Null Hypothesis	Alternative Hypothesis	Eigen Values	λtrace Rank Value	Critical Value 5%	P Values†
$H_0 : r = 0$	$H_1 : r = 1$	0.4608	27.87139	29.79707	0.0820
$H_0 : r = 1$	$H_1 : r = 2$	0.1595	7.488300	15.49471	0.5216
$H_0 : r = 2$	$H_1 : r = 3$	0.0518	1.754826	3.841466	0.1853
			λmax Rank Value		
$H_0 : r = 0$	$H_1 : r > 0$	0.4608	20.38308	21.1316	0.0634
$H_0 : \leq 1$	$H_1 : r > 1$	0.1595	5.733474	14.2646	0.6476
$H_0 : r \leq 2$	$H_0 : r \leq 2$	0.0518	1.754826	3.84147	0.1853

***Notes*:** t-values are in parentheses. ** indicates significance at the 1 percent level and * indicates significance at the 5 percent level. † MacKinnon-Haug-Michelis (1999) p-values.

Source: Authors' calculations.

The cointegrating equation is normalized for LCPI in order to interpret

the estimated coefficients (Table 2). That means 1 percent increase in money supply is associated with a 0.509 percent increase in price level in Nepal, holding budget deficit constant. If we are willing to accept these parameters as elasticity, then the results show that inflation in Nepal is moderately elastic to money supply or, conversely, money demand is elastic to inflation (with elasticity equal to 1.96, i.e., inverse of 0.509). Since the estimated coefficient with budget deficit is statistically significant, it implies that there is significant long-run relationship between inflation and budget deficit. So for the budget deficit and inflation are concerned, 1 percent increase in budget deficit is associated with a 0.0024 percent increase in price level in Nepal, holding money supply constant.

The estimated coefficient of the error-correction term in the inflation variable equation has the expected sign and it is statistically significant at the 5 percent level. The coefficients of the error-correction terms in the money supply and budget deficit equations have the correct signs (negative). However, the error-correction term is statistically significant at the 5 percent level in the money supply equation only. Its insignificance for the budget deficit variable indicates that this variable is weakly exogenous to the model.

Table 3: Summary Results from VECM

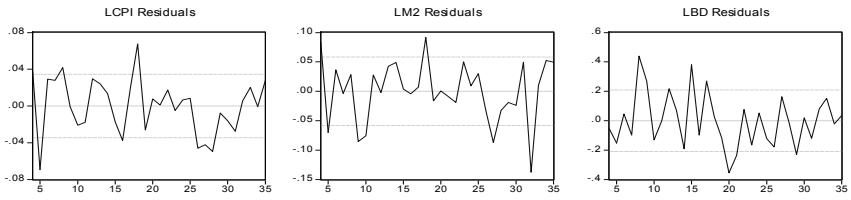
	$\Delta(LCPI)$	$\Delta(LM2)$	$\Delta(LBD)$
Constant	0.034804* (0.02100) [1.65718]	-0.023298** (0.03565) -0.65354]	-0.270691 (0.12724) [-2.12748]
ECT(-1)	-5.334887 (1.93086)	2.061937 (1.03695)	0.149910 (0.18132)
R^2	0.9986	0.9989	0.9762
Adjusted R^2	0.9983	0.9987	0.9707
S.E. of Equation	0.0345	0.05851	0.2088
F-statistics	1.9947*	1.6973*	1.3066

Notes: Standard errors in ( ) and t-statistics in [ ]. ** indicates significance at the 1 percent level and* indicates significance at the 5 percent level.

Source: Authors' calculations.

The following graph shows the nature of error terms (residuals) of three variables LCPI, LM2 and LBD.

