The Economic Journal of Nepal, Vol. 36, No. 3 & 4, July-December 2013 (Issue NO. 142) © CEDECON-TU

Testing Export-Led Growth Hypothesis in Nepal Using Multivariate Cointegration Approach

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Abstract

We examine the relationship between exports and output for a small developing country Nepal which has received little attention in such literature. Using multivariate cointegration and vector error correction model for the data of 1975 to 2011, we find long-run relationship between real exports, investment, and real GDP and bidirectional long-run and short-run causality between real exports and real GDP. This implies that in case of Nepal, exports in an 'engine of growth' and growth is also 'the engine of exports'.

Key words: Export-led growth; Nepal; Multivariate cointegration analysis; Causality

Introduction

Nepal's export performance over the past four decades has been rather mixed. In particular, following the introduction of economic liberalization reforms in 1985/1986 (Sharma, 2000) , real exports trended upward for about one and half decades, but they have been trending downward since fiscal year 2000/2001. This trend is a serious concern for the economic growth of Nepal if export-led growth (ELG) hypothesis holds true.

The empirical evidence on the ELG hypothesis is not conclusive, however. For example, Ghatak,Milner, and Utku (1997), Awokuse (2003), and Love and Chandra (2005) provide evidence in favor of the ELG hypothesis for Malaysia, Canada, and Bangladesh, respectively. However, Shan and Sun (1998) and Sharma and Panagiotidis (2005) reject the ELG hypothesis for China and India, respectively. In addition, Pant (2005) also rejects the hypothesis for Nepal. However, he finds support for the growth-led exports hypotheses.

In this paper, we re-examine the ELG hypothesis for Nepal. Our study differs from Pant (2005) in three ways. First, we use the Johansen's (1991, 1995) cointegration test, whereas

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Acknowledgments:

We are grateful to Mukti P. Upadhyay and an anonymous referee for suggestions that improved the paper. Any remaining errors or omissions are those of authors

Pant (2005) uses the Engle-Granger cointegration test. Gonzalo (1994) shows that Johansen's test performs better than the Engle-Granger cointegration test even when errors do not follow normal distribution and the lag is misspecified in the error-correction model. To our knowledge, the Johansen's (1991, 1995) cointegration test has not been employed previously to examine the export-led growth hypothesis , particularly for the case of Nepal. Second, we use Granger causality test to determine both the long-run and short run-causality, whereas Pant (2005) focuses only on the long-run causality. Finally, we use data from 1975 to 2011. Thus, our study covers the period of internal insurgency of the Maoist armed-rebellion (1996-2006) and the political environment prevailing after the end of insurgency.

The rest of the paper is organized as follows. Section II presents data and the econometric methodology. The estimation results are presented in Section III and Section IV concludes the paper.

Analytical Framework and Data

Analytical Framework

We follow Awokuse (2003) and incorporate exports into the neoclassical aggregate production function to examine the causal relationship between real exports and real GDP. The production function is given by

$$Y = f(L, K, X) \qquad (1)$$

where Y is output, L is labour services, K is capital stock, and X is exports. Approximating (1) by log-linear equation gives,

$$\ln Y = \gamma_0 + \gamma_1 \ln L + \gamma_2 \ln K + \gamma_3 \ln X + \varepsilon \qquad (2)$$ [4]

Equation (2) states that the elasticities of output with respect to L, K, and X are given by γ_1, γ_2, and γ_3 respectively. The signs of the elasticities are hypothesized as follows: $\gamma_1 > 0$, $\gamma_2 > 0$, and $\gamma_3 > 0$. As it stands, equation 2 may be interpreted as a static equilibrium describing an economy's output in the long run. Hence, it will serve as the starting point for the cointegration analysis. Under the existence of single cointegrating relationship, we can then use the following general vector error correction model (VECM) (Johansen, 1995)[5] to determine the causal relationship among the four variables[6].

