A multivariate analysis of savings, investment and growth in Nepal

Budha, Birendra

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A Multivariate Analysis of Savings, Investment and Growth in Nepal

Birendra Bahadur Budha*

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Abstract

This paper examines the relationship between the gross domestic savings, investment and growth for Nepal using annual time series data for the period of 1974/75 to 2009/10. The study employs the Autoregressive Distributed Lag (ARDL) approach to test for cointegration and Error correction based Granger causality analysis for exploring the causality between the variables. Empirical results show that there exist cointegration between gross domestic savings, investment and gross domestic product when each of these is taken as dependent variable. Granger causality analysis shows that there exists short-run bidirectional causality between investment and gross domestic product as well as between gross domestic savings and investment. Nevertheless, no short-run causality is found between gross domestic savings and gross domestic product. Thus, the policy of accelerating growth by promoting investment works to some extant only since the long-run investment multiplier is below one.

Keywords: gross domestic savings, gross capital formation, gross domestic product.

JEL Classification Codes: E2.

I. Introduction

The relationship between economic growth and other macroeconomic variables is crucial for formulating the macroeconomic policies. Thus, the role of savings and investment in promoting growth has received more attention in growth theories and in many of the empirical studies too. The role of investment as a key for promoting economic growth was underscored by Harrod (1939) and Domar (1946) when they, in their models, attempted to integrate Keynesian analysis with elements of economic growth. On the other hand, the neo-classical Solow-Swan model highlights the relative importance of savings in promoting growth and relegates investment to a more passive equilibrating role. The Carroll-Weil hypothesis (1994) states that it is economic growth that contributes to savings, not savings to growth. The new growth theories since the

*Affiliation: Nepal Rastra Bank, Research Department, Kathmandu, Baluwatar, Nepal. E-mail: bc_birendra@hotmail.com.

mid-1990s, typified by Romer (1986, 1990), Lucas (1988) and Barro (1990) reconfirm the view that the accumulation of physical capital are the drivers of long-run economic growth (Verma, 2007). Moreover, the positive relationship between the gross domestic product and gross domestic savings, which is primarily due to the fact that savings have positive impact on investment that is essential for economic growth, is a widely accepted phenomenon documented in the vast empirical economic literature.

Since the inception of the economic planning in Nepal, the emphasis has been posited on savings and investment as a primary instrument of economic growth and increase in national income. One of the major objectives of most of the Nepal's economic plan is to raise economic growth though the emphasis differed over time focusing on different aspects of growth-employment oriented, sustainable, inclusive, equitable and broad based economic growth. To achieve the higher growth, gross fixed capital formation is considered as a pivotal determinant and, thus, targeted gross fixed capital formation for growth is assumed to be backed by the appropriate volume of savings. Increase in savings and the use of it in capital formation constitute one of the strategies for higher growth in Nepal. Given such background, understanding the long-run relationship and causality between the savings, investment and growth is crucial for policy purposes.

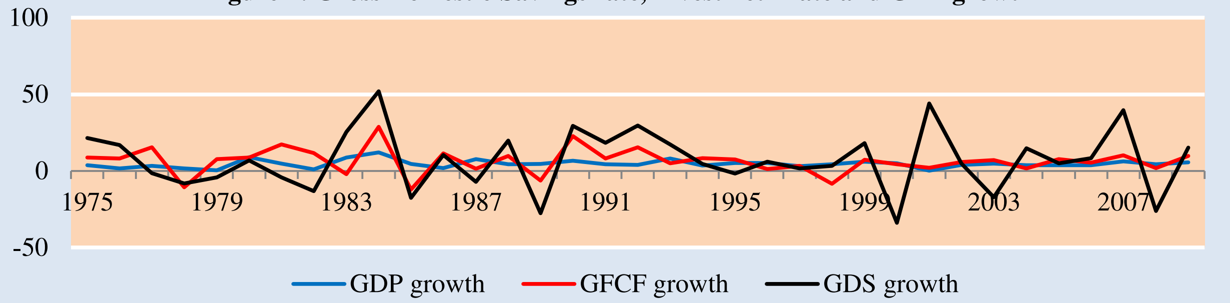
In the Nepalese context, there are many empirical studies on the role of savings and investment in economic growth, but most of these are limited only to the partial analysis. For example, Poudyal (1987) analyzed the behavior and determinants of the Nepalese macroeconomic variables including savings, investment and national income and, thus, estimated the savings and investment functions using ordinary least squares technique (OLS) and distributed lag models. The study concluded that GDP is influenced by both current as well as past values of investment and savings is positively affected by GDP. Investment is also found to be positively associated with the change in GDP. Similar results for the relationship between savings, investment and growth were concluded by Wagle (2000), Yadav (2002) and Budha (2006). Notably, all these empirical studies have used the simple OLS or distributed lag model ignoring the necessity of checking the order of integration of the variables, test of normality, serial correlation, heteroskedasticity, misspecification and cointegration. Thus, the comprehensive study exploring the relationship between savings, investment and growth bears crucial relevance.

This paper, thus, examines the relationship between the savings, investment and growth using ARDL approach. In addition, it tries to have insight over the possibility of saving investment led growth and growth driven savings hypothesis in detail by using the error-correction based Granger Causality tests between the real gross domestic products, savings and investments in Nepal.

