The Impact of Fiscal Deficit on Long-term Nominal Interest Rate in Nepal

Rajendra Pandit[*]

Growth of debt stock, changes in the debt composition, ownership structure of government debt and movement of interest rate on debt have been observed since the very beginning in Nepal. Public debt issues have been more and more market oriented and secondary market activities for short-term securities have expanded in recent years. Presently, the amount of debt service payment which exerts pressure on government budget constitutes more than one fourth of the total government expenditure. The theoretical prediction about the relationship between interest rate and government debt is still a matter of controversy. Empirical evidence of other countries on the relationship between interest rate and public debt has become inconclusive. This paper examines the relationship between long-term nominal interest rate and budget deficit variables in Nepal. The study finds the evidence that there exists positive but insignificant relationship between long-term nominal interest rate of government securities and budget deficit variables.

I.   INTRODUCTION

Background

As the revenue surplus has not been adequate to meet the development expenditure, the deficit budget has remained the prime feature of Nepalese fiscal policy. As such, since foreign grant only could not cover the deficit, foreign and internal loans have been mobilised. Therefore, the value of total loan has been rising and the burden of debt services has been increasing year by year. This situation leads the government to become more and more indebted both in the foreign and internal side. Budget deficit as a ratio of gross domestic product (GDP) increased from about 1 percent in 1971 to more than 3.5 percent in recent years. Similarly as a percentage of GDP, the outstanding domestic loan has also sharply increased from less than one percent in 1971 to 17.9 percent in 2003. Debt services (including both principal and interest payment) have also been increasing and it forms about 29.4 percent of government regular expenditure.

The stock of public debt has always shown an upward trend since the very beginning, while a mixed performance has been observed in the movement of the

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[*] Deputy Director, Research Department, Nepal Rastra Bank.

interest rate on government securities. The short-term interest rate on 91-day Treasury Bills (TBs) has been highly fluctuating. It reached as high as 11.6 percent in 1996, but sharply fell to 2.5 percent in the very next year. The interest rate on long-term securities reached as high as 15.5 percent in 1991 and around 7.0 percent in the recent years. The behaviour of interest rate on government securities is yet to be explained. This paper tries to detect whether or not the government fiscal deficit was responsible for the high interest rate during that period.

Prior to 1988, the Nepalese government was able to mobilize internal loan at non-competitive rates largely by non-marketable instruments. TBs are the only marketable government instruments, which is now sold on auction basis whereas long-term securities like Citizen Investment Certificates and National Saving Certificates are still sold on fixed interest rate basis determined by the government. Now, the public debt management has become more and more market-oriented and secondary market activities have expanded in the recent years. Competitiveness in such market has also been improved. Therefore, the empirical issue of budget deficit and interest rate has become crucial for Nepal. Finding the determinants of interest rates on government internal loan helps the central bank to take appropriate policies in maintaining the desired level of interest rate.

Thus, the objective of the paper is to analyse the relationship between fiscal policy and the interest rate on internal debt in general. This paper focuses on budget deficit and internal loan outstanding to their relationships with long term nominal interest rate in particular.

The structure of this paper is as follows. The second section of Part I briefly reviews the economic theory regarding fiscal deficit and interest rate followed by the literature review on its empirical evidence. Part II presents the overview of public debt and interest rate in Nepal. Part III describes the data series and gives the visual impression of the data. The formulation of the model and the empirical results are presented in Part IV followed by the conclusion in Part V.

Economic Theory

The economic impact of fiscal policy has been the subject of much controversy. The first controversial issue regards the relationship between government deficits with saving, interest rate and capital accumulation (see Knot and Haan, 1995). Most of the economists (for instance Modigliani and Jappelli (1988) in Knot and Haan) believe that government deficits lead to a rise in interest rates and rates of capital accumulation. However, a few economists (Barro, 1974) reason that a government deficit will be matched by a parallel shift in private saving, and deny any influence from government deficit on interest rates.

It is obvious that when the government spends more than it collects in the form of taxes, it must finance the deficit either by selling securities or issuing base money. Deficit can affect interest rates and inflation both directly and indirectly. An increase in government spending or a decrease in taxes both tends to increase demand for consumption and investment directly. This effect is partly offset by the

high supply of government securities to finance the deficit. This tends to increase real interest rates and private spending that is sensitive to interest rates may be crowded out.

A budget deficit may increase demand indirectly because it is associated with expansionary monetary policy. If the central bank purchases government securities, it issues base money that increases supply of money, which enables the private sector to increase the demand for goods[1].

The most widely used conventional macroeconomic paradigm is the IS-LM model. Its widespread use reflects not merely that it is analytically tractable but also many economists generally agree with its structural assumptions and implications. Increase in government spending financed by bonds tends to shift the IS curve to the right and this increases the interest rate and income.