Graph1: Residuals of LCPI, LM2 and LBD



The cointegrating relationship among LCPI, LM_2 and LBD has been

investigated using the Johansen technique. Table 3 reports results based on Johansen's maximum likelihood method. Both trace statistics (λ trace and maximal eigenvalue (λmax) statistics indicate that there is at least one cointegrating vector among the three variables. We can reject the null hypothesis of no cointegrating vector in favor of one cointegrating vector under both test statistics at the 10 percent level of significance. In addition, we cannot reject the null hypothesis of at most one cointegrating vector against the alternative hypothesis of two cointegrating vectors. Consequently, we can conclude that there is only one cointegrating relationship among LCPI, LM_2 and LBD. In sum, there is a long-run equilibrium relationship among inflation, money supply and deficit budget in Nepal.

By turning the attention towards the question of direction of causality, it contains three elements: (a) does money supply cause inflation, or does inflation cause money supply? (b) Does budget deficit cause inflation, or does inflation cause budget deficit? and (c) does money supply cause budget deficit, or does budget deficit cause money supply?

The results of Granger causality in Table 4 reveal a unidirectional causality running from money supply (LM_2) to inflation (LCPI) and budget deficit (LBD) to inflation (LCPI). This result confirms our previous finding that a positive cointegrating relationship exists between inflation and money supply as well as inflation and budget deficit (LBD). Therefore, the widely accepted belief that the budget deficit tends to be inflationary seems to be significant in case of Nepal.

Table 4: Pairwise Granger Causality Tests

Null Hypotheses	Number of Observation	F-statistics	p-value
Causality between LM2 and LCPI			
LM2 does not Granger cause LCPI	34	9.11626	0.0050**
LCPI does not Granger cause LM2		1.54870	0.2227
Causality between LBD and LCPI			
LBD does not Granger cause LCPI	34	9.76488	0.0038**
LCPI does not Granger cause LBD		2.44021	0.1284
Causality between LBD and LM2			
LBD does not Granger cause LM2	34	1.32330	0.2588
LM2 does not Granger cause LBD		1.81486	0.1877

Note: ** indicates the rejection of the null hypothesis at the 1 percent significance level.

Source: Authors' calculations.

Finally, the result shows no causation between budget deficit and money supply. There is a lack of empirical support for the accommodation hypothesis in Nepal. However, fiscal sector is not dominant in Nepal in explaining price movements. The empirical findings of the study suggest that the policy of reducing inflation should shift from budget deficit reduction to other macroeconomic determinants of inflation.

CONCLUSION

Public sector deficits have a bad reputation because, among other things, it is believed that sooner or later the government will resort to money creation, and hence, to inflation, in order to finance the deficit. That is why inflation is generally associated with monetary expansion. Nepal has been grappling with inflationary pressures of varying intensity during last 35 years. The immediate cause of inflation is associated with higher money supply, developments in monetary stance are indicative of other sectors of the economy. It is by and large claimed that budget deficits might have played an important role in explaining price fluctuations in Nepal.

This study indicates that inflation in Nepal is mainly attributable to an increase in money supply as well as budget deficit. There is significant long-run relationship between inflation and money supply as well as inflation and budget deficit. Furthermore, there is no any evidence which suggests that changes in budget deficit leads to changes in monetary expansion in Nepal.

WORKS CITED

Akcay, E. abd Alper, E.C. and Ozmucur, S. (1996). *Budget Deficit, Money Supply and Inflation*. Evidence from Low and High frequency Data from Turkey, Bogazici University Research Paper.

Agha, A.I. and Muhammad, S.K. (2006). *An Empirical Analysis of Fiscal Imbalances and Inflation in Pakistan*. SBP Research Bulletin, **2**(2), 343-362.

Ansen, H. and Juselius, K. (2002). *CATS IN RATS, Cointegration Analysis of Time Series*. Estima Evanston, IL.

Baldini, A. and Marcos, P.R. (2010). *Fiscal and Monetary Anchors for Price Stability: Evidence from Sub-Saharan Africa*. IMF Working Paper WP/08/121, Washing DC.

Bilquees, F. (1988*). Inflation in Pakistan: Empirical Evidence on the Monetarist and Structuralist Hypotheses*. The Pakistan Development Review, **27**(2), 109-129.

Bilquees, F. (2003). *An Analysis of Budget Deficits, Debt Accumulation and Debt Instability*. The Pakistan Development Review, **42**(3), 177-195.