II. Growth of Savings, Investment and National Income

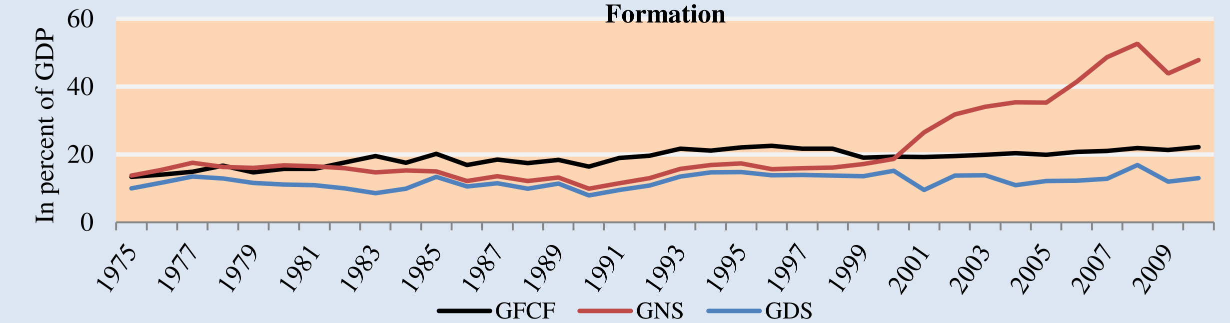
The gross domestic savings, investment and gross domestic product have the upward trend over the study period. Savings rate, investment rate and GDP growth are very low and have the fluctuating trend, however. Real GDP growth was very low, below 5 percent in twenty one fiscal years during the study period. Growth of real gross domestic savings was fluctuating and had negative value too. Similar fluctuating trend was also observed for the growth of investment.

Figure 1: Gross Domestic Savings rate, Investmetn rate and GDP growth



As is evident in figure 1, economic growth, which followed the same growth trend as investment, was largely led by investment demand, which is captured by the gross fixed capital formation in national accounts. Figure 1 also shows that growth of GDS and GFCF follow the similar pattern.

Figure 2: Gross Domestic Savings, Gross National Savings and Gross Fixed Capital Formation



As shown in figure 2, GDS as a percentage of GDP was 10 percent in 1975, which reached to 13.5 in 2010. Similarly, GFCF as a percentage of GDP increased from 13.4 percent in 1975 to 23 percent in 2010. The gap between GDS and GFCF is widening, which is met through the surges net current transfers in the balance of payments particularly remittance inflows in recent years. This is because the capital account has not yet opened for portfolio investments and other kind of capital flows and the flow of foreign direct investment is also low due to poor investment climate.

III. Methodology

1. Data

Data used in this paper are annual figures covering the fiscal year 1974/75 to 2009/10 Real gross domestic product (RGDP) is the proxy for the real income. Gross domestic savings (GDS) is used as a proxy for savings, which is obtained by subtracting final consumption expenditure from gross domestic product. Investment is represented by the gross fixed capital formation (GFCF) in the national accounts. The data on these variables were taken from the various issues

Economic Survey of Ministry of Finance, Government of Nepal. GDP deflator is used to convert the nominal figures of the variables into real. In addition, empirical analysis has been done using the natural logarithms of the variables.

2. Model Specification

The issue of causality between the savings, investment and growth has taken attention in growth economics since the beginning. The controversy can be expressed in terms of two leading theoretical perspectives: the "Marx-Schumpeter-Keynes view" and "Mill-Marshall-Solow view" (Chakravarty, 1993 and Gutierrez *et al.* 2007). The first view states that investment and innovation are the two variables that drive output growth. Under this, savings adjusts passively to meet the level of investment required to hold macroeconomic equilibrium and deliver a certain growth rate of output. In this view, growth leads savings. In the Mill-Marshall-Solow approach, that channel of causality is reversed since it assumed that all savings is automatically invested and translated into output growth under wage-price flexibility and full employment. As a result, savings leads growth.

In order to explain the possible relationship between the savings, investment and growth based on Nepalese data, this study has postulated the following three specifications:

$$GDP = f(GDS, GFCF) \dots\dots\dots\dots\dots (1)$$

$$GDS = f(GDP, GFCF) \dots\dots\dots\dots\dots (2)$$

$$GFCF = f(GDP, GDS) \dots\dots\dots\dots\dots (3)$$

Where, GDP stands for gross domestic product, GDS for gross domestic savings and GFCF for gross fixed capital formation. The model (1) simply assumes that gross domestic product is positively associated with the GDS and GFCF, ceteris paribus. Similarly, GDS is assumed to be an increasing function of GDP and GFCF though it is also determined by other factors such as fiscal policy, macroeconomic uncertainty, demographics and income distribution. GFCF is taken as a function of GDP and GDS in model (3).