For instance as shown in the figure below, an increase in government spending financed by a sale of bonds shifts the IS_0 curve to IS_1. Private spending is crowded out by this transaction effect. The magnitude of this crowding out effect is measured by the distance from Y_0 to Y_1, which depends on the interest rate change from r_0 to r_1. This is called financial crowding out. The increase in the quantity of bonds that financed the deficit spending causes portfolio adjustment in the financial markets. If bonds are considered as net wealth, over the time wealth increases, the demand for money increases and the LM curve shifts to the left. This causes the interest rates to rise to r_2 and depending on the magnitude of this increase, private spending is again crowded out. When these two crowding out effects are taken, they indicate that the effect of deficit spending may be ambiguous on national income, while rate of interest definitely rises (Hoelscher, 1983).
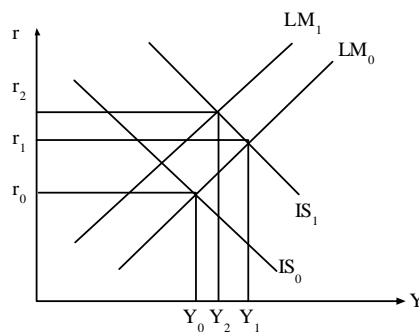
Traditional IS-LM analysis examines the total impact of an increase in government spending by shifting the IS curve to the right. In the basic Hicks-Keynes model, with exogenous taxes and a fixed money supply, the implicit assumption must be that bond sales are used to finance the deficit expenditure. Silber (1970) argues that an increase in bond supply, *ceteris paribus*, would raise interest rates since the public must be induced to increase its holdings of bonds

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[1] Dewald (1983) described these effects as real balance effect and the money multiplier effect.

relative to money. If there was equilibrium at the old rate of interest, the increase in bond supply must raise the rate of interest.

But the economic effects of fiscal policy have not been far from controversy. Some economists argue that a government deficit will be matched by a parallel shift in private saving. The Ricardian Equivalence Theorem, as revitalised by Barro (1974, 1990), concludes that fiscal effects involving changes in the relative amounts of tax and debt finance for a given amount of public expenditure would have no effect on aggregate demand, interest rate and capital formation. Barro argues that the method of financing government spending (taxes or borrowing) has no impact on wealth, once discounted future tax liabilities are considered. Hence if wealth effects were the mechanism through which deficit should affect interest rates, then the effect would be negligible.

Nevertheless, a positive relationship between deficit and interest rates seems a trivial application of supply and demand theorem in economics. If the deficit increases, everything else remaining the same, the price of government bonds falls and the interest rate rises.

Empirical Evidence

The Ricardian and the standard views have different predictions about the effects of fiscal policy on a number of economic variables. The Ricardian view predicts no effect of budget deficit on interest rate, whereas the standard view predicts a positive effect at least in the context of a closed economy.

Many writers have examined on empirical grounds whether there is any relationship between budget deficit and interest rates. So far the evidence is far from conclusive. It appears that the relationship between government budget deficit and the interest rate is not very stable over time. Knot and Haan (1995) studied the fiscal policy and interest rate in the European Community over the period from 1960 to 1989. They conclude that in the European Community persistent deficits have exercised an upward pressure on interest rates thereby contradicting the Ricardian proposition of the neutrality of deficit financing. However, their finding indicates that there is also evidence in support of partial tax discounting. Hoelscher (1986), by studying the US annual data from 1953 to 1984, shows strong support of the correlation of large deficit with ten-year treasury bonds rates. However, the relationship between deficit and short-term interest rate may be tenuous. But Hoelsher (1983) using the quarterly US data for the period of third quarter of 1952 to the second quarter of 1976 shown that there is no significant relationship between federal borrowing and short-term interest rates (3-month TBs rate) and concludes that federal borrowing is a relatively unimportant determinant of short term rates. Evans (1985) has demonstrated no association between large deficit and high interest rate by examining over a century of US history of large deficit, during the war time. Evans (1987) also finds similar results for nominal yields with quarterly data from 1974 to 1985 for Canada, France, Germany, Japan, the United Kingdom, and the United States.

Dewald (1983) examined the US quarterly data from 1953-1981 and argues that deficit in themselves has not been a critical factor in high real interest rates. Also after averaging the data for full peak-to-peak business cycles to eliminate cyclical influences, he found no strong historical association between real interest rate and real deficit.

Ford and Laxton (1995) estimated the effect of fiscal deficit in nine industrialised countries of OECD since 1970 and finds that fiscal development was responsible for the rise in real interest rates in all of these countries.

Mascaro and Meltzer (1983) studied the determinants of three month and ten-year interest rates over the period from the fourth quarter of 1969 to the second quarter of 1981. Their results indicate no significant effects of the deficit on either long term or short-term interest rates. Dewald (1983) analysed the effect of real deficit on short and long term interest rates, using quarterly post-war data. He also finds that the real deficit is only marginally important in explaining real interest rates and concludes that budget deficit account for very little of recent high real interest rates. This has led some authors to argue that the linkage between fiscal policy and assets returns has to be considered from a global instead of a national perspective. Tanzi and Lutz (1991) pose that the government's budget deficit should be analysed from a global perspective in view of the increasing international capital mobility and the growing integration of financial markets.

II. Overview of Public Debt and Interest Rate in Nepal

Government budget was introduced in 1952 for the first time in Nepal and it was a deficit budget. However the system of public debt was introduced in 1961. The main objectives of mobilizing public borrowing were regarded as the people's participation in country's development and persuading the people for savings. So it seems that at that time people and the government were not so much concerned about the determination of interest rate of the government debt.[2] The first internal loan was collected from Nepal Rastra Bank (Central Bank of Nepal) in the form of TBs amounting to Rs 7 million at a very nominal rate of interest of one percent. Since then issuance of long-term bonds also started in the name of Development Bonds, National Saving Certificate, Special Bond, Land Compensation Bonds, Forest Compensation Bond, Non-Interest Bearing Prize Bond and Citizen Investment Bonds. At present, the most common means of government debt are TBs for short-term loan and National Saving Certificate and Citizen Investment Bonds for the long term.