$$\Delta \mathbf{Z}_t = \mathbf{c} + \mathbf{\Pi Z}_{t-1} + \sum_{i=1}^{p-1} \mathbf{\Gamma}_i \Delta \mathbf{Z}_{t-1} + \boldsymbol{\varepsilon}_t \qquad (3)$$

where $\mathbf{c}$ is an $n \times 1$ constant vector representing a linear trend, $\mathbf{Z} = (\ln Y, \ln L, \ln K, \ln X)'$ each of which is I(1), $\mathbf{\Pi}$ is reduced rank parameter matrix, which can be factorized as $\mathbf{\Pi} = \boldsymbol{\alpha\beta}'$ where, $\boldsymbol{\alpha}$ is the adjustment vector (associated with the dynamic behavior) and $\boldsymbol{\beta}$ is the

4 Time subscript is dropped for convenience.

5 Note that variables need to be I(1) for using the model.

6 In case of single cointegrating vector, we normalize cointegrating vector on output. Conditional on this choice of normalization, the adjustment vector contains a parameter that arises in the dynamic economy

cointegrating vector (which corresponds to the static behavior). In terms of four variables, equation (3) can be expressed as

$$\Delta \ln Y_t = c_1 + \alpha_1 \varepsilon_{t-1} + \sum_{i=1}^{m_1} \gamma_{1,i} \Delta \ln Y_{t-i} + \sum_{i=1}^{m_2} \gamma_{2,i} \Delta \ln L_{t-i} + \sum_{i=1}^{m_3} \gamma_{3,i} \Delta \ln K_{t-i} + \sum_{i=1}^{m_4} \gamma_{4,i} \Delta \ln X_{t-i} + e_{1t} \quad (4)$$

$$\Delta \ln L_t = c_2 + \alpha_2 \varepsilon_{t-1} + \sum_{i=1}^{n_1} \delta_{1,i} \Delta \ln Y_{t-i} + \sum_{i=1}^{n_2} \delta_{2,i} \Delta \ln L_{t-i} + \sum_{i=1}^{n_3} \delta_{3,i} \Delta \ln K_{t-i} + \sum_{i=1}^{n_4} \delta_{4,i} \Delta \ln X_{t-i} + e_{2t} \quad (5)$$

$$\Delta \ln K_t = c_3 + \alpha_3 \varepsilon_{t-1} + \sum_{i=1}^{l_1} \mu_{1,i} \Delta \ln Y_{t-i} + \sum_{i=1}^{l_2} \mu_{2,i} \Delta \ln L_{t-i} + \sum_{i=1}^{l_3} \mu_{3,i} \Delta \ln K_{t-i} + \sum_{i=1}^{l_4} \mu_{4,i} \Delta \ln X_{t-i} + e_{3t} \quad (6)$$

$$\Delta \ln X_t = c_4 + \alpha_4 \varepsilon_{t-1} + \sum_{i=1}^{p_1} \omega_{1,i} \Delta \ln Y_{t-i} + \sum_{i=1}^{p_2} \omega_{2,i} \Delta \ln L_{t-i} + \sum_{i=1}^{p_3} \omega_{3,i} \Delta \ln k_{t-i} + \sum_{i=1}^{p_4} \omega_{4,i} \Delta \ln X_{t-i} + e_{4t} \quad (7)$$

where $\Delta \ln Y$ is the growth of output, $\Delta \ln L$ is the growth of the labour services, $\Delta \ln K$ is the growth of the capital, and $\Delta \ln X$ is the growth of the exports; e_1, e_2, e_3, and e_4 are random error terms; ε_{t-1} is the one-period lagged error correction term(ECT),and the m_i's, n_i's, l_i's, and p_i's (i = 1, ... , T) are the optimal orders of the autoregressive process for a given variable.

Equations (4) to (7) allow us to test the Granger causality. The long-run causality is indicated by the significance of *t*-statistic of the coefficient of the lagged error correction term, while the short-run causality is given by the joint significance (F-test) of coefficients of lagged differences of relevant right-hand side variables (Toda and Phillips, 1994). We focus here only on the output and exports, and thus we test the following hypotheses:

Hypothesis 1: Exports do not Granger-cause the output:

1 (a): Exports do not Granger-cause the output in the long run: $H_0 : \alpha_1 = 0$

1 (b): Exports do not Granger-cause the output in the short run $H_0 : \gamma_{4,i} = 0$ for all i