3. ARDL Cointegration Approach

The autoregressive distributed lag (ARDL) cointegration procedure introduced by Pesaran and Shin (1999) and Pesaran, Shin, and Smith (1997, 2001) has been used to examine the long-run relationship between the savings, investment and growth. This test has several advantages over the well-known residual-based approach proposed by Engle and Granger (1987) and the maximum likelihood-based approach proposed by Johansen and Julius (1990) and Johansen (1992). The main advantage of this test is that it can be applied irrespective of the order of integration while other cointegration techniques require all variables be of equal degree of integration. In addition, it does not matter whether the explanatory variables are exogenous (Pesaran and Shin, 1997). The short and long-run parameters with appropriate asymptotic inferences can be obtained by applying OLS to ARDL with an appropriate lag length. Following Pesaran *et al.* (1997, 2001), an ARDL framework for equation (1) can be written as:

$$\Delta lnGDP_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta ln\, GDP_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta lnGDS_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta lnGDI_{t-i} + \alpha_1 lnGDS_{t-1}^{r} + \alpha_2 lnGDP_{t-1} + \alpha_3 ln\pi GDI_{t-1} + \mu_t \ldots\ldots\ldots\ldots (4)$$

Where, Δ is the first difference operator, β_0 the drift component, and μ_t the usual white noise residuals. The coefficients (α_1-α_3) represent the long-run relationship whereas the remaining expressions with summation sign (β_1-β_3) represent the short-run dynamics of the underlying models.

In order to investigate the existence of the long-run relationship among the variables in the system, the bound tests approach developed by Pesaran *et al.* (2001) has been employed. The bound test is based on the Wald or F-statistic and follows a non-standard distribution under the null hypothesis of no cointegration relationship between the examined variables, irrespective of whether the variables are purely I(0) or I(1), or mutually cointegrated. Under this, the null hypothesis of no cointegration α_1=α_2=α_3=0 is tested against the alternative of cointegration $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq 0$. Pesaran *et al.* (2001) provide the two sets of critical values in which lower critical bound assumes that all the variables in the ARDL model are I(0), and the upper critical bound assumes I(1). If the calculated F-statistics is greater than the appropriate upper bound critical values, the null hypothesis is rejected implying cointegration. If such statistics is below the lower bound, the null cannot be rejected, indicating no cointegration. If, however, it lies within the lower and upper bounds, the results is inconclusive. After establishing the evidence of the existence of the cointegration between variables, the lag orders of the variables are chosen by using the appropriate Akaike Information Criteria (AIC) or Schwarz Bayesian Criteria (SBC).

The unrestricted error correction model based on the assumption made by Pesaran *et al.* (2001) was also employed for the short-run dynamics of the model. Thus, the error correction version of the ARDL model pertaining to the equation (4) can be expressed as:

$$\Delta lnGDP_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta lnGDP_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta lnGDS_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta lnGDI_{t-i} + \lambda EC_{t-1} + \mu_t \ldots\ldots\ldots\ldots (5)$$

Where, λ is the speed of adjustment parameter and EC is the residuals that are obtained from the estimated cointegration model of equation (4). The error correction term (EC) is, thus, defined as: $EC_t = lnGDP_t - \gamma_1 lnGDS_t - \gamma_2 GDI_t$. Where, $\gamma_1 = -(\alpha_2/\alpha_1)$, and $\gamma_2 = -(\alpha_3/\alpha_1)$ are the OLS estimators obtained from equation (4). The coefficients of the lagged variables provide the short run dynamics of the model covering the equilibrium path. The error correction coefficient ($\boldsymbol{\lambda}$) is expected to be less than zero and implies the cointegration relation. In order to check the performance of the model, the diagnostic tests associated with the model which examines the serial correlation, functional form and heteroscedasticity have been conducted. The CUSUM and CUSUMSQ tests to the residuals of equation have also been applied in order to test the model stability. The CUSUM test is based on the cumulative sum of recursive residuals based on the first set of n observations. For the stability of the long-run and short-run coefficients, the plot of the two statistics must stay within the 5 % significant level.

4. Causality Analysis

The existence of a cointegration indicates the presence of causality at least in one direction but does not indicate its direction. Thus, in order to examine the direction of causality, this paper has employed the error-correction based Granger causality tests. In contrast to conventional method, the error-correction based causality test allows the inclusion of the lagged error-correction term derived from the cointegration equation (Narayan and Smyth, 2008 and Odhiambo, 2007). The F-statistics or Wald-test is used to determine the statistical significance of the short-run causality on the coefficients of the differenced explanatory variables. The t-test on the coefficients of the lagged error correction term implies the long-run causal effect.

IV. Empirical Results

Cointegration analysis, at first, requires determining the order of integration of variables under study. This is because of the fact that ARDL technique cannot be used if the order of the integration of the variables is two or more. Thus, for this purpose, this study has employed the Augmented Dickey Fuller (ADF) test both at the level and difference of the variables. The lag length used for this test is determined using a model selection procedure based on the Schwarz Information Criterion. The statistical results of the ADF tests are presented in table 1.

Table 1 show that all the variables are stationary in the first difference. Gross domestic savings is trend stationary at the level, but gross domestic product and gross fixed capital formation are non-stationary at the level for both cases with intercept and intercept with trend. The ARDL approach to cointegration, therefore, may be better to use since the variables are either I (0) or I (1).