The demand for funds whether originating in the public or in the private sector can be met by both domestic and foreign sources. Funds may be obtained in the form of grants and loans. Although a significant feature in the fiscal front over the

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[2] In the preamble of the Public Debt Act, 1960 and the Public Debt Regulation, 1963 the objective was stated as "to encourage the saving by issuing the securities for the economic development and progress of the country."

last several years has been the heavy reliance on foreign sources in financing the budget deficit, the relative share of funds from domestic sources for deficit financing increased considerably in relation to foreign sources of funds. Domestic funds are obtained primarily from the market sources, which consists of both private and banking sector including the central bank.

Short-term and Long-term Securities

TBs are one of the popular means of government borrowing for the short term. However it can be sold for the longer maturity. Before 1988 TBs were sold on a fixed interest rate. The administered interest rate was one percent at the beginning (in 1962) and maximum of five percent in 1988. TBs are now sold at a discount rate and the face value is paid to the holder on maturity. The spread between selling price and payment of full face value is known as the yield on the investment. Because of competitiveness and short term maturity this type of securities is usually confined to institutional investors like banks, finance and insurance companies. The operation of TBs is governed by the Public Debt Act 1961 according to which the amount of securities to be issued for any fiscal year is fixed in the Budget Speech. And then, Nepal Rastra Bank, on behalf of the government, issues the bills, all at a time or in instalments, depending upon the directives of the Finance Ministry. The Ministry, observing the budgetary and general economic situation of the country, fixes the amount, interest rates, and maturity of the bills. The interest rate used to be fixed at a lower level—lower than saving deposit rates or three month fixed deposit rates. As a result, the bulk of the TBs used to remain under subscribed in the primary issue and NRB had to own them as a manager of those issues. So from the beginning, the NRB has been holding a substantial part of the government borrowing. The auction system of TBs on the weekly basis was started in November 1988 and since then the interest rate is being determined by the market forces. In order to make the securities market active and attractive, the NRB has started to operate secondary market for TBs since 1995.

Development Bonds, National Saving Certificates and Citizen Investment Certificates are regarded as long-term government bonds to mobilize the domestic resources. These bonds give rather higher yields and are very popular in public. The government has issued these types of securities with a maturity period ranging from 3 years to 15 years. The interest rate of these bonds is still administered which is determined by the government. These securities usually offer high interest rates and focus on absorbing savings of individuals and non-profit making institutions. The instrument aims at reducing the gap between banking and non-banking sectors' investment on government securities.

As per practice, the volume of internal loan for any fiscal year is fixed by a "Bill to collect Internal Loan". However, the Open Market Operation Committee (OMOC) consisting of members of the NRB and the Ministry of Finance decides on the volume and instrument that is to be sold at any particular time.

Interest Rate

The operations of the Nepalese financial system prior to 1988 reflected the outcome of extensive government (or central bank) interventions. As a part of economic liberalisation policy, in 1989, control over the interest rate policy was removed. Since then, the interest rate on short-term government securities has been determined by market forces; however, the government still administers the interest rate on long-term bond.

Likewise, after the interest rate liberalisation, it has been observed that the commercial banks are cartelling in the determination of interest rate. As a result, deposit rates declined faster than the lending rate resulting in a wider spread between deposits and lending rates of commercial banks. The NRB issued the first ever directives to the commercial banks to increase deposit rates effective from 1966 with a view to attract savings into the banking sector and to make the deposit rate structure competitive with that of India. Accordingly, the minimum interest rate on saving deposit was fixed at 4 percent and on fixed deposit of one year or more at 6 percent per annum. In 1974, the Nepalese price situation along with the exploding world price due to the oil price hike moved upward and inflation was recorded as high as 18 percent. This resulted in a negative real interest rate on savings discouraging deposit mobilisation. Therefore, the rate on saving deposit was raised to 8 percent, rates on three month fixed deposit to 4 percent and one-year deposit was increased to 15 percent. In 1984, the NRB granted partial autonomy to the commercial banks in determining the rates of interest on saving and time deposit i.e. free to deviate to the extent of 1.5 percentage points from the rate given by the NRB. Few changes were made in 1986 and the commercial banks and financial institutions were set free in fixing the interest rates on their deposit rates above the directed minimum interest rate. The minimum interest rates were 8.5 percent on saving deposit and 12.5 percent for one year fixed deposit. In 1989, some major policy changes were made on the interest rate. Interest rate were completely liberalised and banks and financial institutions have been given full autonomy to determine their interest rates on deposit and lending on their discretion. Since then, the administered interest rate regime has ended and interest rates is being determined by the market forces, i.e. supply and demand for the fund.

Ownership Pattern of Government Debt

The overview of ownership structure of government debt is important for the study of the relationship between interest rate and government securities. Private holding of debt would reduce the money supply, but on the other hand, when the central bank purchases government securities it creates the high-powered money which builds up an inflationary pressure by increasing money supply in the economy. The government is seemed more keen to sell the securities to the central bank to minimise the interest bearing debt. The following table shows the ownership structure of government bonds.

TABLE 1. Ownership Structure of Government Bonds (Amount in Million Rupees)

Year	Total Govt. Bonds (5-year average)	Nepal Rastra Bank (%)	Commercial Banks (%)	Others (%)
1975-79	996	57	27	16
1980-84	2411	56	31	12
1985-89	9349	54	28	18
1990-94	23030	46	33	21
1995-99	38053	48	24	28
2000-03	72769	30	43	27

Source: Ministry of Finance.