Hypothesis 2: Output does not Granger-cause exports:

2 (a): Output does not Granger-cause exports in the long run: $H_0 : \alpha_4 = 0$

2 (b): Output does not Granger-cause exports in the short run $H_0 : \omega_{1,i} = 0$ for all i

Data

We obtain the annual data for GDP (GDP), population (POP), gross fixed capital formation (GFCF), and exports (EXP) from World Development Indicators (WDI) constructed by World Bank. GDP, GFCF, and EXP are in current local currency and are converted into constant local currency using GDP deflators from WDI. The real GDP (RGDP), POP, real GFCF (RGFCF), real exports (REXP) proxy output, labor services, physical capital stock, and exports, respectively.[7] The sample ranges from 1975 to 2011.

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7 The choice of annual data arises because there are no quarterly data for these variables. In addition, Zestos and Tao (2002, p.864) argue that annual, instead of quarterly, data are suitable for testing the Granger causality.

Empirical Results

Univariate Analysis

We perform three types of univariate analysis to examine the presence of unit roots in the series; looking at plots of data, examining autocorrelations, and conducting ADF formal test for unit roots. Examining the plots in Figure 1, real GDP (RGDP), population (POPN), real gross fixed capital formation (RFCF), and real exports (REXP) appear to be non-stationary. Plots of the first differences strongly indicate that all the variables except population are stationary (not reported).