Table 1. Results of ADF tests

Variables	Level		First Difference	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
RGDP	-0.26(0.92)	-1.34(0.85)	-5.53(0.00)*	-5.44(0.00)*
RGDS	-0.63(0.85)	-3.78(0.02)**	-8.36(0.00)*	-8.22(0.00)*
RGFCF	-1.15(0.68)	-1.93(0.62)	-9.19(0.00)*	-9.21(0.00)*

Notes: 1. * and ** denote the statistical significance at the 1% and 5% level respectively.
2. The numbers within the parentheses for the ADF statistics are the p-values.

In the first stage of ARDL procedure, we impose arbitrary and the same number of lags on each first differenced variables in equation (4) as well as the equations for the models of savings and investment and carry out F-test. The result will depend on the choice of the lag length (Bahmani-Oskooee & Brooks, 2007). Akaike's and Schwarz's Baysian Information Criteria have been employed in order to select the optimal lag length. The LM test has been used in order to test the serial correlation in residuals.

The results for selecting lag order are reported in table 2. The results of both AIC and SBC criteria for GDP imply the best lag of two. For the model of gross domestic savings, AIC and SBC criteria give the conflicting results. Thus, based on the SBC criteria which is preferred more among model specification criteria because it often has more parsimonious specifications, the optimal lag length selected for the ARDL equation of savings with no serial correlation problem is one. Both AIC and SBC give the similar results of lag one for GFCF.

Table 2. Statistics for Selecting Lag Order

	Real GDP			Real GDS			Real GFCF		
Lags	AIC	SBC	LM(1)	AIC	SBC	LM(1)	AIC	SBC	LM(1)
1	-4.57	-4.17	3.15*	-0.66	-0.26	2.43**	-2.46	-2.05	0.06***
2	-5.15	-4.60	0.09***	-0.76	-0.22	0.80***	-2.37	-1.82	0.01***
3	-5.01	-4.32	1.20***	-0.75	-0.06	0.01***	-2.31	-1.52	12.42

Note: *, ** and *** refers to marginal significance level at 1%, 5% and 10% respectively.

The existence of the long-run relationship between GDP and its determinants (GDS and GFCF) has been tested by calculating F-statistics with two lag. But, for GDS and GFCF, one lag has been used. The F-statistics is calculated by applying Wald tests that imposes zero value restriction to only one period lagged level coefficient value of the variables. These test results are reported in table 3 with new critical values as suggested by Pesaran *et al.* (2001) and Narayan (2004) for bounds test procedure.

The computed F-statistics in table 3 was compared with the critical values provided by Narayan (2004) for small samples. The results clearly indicate that, since computed F-statistic is greater than critical values, there is long-run relationship between real gross domestic product, real gross domestic savings and real gross fixed capital formation when real GDP is the dependent variable; that is the null hypothesis of no cointegration is rejected for GDP. It implies that gross domestic savings and gross capital formation both had an effect in the Nepal's long run growth. But, taking real GDS as dependent variable, the result is inconclusive because the calculated F-statistics (2.57) is between the upper and lower bound critical values, suggested by Narayan for small samples. Similar inconclusive outcome is obtained for the real GFCF. In such inconclusive case, following Kremers *et al.* (1992) and Bannerjee *et al.* (1998), we can use the error correction term to establish the evidence of cointegration.

Table 3. Bounds tests for Cointegration Analysis

Variables	Order of Lag	F-statistics
RGDP	2	7.21*
RGDS	1	2.57
RGFCF	1	2.56

Notes:

1. The relevant critical value bounds are obtained from Table C1. iv (with an unrestricted intercept and restricted trend; with three regressors k=3) in Pesaran et al. (2001). These are 2.97- 3.74 at 90 %, 3.38-4.23 at 95% and 4.30-5.23 at 99%.
2. * denotes the significance at 99%.
3. The critical values presented in Pesaran et al. (2001) are based on large samples (Narayan, 2004). For small sample sizes ranging from 30 to 80 observations, Narayan (2004) provides a set of critical values, which are 2.496-3.346 at 90%, 2.962-3.910 at 95% and 4.068-5.250 at 99%.

The lag length for each variable need not be identical except for the identification purpose above[1]. In this stage, a more parsimonious model is selected for the long-run money demand using the SBC criteria. Pesaran and Shin (1997) and Narayan (2004) suggested two as the maximum order of lags in the ARDL approach for the annual data series. The total number of regressions to be estimated for the ARDL *(p, q, r)* is $(p+1)^k$, where *p* is the maximum number of lag order to be used and *k* is the number of variables in the equation. As $p=2$ and $k=3$, the total number of regressions to be estimated are 27. For this procedure, the Microfit 5.0 software program has been used and, thus, estimated ARDL *(1, 0, 0)* model for both of the gross domestic product and gross domestic savings, and ARDL *(1, 0, 1)* model for gross fixed capital formation based on SBC criterion.

The long-run coefficients of the real gross domestic product, gross domestic savings and gross fixed capital formation are reported in table 4. Table 4 shows that when GDP is taken as dependent variable, the coefficients of real gross domestic savings and gross fixed capital formation both have the expected positive signs as suggested by economic theories, but only the coefficient of the GFCF is statistically significant. Since the coefficient of the GFCF is very low i.e. 0.82, it implies the low long-run investment multiplier implying that GDP increases by only 82 percent if investment increases by 100 percent. This implies the existence of many leakages in the Nepalese economy that are hindering the working of investment multiplier. The long run model of the corresponding ARDL *(1, 0, 0)* for real gross domestic product can be written as:

$$RGDP = 3.37 + 0.014\ RGDS + 0.82\ RGFCF \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

Table 4. Estimated Long-run Coefficients

Dependent Variable	Explanatory Variables		
	RGDP	RGDS	RGFCF
RGDP	-	0.014 (0.09)	0.82* (5.91)
RGDS	0.24 (0.71)	-	0.74 (0.16)
RGFCF	1.21* (5.12)	0.18 (0.08)	-

Notes: Figures in parenthesis are t-values. * represents significant at the 1 %.