As long as the central bank keeps on holding the government bonds, this encourages the government to issue more bonds. This will lead to a rise in the inflation rate in the country. As the central bank dominates in market, the interest rate on the government securities will become less competitive. Table 1 illustrates that the NRB has been the major owner of the government bonds. Currently, it is still holding about 30 percent of the total outstanding government bonds. This means that the government has about 70 percent interest bearing debt. Despite several efforts of the NRB to contain the volume of government debt stock held by it at par with the mandated benchmark, it is unlikely that the NRB would succeed in reducing its holdings to the stipulated limit.

Nepal Rastra Bank Act 2002 limits the holding of government debt stock within the 10 per cent level of previous year's adjusted government revenue. The NRB is trying its best to contain the holdings to the mandated level and reducing its holding in the recent years. It is selling the securities through the secondary markets to reduce the holdings; therefore, the volume of stock is declining.

Against the earlier practice, when the NRB used to buy unsold government securities, it has now decided not to purchase the unsold debt stocks from the primary market. This will help scale down the holdings to the desired level.

III. DATA ANALYSIS AND VISUAL IMPRESSION

Data Sources and Definition

The main sources of the data for this study are the *International Financial Statistics*, International Monetary Fund; *Quarterly Economic Bulletin* of Nepal Rastra Bank; and *Economic Survey* of Ministry of Finance, His Majesty's the Government of Nepal. The sample period is 1971 through 2003 and the frequency of the data is annual. So, there are 33 observations in the sample. The data set for this study comprises:

$RL =$ Long-term nominal interest rate,
$bd =$ Budget deficit as a ratio of nominal GDP,
$ol =$ Outstanding internal loan as ratio of nominal GDP,
$cpi =$ Log of consumer price index,
$\Delta cpi =$ Inflation rate,
$cb =$ log of Central Bank holding of Government Bonds and
$rgdp =$ Log of real GDP.

Measuring the Deficit

The major problem in this type of analysis is to measure the government deficit. There are some disagreements about the proper measure of government deficit. Different writers suggest and apply different measures in their studies. Hoelscher (1986) has applied three different measures of fiscal deficit[3]. He found that all these three measures are highly correlated and the results are not significantly different. As the present paper focuses on the internal borrowing side of the fiscal deficit, two measures of fiscal deficit have been presented to measure the deficit. These measures are fiscal deficit and outstanding internal borrowing and these are plotted in Figure 1 for the period 1971 to 2003. Both show an upward trend and depict a sharp growth after 1985. However outstanding internal loan has grown faster than the budget deficit. Outstanding internal loan is becoming higher in recent years. From the figure, it is noticed that these two measures are highly correlated.

FIGURE 1. Relationship between Budget Deficit and Internal Loan Outstanding (Log)

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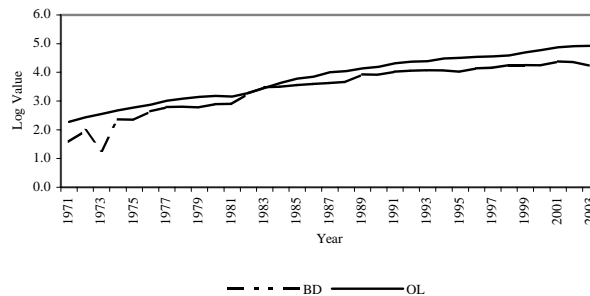
[3] Hoelsher (1986) developed and applied three different measures of fiscal deficit. The first measure of government deficit (USDEF) is expressed in per capita dollars. The second measure of government deficit include borrowing by state and local government as well as federal borrowing on a national income account basis. And the third alternative measure of the deficit subtracts depreciation in the stock of publicly held bonds from explicit federal government borrowing.

Correlation among the variables has been calculated. The result is shown in correlation matrix in Table 2 below.

TABLE 2. Correlation between Budget Deficit and Internal Loan Outstanding (Correlation Matrix)

|	Budget Deficit	Internal Loan Outstanding
Budget Deficit	1.00	0.98
Internal Loan Outstanding	0.98	1.00

As seen in Table 2, the correlation coefficient between budget deficit and outstanding internal loan is 0.98. This suggests that one can use any of the variables to examine the relationship with interest rate. However, these variables are expressed as percentage of current GDP of corresponding year to see the real magnitude of their growth. So, the budget deficit and internal loan outstanding as a ratio of GDP are used in the regression analysis in Part IV.

Table 3 demonstrates the correlation between these variables after taking their ratios to GDP. The interesting point to note here is that the correlation coefficient has changed from above. The correlation coefficient for budget deficit/GDP and internal loan outstanding/GDP is still high and significant (see also Figure 2). Therefore, it can be argued that the variables used in the regression should not change the regression results significantly.