Catao, L. and Terrones M. (2003). "Fiscal Deficits and Inflation: A New Look at the Emerging Market Evidence". IMF Working Paper, No. 65, International Monetary Fund, Washington, DC:

CBS, (2009). *Statistical year Book*. Kathmandu, Nepal.

Chaudhary, M.A. and Naved A. (1995). *Money Supply, Deficit and Inflation in Pakistan*, The Pakistan Development Review, **34**(4), 945-956.

Cochrane, J. (2000). *Money as Stock: Price Level Determination with no Money Demand*. NBER Working Paper No. W7498 MA: MIT Press, Cambridge.

De Haan, J. and Dick, Z. (1990). "The Impact of Government Deficits on Money Growth in Developing Countries." *Journal of International Money and Finance,* **9**(4), 455-469.

Durevall, D. and Ndung'u, N.S. (2001), *A Dynamic Inflation Model for Kenya,* 1974-1996", *Journal of African Economics,* **10**(1), 92-125.

Dutta, D. and Nasiruddin A. (1997),. *An Aggregate Import Demand Function for Bangladesh: A Cointegration Approach*, Working Paper, No. 9703, Department of Economics and Business, University of Sydney, Sydney.

Economic Survey. various issues, The Government of Nepal, Kathmandu.

Fry, M. (1995*). Money, Interest and Banking in Economic Development*. Second Edition, Hopkins University Press, Johns.

Hilbers, P. (2005). *Interaction of Monetary and Fiscal Policies: Why Central Bankers Worry about Government Budgets.* Paper Presented at an IMF Seminar on Current Developments in Monetary and Financial Law, Washington DC.

Johansen, S. and Katarina, J. (1990). *The Maximum Likelihood Estimation and Inference on Cointegration- with Application to Demand for Money. Oxford Bulletin of Economics and Statistics*, **52**(2), 169-210.

King, R.G. and Plosser, C.I. (1985). *Money, Deficits and Inflation.* Carnegie-Rochester Conference Series on Public Policy (22), 147-196

Laurens, B. and Enrique D.P. (1998). *Co-ordination of Monetary and Fiscal Policies*. IMF Working paper WP/98/25, Washington, D.C.

Leeper, E.M. (1991). "Equilibria under Active and Passive Monetary and Fiscal Polices. *Journal of Monetary Economics.* **27**(1), 129-147.

MacKinnon, J.; Alfred, A.H. and Leo, M. (1999). "Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration." *Journal of Applied Econometrics,* **14**(5), 563-577.

Miller, P.J. (1983). *Higher Deficit Policies Lead to Higher Inflation*. Federal Reserve Bank of Minneapolis, Quarterly Review, Vol. 7, 8-19.

Neyapti, B. (1998). *Budget Deficits and Inflation: An Analysis in the Light of Roles of Central Bank Independence and Financial Market Development*. Working Papers, No. 997, Department of Economics, Bilkent University, Ankara.

Odhiambo, N.M. (2011). *Financial Liberalization and Financial Deepening: Evidence from Three Sub-Saharan African Countries*. African Review of Money, Finance and Banking (Savings and Development Supplement), **19**(1), 5-23.

Shabbir, T. and Ayaz, A. (1994). *Are Government Budget Deficits Inflationary? Evidence from Pakistan.* The Pakistan Development Review, **33**(4), 955-967.

Sims, C.A. (1994). *A Simple Model for Study of the Determination of the Price Level and the Interaction of Monetary and Fiscal Policy*. Economic Theory (4), 381-399

Solomon, M. and Walter, A.D. (2004). *The Effect of a Budget Deficit on Inflation: The Case of Tanzania*. SAJEMS NS, **7**(1), 100-116.

Walsh, E.C. (2003). *Monetary Theory and Policy*. The MIT Press, Cambridge Massachusetts

Woodford, M. (1995). *Price Level Determinacy without Control of Monetary Aggregates*. Carnegie-Rochester Conference Series on Public Policy (43), 1-46.