Similarly, the long-run coefficients of gross domestic product and investment, when RGDS is dependent variable, both have positive signs, but statistically insignificant. The long run model of the corresponding ARDL (*1, 0, 0*) for real gross domestic savings (RGDS) can be written as:

$$RGDS = -0.67 + 0.24\ RGDP + 0.74\ RGFCF \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

With GFCF being the dependent variable, the results reported in table 4 show that the coefficients of RGDP and RGDS have the positive sings. And, the coefficient of the RGFCF is statistically significant implying that growth of real GDP causes investment growth. A one percent increase in GDP leads to 1.21 percent increase in GFCF in the long-run. The coefficients of real gross domestic savings, although statistically insignificant, have the expected positive

[1] See Pesaran (2001) and Dagher and Kovanen (2011).

sign indicating the positive relationship between RGDS and RGFCF. This low impact of savings may be due to the fact that investment is influenced by foreign inflows such as foreign direct investment and positive net current transfer in balance of payments. The long-run model of the corresponding ARDL *(1, 0, 1)* for gross fixed capital formation is:

$$RGFCF = -3.67 + 1.21RGDP + 0.18\ RGDS \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (8)$$

After the estimation of the long-run coefficients, the short-term dynamics of the model has been examined by estimating an error correction model. The ECM shows the speed of adjustment to restore equilibrium in the dynamic model after disturbance in any variables in the model. The diagnostic tests, which are used in this paper to examine the properties of the model, include the test of serial autocorrelation ($\chi 2_{Auto}$), normality ($\chi 2_{Norm}$), heteroskedasticity ($\chi 2_{BP}$) and omitted variables /functional form ($\chi 2_{RESET}$). The results of the short-run dynamic money demand models and the associated diagnostic tests are reported in table 5, 6 and 7.

Table 5. Error Correction Representation of ARDL Model, ARDL (1, 0, 0)

Dependent Variable: Gross Domestic Product, RGDP					
Regressor	Coefficient	t-statistic	p-value		
$\Delta RGDP_{-1}$	-0.29	-1.42	0.17		
$\Delta RGDS$	-0.004	-0.15	0.87		
$\Delta RGFCF$	0.25*	3.64	0.00		
Ecm_{-1}	0.50*	95.33	0.00		
Constant	1.61*	17.62	0.00		
R^2= 0.99	R^2_{adj}= 0.95	F = 2319.43 (0.00)	S.E. = 0.03	DW= 1.10	AIC=-4.16
Diagnostic test:					
Serial correlation	$\chi^2_{Auto}(2)=8.74\ (0.00)$				
Functional Form	$\chi^2_{RESET}\ (2)=1.32(0.28)$				
Normality	$\chi^2_{Norm} = 3.54(0.17)$				
Heteroscedasticity	$\chi^2_{BP}\ (2) =4.13(0.60)$				

Notes: 1. * indicates the significance at the 99% level.
2. The values in parentheses are the probabilities.

Table 5 shows that the estimated lagged error correction term (ECM_{-1}) is negative and statistically significant, which confirms the results of the bounds tests for cointegration. The statistical significance of the error correction term implies the long-run Granger causality i.e. both RGDS and RGFCF Granger cause real GDP. The absolute value of the coefficient of error correction term (i.e. 0.50) implies that about 50 percent of the disequilibrium in the real gross domestic product is adjusted toward equilibrium annually. For instance, if the real gross domestic product exceeds its long-run relationship with other variables in the model, then the RGDP adjust downwards at a rate of 50% per year. As presented in the table 5, there is no evidence of diagnostic problem with the model. The Lagrange Multiplier (LM) test of serial correlation indicates the evidence of no serial correlation since the estimated LM value or χ^2_{Auto} is less than the critical values. The Jarque-Bera normality test implies that the residuals are normally distributed. The Breusch-Pagan test (BP) for heteroscedasticity shows that the disturbance term in the model is homoscedastic. The Ramsey's RESET test for functional specification shows that the calculated RESET statistic or $\chi 2_{RESET}$ is less than its critical values and, thus, the ARDL model is correctly specified.

Table 6. Error Correction Representation of ARDL Model, ARDL (1, 0, 0)

Dependent Variable: Gross Domestic Savings, RGDS			
Regressor	Coefficient	t-statistic	p-value
$\Delta RGDS_{-1}$	-0.14	-1.99	0.32
$\Delta RGDP$	0.69	0.60	0.56
$\Delta RGFCF$	0.84*	2.45	0.02
Ecm_{-1}	-0.51**	21.18	0.00
Constant	-0.52	-1.25	0.22
R^2= 0.94 R^2_{adj}= 0.93	F = 112.69 (0.00)	S.E. = 0.15 DW= 2.00	AIC=-0.84
Diagnostic test:			
Serial correlation	$\chi^2_{Auto}(2)=1.00\ (0.61)$		
Functional Form	$\chi^2_{RESET}\ (2)=0.14(0.91)$		
Normality	$\chi^2_{Norm} = 1.81(0.40)$		
Heteroskedasticity	$\chi^2_{BP}\ (2) = 1.27(0.87)$		

Notes: 1. * and ** indicates the significance at the 99% and 95 % level.
2. The values in parentheses are the probabilities.