TABLE 3. Correlation between Budget Deficit and Outstanding Internal Loan (all as a percentage of GDP)

	Budget Deficit/GDP	Internal Loan Outstanding/GDP
Budget Deficit/GDP	1.00	0.83
Internal Loan Outstanding/GDP	0.83	1.00

FIGURE 2. Relationship between Budget Deficit and Internal Loan Outstanding (both as percentage of GDP)
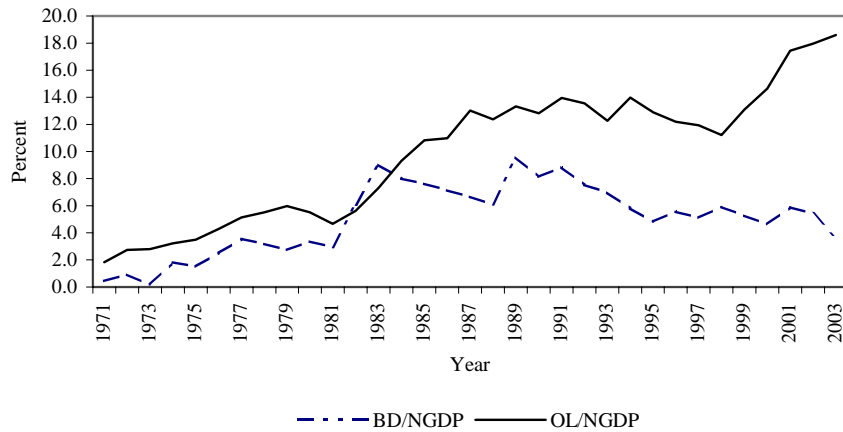
Visual Impression of the Data

The first step in the empirical analysis is to gather a visual impression of the data followed by more formal testing of the order of integration. Three graphs are depicted to see the relationship between deficit variables as well as NRB's holding of bonds, consumer price index and real GDP.

In Figure 3, we demonstrate the movement of long-term nominal interest rate and budget deficit (as percentages of NGDP). As it can be seen, these two variables exhibit similar trend over the period.

FIGURE 3. Long-term Interest Rate and Budget Deficit (as percentage of NGDP)
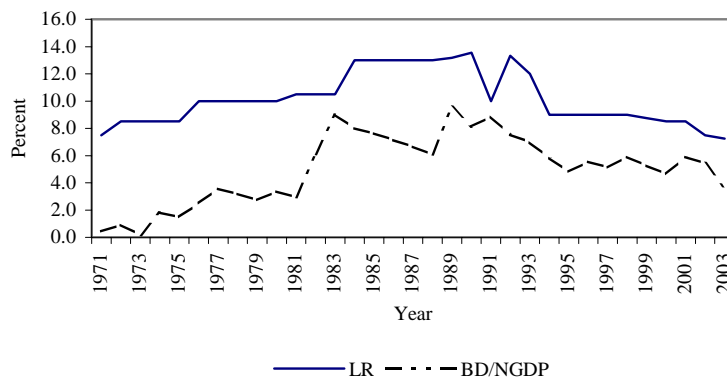
In Figure 4 below, we graph nominal interest rate and internal loan outstanding. It can be observed that there exists somewhat a close relationship between interest rate and internal loan outstanding; nonetheless, the relationship is not as strong as above.

FIGURE 4. Long-term Nominal Interest Rate and Outstanding Internal Loan (as a percentage of NGDP)
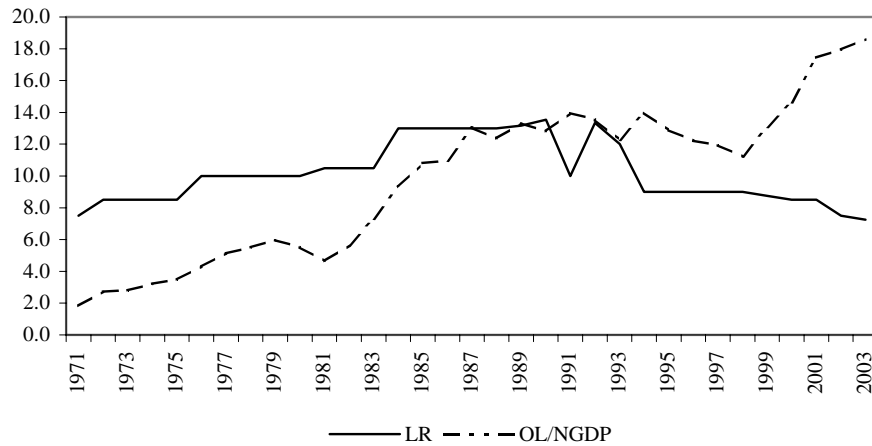
Likewise in Figure 5, we depict long-term nominal interest rate with log of NRB's holding of government securities, log of consumer price and log of real GDP. Consumer price index, NRB's holding of government securities and real GDP have shown the stable movement whereas long-run interest rate has shown some fluctuations since 1984/85.

FIGURE 5. Long-term Interest Rate, Log of Consumer Price Index, Log of Central Bank Holding of Government Bonds and Log of RGDP
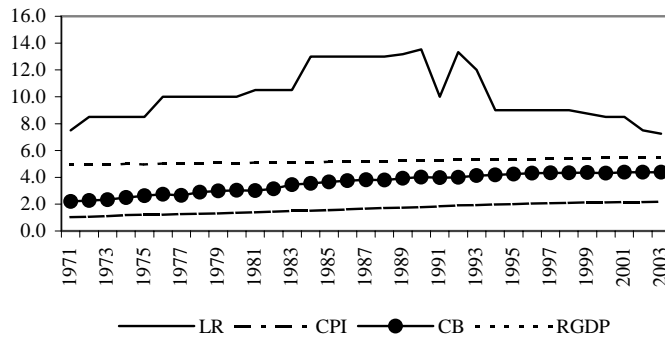
IV. MODEL SPECIFICATION AND EMPIRICAL RESULTS