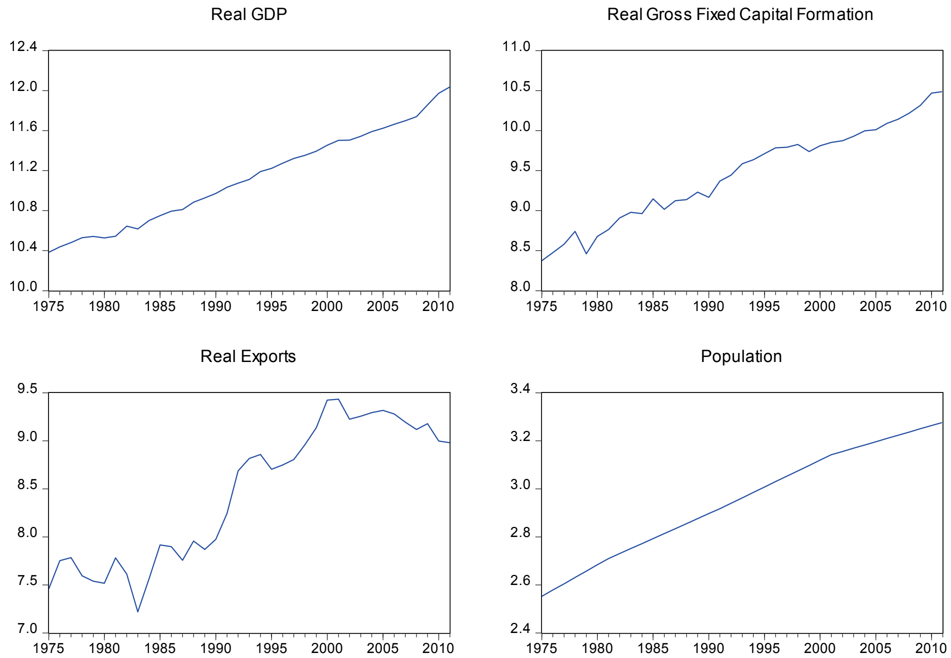


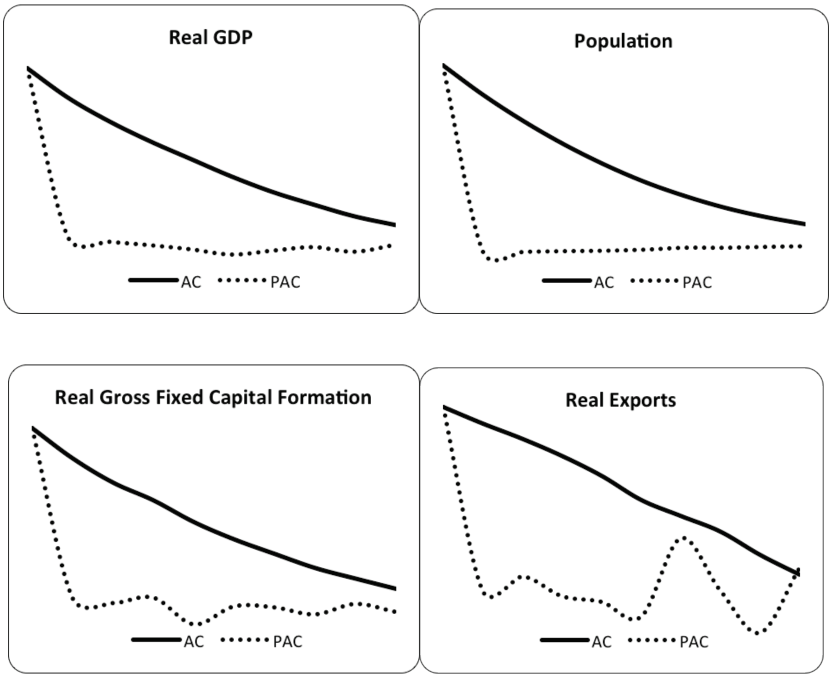
Figure 1: Evolution of Data in Levels

Notes: Real GDP, real gross fixed capital formation, and real exports are in logs.

The autocorrelations and partial autocorrelations of the variables are plotted in Figure 2. The autocorrelations of real GDP, population, real gross fixed capital formation, and real exports do not die away quickly, indicating nonstationarity. The plots of partial autocorrelations of all variables in Figure 2 exhibit a spike at the first lag suggesting AR (1) process.

Table 1 reports the results of augmented Dickey Fuller (ADF) test, which has the unit root as the null hypothesis (Dickey and Fuller, 1979, 1981). The lag length, k, for ADF is chosen by Swartz Information Criteria (SIC). The trend and intercept are included when the data are in level form, but when the data are in first difference, the trend is omitted because the data do not appear to be trending in that case. The results for ADF are presented in columns 3 and 5 of Table 1. The third column shows that levels of RGDP, POPN, RFCF, and REXP are non-stationary, while the fifth column shows that the first-differences of RGDP, RFCF, and REXP are stationary but that of POP is not stationary. We follow Sinha (1999) and proceed towards the cointegration test by excluding the population variable since it is I (2).[8]

Figure 2: Autocorrelations (AC) and Partial Autocorrelations (PAC) in Levels of the Data



Notes: Real GDP, real gross fixed capital formation, and real exports are in logs.

Table 1: Unit Roots Tests[a]

Variable	Level[c]		First-Difference[d]	
	Lag length[e]	ADF	Lag length[e]	ADF
RGDP	0	-1.405	0	-5.769[b]
POP	1	-2.969	0	-1.930
RFCF	2	-2.387	0	-9.324[b]
REXP	0	-1.368	0	-5.049[b]

[a] RGDP, POP, RFCF, and REXP denote, respectively, the logs of real GDP, population, real gross fixed capital formation, and real exports. ADF denotes the Augmented Dickey Fuller test statistic for the unit root null hypothesis. The sample period is 1975 -2011.

[b] Indicate rejection of the null at 1,5,or 10 percent level respectively. Critical values for ADF are obtained from Mackinnon (1996).

[c] Test uses intercept and deterministic time trend.

[d] Test uses intercept .

[e] Lag length selected using SIC.

8 As per the suggestion of referee, we also performed all analysis by transforming RGDP, RFCF, and REXP into per capita terms using POP. The conclusions remain qualitatively the same (results available upon request).

Cointegration Analysis

We use the maximum likelihood method developed by Johansen and Juselius (1990) and Johansen (1995) to estimate cointegrating relationship among variables: RGDP, RFCF, and REXP.[9] Following Enders (2004), the Johansen procedure is performed using the following steps: choice of optimum lag length of a VAR, determining the number of cointegrating vectors, and normalizing the cointegrating matrix and adjustment matrix.