Table 7. Error Correction Representation of ARDL Model, ARDL (1, 0, 1)

Dependent Variable: Gross Fixed Capital Formation, RGFCF			
Regressor	Coefficient	t-statistic	p-value
$\Delta RGFCF_{-1}$	-0.21	-1.35	0.20
$\Delta RGDP$	0.96***	1.94	0.06
$\Delta RGDS$	0.14**	2.15	0.04
$\Delta RGDS_{-1}$	0.07	1.02	0.31
Ecm_{-1}	0.49*	51.80	0.00
Constant	-1.75*	-8.70	0.00
R^2= 0.99 R^2_{adj}= 0.98	F = 549.14 (0.00)	S.E. = 0.06 DW= 1.94	AIC=-2.55
Diagnostic test:			
Serial correlation	$\chi^2_{Auto}(1)=0.01\ (0.93)$		
Functional Form	$\chi^2_{RESET}\ (2)=0.38(0.68)$		
Normality	$\chi^2_{Norm} = 0.58(0.75)$		
Heteroskedasticity	$\chi^2_{BP}\ (2) = 9.82(0.08)$		

Notes: 1. *, ** and *** indicates the significance at the 99%, 95 % and 90 % level.
2. The values in parentheses are the probabilities.

Table 6 presents the results for real gross domestic savings. Although the Bounds test implies the inclusive outcome, the coefficient of the error correction term is negative and statistically significant, indicating the evidence of the cointegration among the gross domestic savings and other variables in the model. And, it also shows the long-run Granger causality between RGDS and other explanatory variables-RGDP and RGFCF. The high value of the error correction term for GDS implies relatively faster adjustment in gross domestic savings back to the long-run equilibrium when shocks arise. The coefficient of error correction term (i.e. 0.51) implies that deviation from the long-run GDS path is corrected by 51 % over the following year when shock arises. The diagnostic tests applied to the error correction model indicate that there is no evidence of serial correlation and heteroskedasticity. In addition, the RESET test implies the correctly specified ARDL model and the Jarque-Bera normality test indicates that the residuals are normally distributed.

Table 7 shows the empirical results of gross fixed capital formation, RGFCF. In the case of RGFCF also, the error correction term is statistically significant implying the cointegration between the gross fixed capital formation and other variables-RGDP and RGDS, albeit the Bounds test implies the inclusive outcome. The error correction term (0.49) implies that about 49 percent of total adjustment takes annually when shocks arise. The diagnostic tests imply that there is no evidence of the serial correlation, non-normality and misspecification of the model. But, there is evidence of the heteroskedasticity.

In the final stage, the stability of the long-run coefficients is examined by using the CUSUM and CUSUM squares test. The graphical presentation of these tests is presented in the figure below.

Figure 3: Cumulative Sum of Recursive Residuals (RGDP)

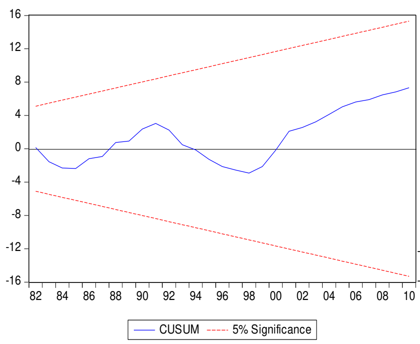


Figure 4: Cumulative Sum of Squares of Recursive Residuals (RGDP)

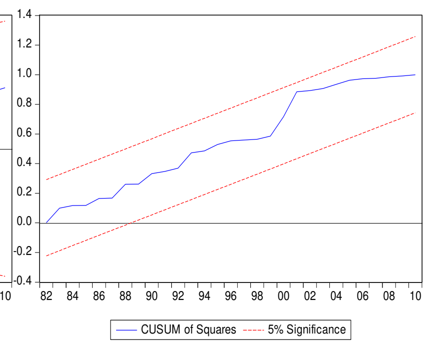


Figure 5: Cumulative Sum of Recursive Residuals (RGDS)

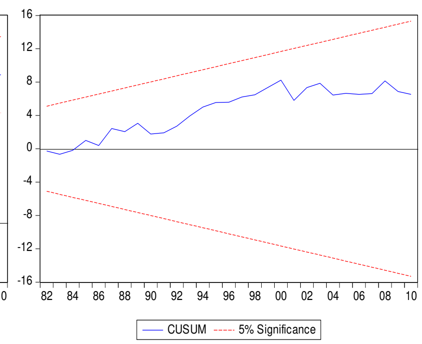


Figure 6: Cumulative Sum of Squares of Recursive Residuals(RGDS)