Model Specification

In the following section, a loanable funds model of the interest rate is developed. This approach is related to the IS-LM model of the interest rate, but it has a distinct advantage for the purpose of this study. In particular, the loanable funds model highlights the direct connection between government borrowing and interest rates where as the IS-LM model only shows this connection indirectly. The model that is used here is adopted from Hoelscher (1983, 1986)

As it is well known, equilibrium in the IS-LM model implies bond market equilibrium because of Walras law. The bond market equilibrium requires that the private sector's excess demand for bonds is equal to the public sector's excess supply of bonds. Equation (1) is the flow version of this equilibrium condition.

$$BD - BS = D - M \qquad (1)$$

where
BD = real private sector bond demand,
BS = real private sector bond supply,
D = real borrowing by the government, and
M   = the real purchase of securities by the central bank

The following behavioural relationship is proposed for the study

$$BD = BD(i, p, y) \qquad (2)$$
$$BD_1 > 0, BD_2 < 0, BD_3 < 0$$
$$BS = BS(i, p, y) \qquad (3)$$
$$BS_1 < 0, BS_2 > 0, BS_3 < 0$$

where i is the nominal interest rate, p is the rate of inflation and y is the income or economic activities.

Equation (2) implies that the private sector's demand for bonds reacts positively to the interest rate, negatively to the inflation rate and negatively to the economic activities.

Equation (3) signifies that the supply of bonds should react negatively to the interest rate and positively to the rate of inflation. In addition, as economic activities decline, the supply of bonds offered by the private sector should also diminish because of the falling credit demand in business sector.

When (2) and (3) are substituted into (1) a reduced form equation with the interest rate as the dependent variable can be derived. The above equation determines the interest rate if p, y, d, m are exogenously determined.

Solving to equation (1) and linearzing yields:

$$i = i(P, Y, D, M) \qquad (4)$$

Therefore, the functional form of the estimating equation for this study is written as:

$$i_t = \alpha + \beta_1 p_t + \beta_2 y_t + \beta_3 d_t + \beta_4 m_t \qquad (5)$$

Here, p represents inflation rate, y represents income, d represents fiscal policy variables and m represents the central bank holding of government securities. In this study GDP is taken as a proxy for income and budget deficit whereas internal loan and outstanding internal loan are taken separately to test the relationship for the fiscal policy variables.

Examination of equation (4) or (5) reveals that the following partial derivatives or sign of the coefficients should be expected

$$i_1(\beta_1) > 0, i_2(\beta_2) >< 0, i_3(\beta_3) > 0, i_4(\beta_4) < 0 \qquad (6)$$

The interest rate should rise with an increase in inflation because the bond demand decreases while bond supply increases. The effect of cyclical economic activities on the interest rate is theoretically ambiguous because both the supply and demand of private bonds should fall as the economic activities increase. However Tanzi (1980) reports that i_2 is negative. He theorises that business borrowing is much more sensitive to a decline in economic conditions than consumer lending.

The effect of government borrowing on interest rates should of course be positive. The purchase of government securities by the central bank offset government borrowing and because of the usual loanable funds liquidity effect, i_4 should be negative.

Equation (4), (5) and (6) comprise the interest rate model which is tested in this study. This loanable funds version of interest rate determination allows the direct effects of government borrowing on interest rates to be modelled. In the section the hypothesis embodied in (4) or (5) and (6) are tested by regression analysis. The main concern is the significance and the size of the government borrowing effect on short-term as well as long term interest rate.

Estimations and Empirical Results of the Study

The first part of this section analyses the test of stationarity of the variables used for this study where as the second part presents the empirical results of the study.

Unit Root Analysis

A meaningful econometric estimation of a model using time series data requires that the data series should be stationary. According to Granger and Newbold (1974), econometric estimation using non-stationary time series data often leads to spurious results. A static regression will generally be subject to considerable serial correlation and will give rise to inconsistent estimates of the standard errors of the parameters. On the other hand, the non-stationary in the data series would lead to produce nuisance parameters. In both the cases, this would lead to wrong conclusions. In either case, the standard errors produced by Ordinary Least Squares (OLS) regression are biased and valid inferences cannot be drawn. In the presence of unit root, we cannot use standard regression model because these data do not satisfy the usual assumption of econometric theory of constant mean and variance. So, to avoid the spurious regression of econometric estimation using non-stationary time series, we take differenced times of the level of the series. Moreover, we have to analyse the order of integration of each variable whether they present a stochastic trend in order to apply the co integration and ECM (error correction mechanism) methodology. Therefore the most commonly used Dicky-Fuller (DF) and Augmented Dicky-Fuller (ADF) univariate test are employed to test the null hypothesis of a unit root against the alternative that the process is stationary. Theoretically, DF and ADF equations are estimated in this form:

$$X_t = \alpha + \beta_0 X_{t-1} + \delta T + \mu_t \text{ (for the DF test)}$$

$$X_t = \alpha + \beta_0 X_{t-1} + \sum_{i=1}^{k} \beta_i X_{t-1} + \delta T + \mu_t \text{ (for ADF test)}$$

Here, the null hypothesis (H_o) is $\hat{\beta}_o = 1$

Based on the above theoretical knowledge, the unit root test has been carried out and the test results are shown in the Table 4(A) and 4(B). Null Hypothesis (H_0) is unit root.