In the first step, we estimate a vector autoregressive (VAR) model of the variables RGDP, RFCF, and REXP in their levels and selected a lag length, k, by using the Akaike Information Criteria (AIC), Swartz Information Criteria (SIC), and Hann-Quin Criteria (HQC) the statistics of which are presented in Table 2. We initially used 4 lags (k=4) for this purpose[10] .

Table 2: Statistics for the VAR Model of RGDP, RFCF, and REXP [a]

Lag length (k)	AIC (k)	SIC (k)	HQC(k)
0	-0.272	-0.136	-0.227
1	-6.633	-6.088	-6.450
2	-7.112	-6.160 [b]	-6.792 [b]
3	-7.200	-5.840	-6.742
4	-7.366 [b]	-5.597	-6.770

[a] RGDP, RFCF, and REXP denote, respectively, the logs of real GDP, real gross fixed capital formation, and real exports. The maximum lag-length is set to 4. The sample period is 1975 -2011.

[b] Indicate minimum values under each statistics.

Table 2 shows that the optimal lag length for SIC and HQC information criteria is 2 while that for AIC information criteria is four. However, we proceed with the use of VAR of lag length 2 as residuals show absence of autocorrelation and non-normality[11] when we use the autocorrelation LM test and Jarque-Bera test, respectively. Note that the number of lagged differences in a VECM is then given by k-1 (Lütkepohl, 2005).

The second step involves the determination of cointegrating vectors. Since Figure 1 indicates visible trends in individual variables, we estimate the cointegration model with unrestricted intercepts and no trends [12] (i.e., the cointegrating equations have intercept and allow the level data to have linear time trends) and with the lag length based on SIC. The null hypothesis of r cointegrating vectors (CI rank r) is tested against the alternative of r +1 cointegrating vectors using the maximum eigenvalue test statistic, and the more general trace statistic. The results are shown in Table 3.

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9 Engle and Granger (1987) methodology produces some problems when more than two variables are present. In particular, it is not invariant to the choice of the variable selected for normalization and it has no systematic procedure for the separate estimation of the multiple cointegrating vectors (Enders, 2004).

10 There is no question that some trial and error is inevitable in lag-length selection. The results remain the same when we choose the initial lag length lower or higher than 4.

11 The non-normality of residuals is accepted at 5 percent significance level.

12 Johansen (1995) considers five deterministic trend cases. We have estimated case 3.

Table 3: Test Statistics for Cointegration of RGDP, RFCF, and REXP [a]

Null Hypothesis	Alternative Hypothesis	Computed statistic	Critical Value[d]	
			5%	1%
Trace Tests[b]		Trace value		
r=0	r>0	32.027 [e]	29.68	35.65
r≤1	r>1	7.623	15.41	20.04
r≤2	r>2	1.562	3.76	6.65
Max-Eigenvalue Tests[c]		Max-Eigenvalue value		
r=0	r=1	24.404 [e]	20.97	25.52
r=1	r=2	6.061	14.07	18.63
r=2	r=3	1.562	3.76	6.65

[a] RGDP, RFCF, and REXP denote, respectively, the logs of real GDP, real gross fixed capital formation, and real exports. The cointegration model estimated corresponds to case 3 of Johansen (1995) and thus allows for the linear deterministic trend in the level data.

[b] The trace statistic tests the null hypothesis of at most r cointegrating relations against the alternative of more than r cointegrating relations.

[c] The maximum eigenvalue statistic tests the null hypothesis of at most r cointegrating relations against the alternative of r + 1 cointegrating relations.

[d] The critical values for these statistics are based on Osterwald-Lenum (1992).

[e] Significant at the 5 percent level.

The results in Table 3 strongly support the null of one cointegrating vector for both Trace and Max-Eigen tests. This is because for the null of no cointegrating vectors and alternative of one or more cointegrating vectors, the trace value 32.027exceeds the 5 percent critical value of trace statistic (29.68) but for the null of at least one cointegrating vectors and alternative of more than one cointegrating vectors, the trace value 7.623 is less than 5 percent critical value of trace statistic (15.41). In addition, maximum eigenvalue test supports the existence of one cointegrating vector for both specifications as the maximum eigenvalue value 24.404 is more than 5 percent critical value of maximum eigenvalue statistic (20.97) for the null of no cointegrating vectors and alternative of one cointegrating vector but for the null of one cointegrating vector and alternative of two cointegrating vectors, the maximum eigenvalue 6.061 is less than 5 percent critical value of maximum eigenvalue statistic (14.07). Since trace and maximum eigenvalue statistics suggest similar results, we proceed with the maintained hypothesis of one cointegrating vector.