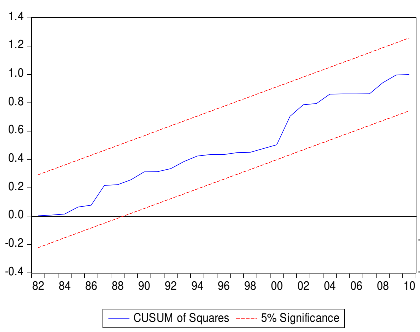


Figure 7: Cumulative Sum of Recursive Residuals (RGFCF)

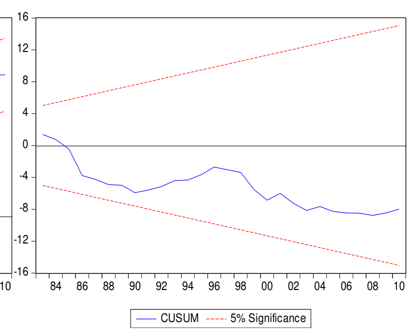
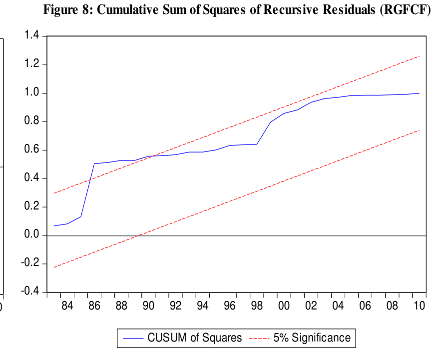


Figure 8: Cumulative Sum of Squares of Recursive Residuals (RGFCF)



Since the plots of CUSUM and CUSUMSQ statistic for RGDP are within the critical lines at the 5% significance level, the model for RGDP is stable. Similar result of CUSUM and CUSUMSQ for GDS is found implying the stability in the model. But, the plot CUSUMSQ in case of model for GFCF does not lie within the critical limits implying some instability in investment function. Since the plot of CUSUMSQ is returning back towards the critical bands, the deviation is only transitory.

Table 7 shows the Granger causality tests. The results reported in Table 3 indicate that there is a statistical evidence of bidirectional short-run Granger causality between real GDP and real GFCF. Similarly, the bidirectional causality has been found between the real GDS and real

GFCF in the short run also. But, there is no short-run Granger causality between real gross domestic savings and real GDP as shown in table 7.

Table 7. Results of Granger Causality Tests

Dependent Variable	F- statistics of explanatory Variables		
	ΔRGDP	Δ RGDS	ΔRGFCF
ΔRGDP	-	0.02 (0.88)	13.28* (0.00)
ΔRGDS	0.36 (0.56)	-	6.00** (0.02)
ΔRGFCF	3.78*** (0.06)	4.62** (0.04)	-

Notes: Figures in parenthesis are t-values. *, ** and *** represent significant at the 1 %, 5% and 10 % respectively.

V. Conclusion

This paper attempts to estimate the interdependence between gross domestic savings, investment and gross domestic product in Nepal for the period of 1975 to 2010 based on annual data. The long-run cointegrating relationships and short-run adjustments are estimated in a multivariate setting using ARDL approach to cointegration. In addition, it examines the direction of relationship between the gross domestic savings, investment and gross domestic product using the Granger causality tests based on the VECM framework. Though unavailability of the quarterly data series on the variables and, thus, small sample size of only 35 is a limitation, this paper has provided the empirical basis for analyzing the causality between savings, investment and growth in Nepal.

ARDL cointegration technique shows that there is evidence of cointegration between GDS, GFCF and GDP when GDP is taken as a dependent variable. Similarly, the long-run relationship between GDP, GDS and GFCF has also been found when GDS and GFCF are separately chosen as dependent variables. As the determinants of growth, the long-run coefficients of GDS and GFCF both are positive implying the positive association between GDS and GDP, and between GFCF and GDP. But, the long-run investment multiplier is very low implying the low impact of investment on growth. In addition, GDS is positively affected by GDP and GFCF, but the coefficients of both are statistically insignificant. GDP has significant positive impact on investment, but gross domestic savings do not have significant impact on investment in Nepal. Moreover, the long-run causality between GDS, GFCF and GDP has been proved by statistically significant estimated error correction coefficients. The error correction models show that GFCF and GDS both Granger cause the GDP in the long-run. In the same way, GDS and GDP both Granger cause the GFCF in the long run. The long-run causality runs from GDS and GDP to GFCF also. These results are further validated by the diagnostic tests of the models. Regarding short-run causality, there is bidirectional causality between GFCF and GDP and between GDS and GFCF. But, no short-run causality exists between GDP and GDS.

Though gross domestic savings do not have short run effect on growth in Nepal, it should be encouraged for its desirable level effects in the long-run. As investment and growth have bidirectional relationship both in the short-run and long-run, promoting investment for higher growth is a better strategy for Nepal. For policy purpose, enhancing investment growth through savings is also a policy option suitable from short-run to long-run as evidenced by this paper. Although this paper has explored some evidence on the causality between savings, investment and GDP, much more improvement in this front can be done through the use of quarterly data with large sample size and considering structural break in the data.

References

Bahmani-Oskooee, M. & Wang, Y. (2007). How Stable is the Demand for Money in China? *Journal of Economic Development, Vol. 32*. Retrieved from http://www.jed.or.kr/full-text/32-1/32-1-2.pdf.