TABLE 4 (A) Testing for Unit Root of the Variables in Level Form

Variable	Mackinnon Critical value		ADF Statistics	Comments
	1%	5%		
cpi	-4.2605	-3.5514	-1.2980	Cannot reject H_o
cb	-4.2605	-3.5514	-0.4636	Cannot reject H_o
bd	-4.2605	-3.5514	-1.1359	Cannot reject H_o
ol	-4.2605	-3.5514	-1.7695	Cannot reject H_o
LR	-4.2605	-3.5514	-1.1610	Cannot reject H_o
rgdp	-4.2605	-3.5514	-3.1571	Cannot reject H_o

From the above results, we cannot reject the null hypothesis of non-stationary in level of consumer price, central bank holding of bonds, budget deficit, internal loan outstanding, long term nominal interest rate and real GDP. Further testing of non-stationary from ADF test is to take the first difference of the variables. The result of this test is summarized in the Table 4(B).

TABLE 4 (B) Testing for Unit Root of the Variables in First Difference

Variable	Mackinnon Critical value		ADF Statistics	Comments
	1%	5%		
Δcpi	-4.2605	-3.5514	-3.9947**	Reject H_o
Δcb	-4.2605	-3.5514	-5.8086*	Reject H_o
Δbd	-4.2605	-3.5514	-4.3588*	Reject H_o
Δol	-4.2605	-3.5514	-3.2295***	Reject H_o
ΔLR	-4.2605	-3.5514	-6.3799*	Reject H_o
$\Delta rgdp$	-4.2605	-3.5514	-5.8664*	Reject H_o

* denotes rejection of H_o at 1 percent level
** denotes rejection of H_o at 5 percent level
*** denotes rejection of H_o at 10 percent level.

All explanatory variables are stationary at the first difference. Therefore, the regression equations of long term nominal interest rate with the explanatory variables at first difference have been estimated. Since all the variables are in the same order of integration, we could use the cointegration relationship in such a case. A formal test of cointegration has been carried out based on the approach proposed by Engle-Granger (1987) while modelling long-term nominal interest rate.

Cointegration Analysis

In this paper, the Engle-Granger methodology has been used to test the cointegration and to produce a long run equilibrium relationship among the variables. Engle and Granger (1987) propose the following straightforward procedures.

The first step is to pre-test each variable to determine its order of integration. The Dickey-Fuller and/or Phillips-Perron test can be used to infer the number of unit root in each of the variables.

The second step is to estimate the long run equilibrium relationship. If the result of step 1 indicates that all the variables of interest are of the same order of integration, say I(1), then the static regression has to be run to estimate the long run equilibrium relationship in the form

In order to determine if the variables are actually cointegrated, we save the residual of the static equation and test the order of integration of it. If it is found to be I(0), we conclude that the variables are cointegrated and there exist a long run relationship among the variables. Therefore, the residual from the equilibrium regression can be used as an additional repressor to estimate the error correction model.

If the variables are cointegrated, an OLS regression yield a 'super consistent' estimator of the cointegrating parameter of β. Stock (1987) proves that the OLS estimates of β converge faster than in OLS models using stationary variables.

TABLE 5. Testing for Order of Integration of Residuals

Variables	Mackinnon Critical Value		ADF Statistics	Comments
	1%	5%		
Res_bd (ecm(bd))	-3.6576	-2.9591	-4.2707**	Reject H$_o$
Res_ol (ecm(ol))	-3.6576	-2.9591	-5.0107**	Reject H$_o$

** denotes rejection of H$_o$ at 1 percent level and
* denotes rejection of H$_o$ at 5 percent level.

In Table 5, Res_bd (ecm(bd)) = residual obtained from regressing long-term nominal interest rate using budget deficit and
Res_ol (ecm(ol)) = residual obtained from regressing long term nominal interest rate using outstanding internal loan.

The residual from static regression is found to be I(0), therefore the residual can be included as a regressor (i.e., as error-correction term) in place of the level terms of cointegrating variables in the estimation of short-run dynamic of interest rate. The error correction mechanism has been used to estimate the dynamic equation of short term and long-term nominal interest rates.

To estimate the dynamic equation of nominal interest rate, the following static regressions have been estimated and each residual has been saved separately.

Using budget deficit

$$LR = 17.12 + 34.65bd + 2.70cb - 5.34cpi - 0.88rgdp \ \text{.......(ecm(bd))} \quad (7)$$
$$\quad\quad (0.40) \quad (2.14) \quad\quad (2.79) \quad\quad (1.95) \quad\quad (0.21)$$

$$R^2 = 0.74 \quad \text{Adjusted } R^2 = 0.70 \quad Se = 1.04 \quad DW = 1.96$$

Using outstanding internal loan

$$LR = 64.13 + 22.38ol + 3.33cb - 5.21cpi - 5.35rgdp \ldots\ldots\ldots(\text{ecm(ol)}) \quad (8)$$
$$\quad (1.42) \quad (11.96) \quad (4.20) \quad (1.85) \quad (1.23)$$

$$R^2 = 0.73 \quad \text{Adjusted } R^2 = 0.70 \quad Se = 1.06 \quad DW = 2.04$$

where the numbers in parentheses below the estimated parameters are standard errors.

As far as the economic interpretation of ECM long run equilibrium (solution to the cointegrating equation) implies, in the long run elasticity of budget deficit and outstanding internal loan is quite low. The estimated signs are positive, which is according to the non-Ricardian (standard) version of economic theory. On the other hand, NRB's holding of government bonds has been seen to have a positive impact on long-term nominal interest rate, which, contradicts the economic theory. Moreover, consumer price has shown negative impact on long-term nominal interest rate, which also contradicts the economic theory.