The third step involves the normalization of the cointegrating and adjustment matrices. The estimated single cointegrating vector is given economic meaning by means of normalizing on real GDP. The corresponding long run relationship between RGDP, RFCF, and REXP (with standard errors and t-statistics in parentheses) is given by[13]

$$\text{RGDP}_t = -2.23RFCF_t + 2.08REXP_t + 14.59 \qquad (8)$$

s.e.	(0.528)	(0.400)
t	(-4.214)	(5.193)

13 The Lagrange-multiplier (LM) test suggests an absence of serial correlation in the residuals. In addition, Jarque-Bera test indicates the presence of normal residuals.

Equation (8) is the long run relationship between the three variables RGDP, RFCF, and REXP. The significance of the normalized coefficient is indicated by the *t* statistics. The export elasticity is positive as expected and significant at the 1 percent level. The elasticity entails that real GDP increases by 2.08 percent if exports increase permanently by 1 percent *ceteris paribus*. However, the negative and significant relationship between GDP and capital is not plausible. It can be explained as a long run phenomenon where growth would be enhanced by factors other than real gross fixed capital formation. It may be that the effect of investment on GDP is absorbed by the exports variable, or it may be due to persistence of political instability(frequent changes of government, strikes, and Nepal *bandha*), inadequate physical infrastructure (e.g., transportation and communication problem, irregular electricity supply, etc.), and the one decade long (1996-2006) Maoist insurgency. It could be also that increase in foreign investment through import penetration is reducing the environment climate required for the private sector's investment in Nepal.

Granger Causality Test

As the variables RGDP, RGFCF and REXP are found cointegrated and Johansen's cointegrated test indicated one cointegrating relation, Granger causality test is performed under the VECM specification, the estimate of which are presented in Table 4.

Table 4: Granger Causality Test

	ΔRGDP [a]	ΔRFCF [a]	ΔREXP [a]	Lagged ECT [b]
ΔRGDP		0.671	5.668	3.515
		(0.41)	(0.02)	
ΔRFCF	0.180		1.754	0.125
	(0.67)		(0.19)	
ΔREXP	20.087	0.053		3.798
	(0.00)	(0.82)		

[a] RGDP, RFCF, and REXP denote, respectively, the logs of real GDP, real gross fixed capital formation, and real exports. Chi-square statistic and p-value in parentheses.

[b] t-statistics (estimated) for the test of the null that the lagged error correction term (ECT) is not significantly different from zero.

Table 4 reports the results from the long-run and short-run Granger causality tests. Emphasis is placed only on the relationships between real exports and real GDP. The results for the long-run causality test in column 4 show that the lagged error correction term is statistically significant in both real GDP and real exports equations. This implies that real exports Granger cause the real GDP in the long run and vice versa. Similarly, the results for short-run causality test in column 4 for the real GDP equation and column 2 for the real export equation strongly support the short-run causality from real exports to the real GDP and vice versa. Our findings are not consistent with Reppas and Christopoulos (2005) and Pant (2005) who find only unidirectional causality from output to exportsfor Nepal. However, it should be noted that these two studies did not distinguish between long-run and short-run causality. In addition, the difference in cointegration methodology may also explain the inconsistent finding.

Conclusion

We examine the relationship between exports and output for a small developing country, Nepal, which has received little attention in such literature. Using Johansen (1991, 1995) method of multivariate cointegration and vector error correction model for the data of 1975 to 2011,the study documents long-run relationship between real exports, investment, and real GDP. In addition, the Granger causality results indicate bidirectional long-run and short-run causality between real exports and real GDP. This implies that in case of Nepal, exports serve as an 'engine of growth' and growth is also 'the engine of exports'. The most important policy implication of our finding is that any export promotion strategy will contribute to economic growth in Nepal and vice versa.

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