Bannerjee, A., Dolado & Mestre, R. (1998). Error-correction mechanism tests for cointegration in single equation framework. *Journal of Time Series Analysis*, *Vol. 19*:267-283. Retrieved from http://e-archivo2.uc3m.es/jspui/bitstream/10016/3275/2/error-correction-JTSA-1998-ps.pdf.

Budha, B.B. (2006). *An Analysis of Savings, Investment and Capital Formation in Nepal*. Unpublished Master's Thesis, Central Department of Economics, Tribhuvan University, Kathmandu.

Carroll, C. & D. Weil (1994). *Savings and Growth: A Reinterpretation*. Carnegie-Rochester Conference Series on Public Policy 98:103-125.

Chakravarty, C. (1993). Alternative Approaches to a Theory of Economic Growth: Marx, Marshall and Schumpeter. *Selected Economic Writings*. Oxford: Oxford University Press.

Dagher, J. & Kovanen, A. (2011). On the Stability of Money Demand in Ghana: A Bounds Testing Approach. *IMF Working Paper-WP/11/273*. Retrieved from http://www.imf.org/external/pubs/ft/wp/2011/wp11273.pdf.

Domar, E. (1946). Capital Expansion, Rate of Growth, and Employment. *Econometrica 14(2)*: 137-147. Retrieved from *http://*www.ie.ufrj.br/hpp/intranet/pdfs/domar1946.pdf.

Engle, R.F. & Granger, C.W.J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, *Vol.55*, No 2. Retrieved from http://www.uta.edu/faculty/crowder/papers/Engle_Granger_1987.pdf.

Gutierrez, M. & Solimano, A. (2007). Savings, Investment and Growth in the Global Age: Analytical and Policy Issues. *American University of Paris's Working Paper No. 43*. Retrieved from http://www.aup.edu/pdf/WPSeries/AUP_wp43-Gutierrez.pdf.

Harrod, R.F. (1939). An Essay in Dynamic Theory. *The Economic Journal 49(193)*:14-33. Retrieved from http://www.fea.usp.br/feaecon/.../P2_Harrod_Essay_Dynamic_Theory.pdf.

Johansen, S. & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration with Application to the Demand for Money. *Oxford Bulletin of Economics and Statistics 52*. Retrieved from http://nhjy.hzau.edu.cn/kech/hgjjx/Article/UploadFiles/tese/xuexiziyuan/jdwxxd/lwl/8.pdf.

Johansen, S. (1988). Statistical Analysis of Cointegrating Vectors. *Journal of Economic Dynamics and Control, Vol. 12, No. 2/3.*

Kremers, J.J.M., N.R. Ericsson and Dolado, J.J. (1992). The Power of Cointegration tests. *Oxford Bulletin of Economics and Statistics 54:*325-543.

Lutkepohl, H. & Kratzig, M. (2004). *Applied Time Series Econometrics*. Cambridge: Cambridge University Press, UK.

Ministry of Finance (2010). *Economic Survey*. Kathmandu: Ministry of Finance, Government of Nepal.

Ministry of Finance (2011). *Economic Survey*. Kathmandu: Ministry of Finance, Government of Nepal.

Narayan, P.K. 2004. Reformulating Critical Values for the Bounds F-statistics Approach to Cointegration: An Application to the Tourism Demand Model for Fiji. *Discussion Papers, ISSN 1441-5429*. Retrieved from http://arrow.monash.edu.au/vital/access/%20/services/Download/.../DOC.

Narayan, P.K. & Smyth, R. (2008). Energy consumption and real GDP in G7 countries: new evidence from panel cointegration with structural breaks. *Energy Economics 30:*2331-2342.

Odhiambo, N.M. (2007). Supply-leading versus demand-following hypotheses: empirical evidence from three SSA countries. *African Development Review 19:* 257-279.

Pesaran, M. H. & Y. Shin (1997). Autoregressive Distributed Modeling Approach to Cointegration Analysis. Retrieved from http://www.eprg.org.uk/faculty/pesaran/ardl.pdf.

Pesaran, M. H. & Shin, Y. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics 16*. Retrieved from http://www.econ.cam.ac.uk/faculty/pesaran/pss1r1.pdf.

Pesaran, M.H., Shin, Y. & Smith, R.J. (1999). Bounds Testing Approaches to the Analysis of Long Run Relationships. Retrieved from http://www.econ.cam.ac.uk/ faculty/pesaran/pss1.pdf.

Poudyal, S.R. (1988). *Foreign Trade, Aid and Development in Nepal*. New Delhi: Commonwealth Publishers Pvt. Ltd.

Verma, R. (2007). Savings, Investment and Growth in India: An Application of ARDL Bounds Testing Approach. *Faculty of Commerce Papers*, University of Wollongong, Australia.

Wagle, S. (2000). *A study on Trends of Savings, Investment and Capital Formation in Nepal*. Unpublished Master's Degree Thesis, Central Department of Economics, Tribhuvan University, Kathmandu.

Yadav, M.P. (2002). *Savings, Investment and Capital Market in Nepal*. Unpublished M.B.S Thesis, Central Department of Management, Tribhuvan University, Kathmandu.