Dynamic Estimates

The above result indicates that the cointegration among the variables of interest exists. Therefore, we can estimate the dynamic behavior of short term and long-term nominal interest rate. Hence, the dynamic model has been estimated using cointegration in the following form:

$$r_t = \alpha_0 + \sum_{i=1}^{1} \alpha_i r_{t-1} + \sum_{i=0}^{1} \beta_i d_{t-i} + \sum_{i=0}^{1} \gamma_i cb_{t-i} + \sum_{i=0}^{1} \delta_i cpi_{t-i} + \sum_{i=0}^{1} \eta_i y_{t-i} + \mu ecm_{t-1}$$

Since the paper is based on annual data one year lag length has been included to examine the lag effect, which is believed to be enough for annual data. Because of the limited sample size, we could not include more than one lag in our dynamic model.

Therefore, the following parsimonious equations have been estimated, where insignificant variables has been dropped and valid restriction has been imposed where it is applicable.

Using budget deficit

$$\Delta LR = -0.50 + 0.16\Delta LR_{t-1} + 19.06\Delta bd_t + 21.96\Delta bd_{t-1} - 1.82\Delta cb_{t-1}$$
$$\quad (0.37) \quad (0.16) \quad (12.40) \quad (14.61) \quad (0.95)$$
$$+7.02\Delta cpi_{t-1} + 4.88\Delta rgdp_t - 1.03ecm \ (bd)_{t-1} \quad\quad\quad (9)$$
$$\quad (3.51) \quad (3.79) \quad (0.23)$$

$$R^2 = 0.61 \quad \text{Adjusted } R^2 = 0.51 \quad Se = 0.84 \quad DW = 1.93$$

Using internal loan outstanding

$$\Delta LR = -0.89 + 0.17\Delta LR_{t-1} + 15.64\Delta ol_{t-1} + 1.94\Delta cb_t + 4.83\Delta cpi_{t-1}$$
$$\quad\quad (0.39) \quad\ (0.16) \quad\quad\ (13.74) \quad\quad\ (0.92) \quad\quad\ (3.62)$$
$$\quad + 3.75\Delta rgdp_{t-1} - 1.01ecm(ol)_{t-1} \quad\quad\quad\quad\quad\quad (10)$$
$$\quad\quad (4.03) \quad\quad\quad\quad (0.23)$$

$R^2 = 0.59$ Adjusted $R^2 = 0.49$ Se $= 0.86$ DW $= 2.04$

Interpretation of the Result

Error correction methodology (ECM) has been applied in the above equations. Modelling long-term nominal interest rate while using two different deficit variables produce similar results. As it is clear from equation (9) the current and one year lag growth of budget deficit as a ratio of nominal GDP is positively associated with the growth of long term nominal interest rate. Although the size of the coefficients indicates that the budget deficit marginally contributes to the higher long term interest rate, the t-values indicates that the size of the coefficient is too low to be significant.

Similarly modelling long-term nominal interest rate using the internal loan outstanding gives the similar result as it was found in using the budget deficit. The growth of one year lag internal loan outstanding has established a positive relationship, with long-term nominal interest rate and again most importantly the coefficient is insignificant affecting the interest rate.

Observing these results, it can be said that the effect of central bank holding of bonds is ambiguous, whereas the growth of consumer price index, and real GDP are unambiguously positively associated with long-term nominal interest rate in Nepal, which is in line with economic theory. Moreover, the coefficients of ECMs are negative, large and significant. In all cases, the long-term equilibrium plays an important role in determining the short run dynamics of the long-term interest rate in Nepal.

V. CONCLUSION

The result suggests that budget deficit and stock of public debt in relation to GDP have positive but statistically insignificant effect in the determination of long term nominal interest rates on of the government bonds in Nepal. Therefore, the sole conclusion about the effect of two deficit variables on the long term nominal interest rate is that there is a positive relationship between deficit and interest rate. The magnitude of the coefficient varies. The regression results are weak and insignificant. Therefore, the empirical evidence presented in this paper does support the theoreitical prediction that the deficit causes interest rates to rise but insignificantly in the Nepalese case. The less meaningful association with deficit

variables is mainly due to the inefficient government bonds market and certain characteristics associated with the debt structure and the intervention in the determination of interest rates in some catagories of debt issues. Both supply and demand for long term government securities have not been market based. Supply of securities is still determined by the fund requirement of the government for the budgetary purposes irrespective of the interest rate. The medium and long term interest rate are still determined administratively. The governemt was able to mobilise funds at lower than the market rates through administraive arrangement. In the past government bonds were not very popular among the public because of lower interest rate and as such most of the bonds had to be accepted by the NRB.

The findings of this paper provides an insight into a policy agenda for Nepal, especially to provide basic pre-requisites to ensure the smooth functioning of the market for achieving efficiency of the policies. Some of the important recommendations are as follows:

- The government's fiscal policy has produced insignificant positive effect on the determination of long term interest rate of the government securities. Monetary policy could only be the policy measure to influence the rate of interest in Nepal.

- Developed and market based debt instruments both for short term and long-term government bonds are felt necessary for the smooth functioning of the market.

- Reduction of the amount of governement bonds holding by the NRB in order to determine interest rate on a competive basis help the market forces to work in its own way.

- There should be a developed secondary market for the trading of short term as well as long term securities.

- The transactions including the issuance of long-term bonds should be market based so that the price of bonds will be determined by the market forces.

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