The Economic Journal of Nepal, Vol. 32, No. 2, April-June 2009 (Issue No. 126) © CEDECON-TU

Foreign Aid and Economic Growth in Nepal: An Application of Cointegration and Error Correction Modeling

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Abstract

This article attempts to assess the impact of foreign aid on economic growth in Nepal, using unit root test, co-integration test, and vector error correction technique for the period 1975-2003. The unit root test indicates that foreign aid and Gross Domestic Product are non-stationary in level forms and stationary in first differences. Foreign aid has significantly contributed to economic growth in Nepal by supplementing domestic savings and investment, by stimulating purchase of essential imports required for industrial growth, by maintaining a minimum level of expenditure on education and health services as well as providing skilled manpower, technical skills and organizational ability.

Introduction

The main objective of this paper is to assess the impact of foreign aid on economic growth in Nepal, using unit root test, co-integration test, and vector error correction technique for the period 1975-2003. The planners and policy makers of developing countries have assumed that foreign aid plays a crucial role in economic growth of these countries. In the early stage of development, sufficient amount of economic resources is needed to expedite the pace of economic development for which they have to depend to a large extent on foreign aid because "poor countries, like poor people, tend to consume most of their income, leaving little for savings. Thus, they depend on aid to raise investment, to purchase essential imports, and to maintain a minimum level of expenditure on education and health services" (World Bank, 1997). Aid inflows would cause investment to increase, this would generate subsequent increases in income which in turn would raise domestic savings and increase the rate of development. (Griffin, 1970, Rana and Dowling, 1988). Foreign aid not only supplements domestic saving in the receiving country but also helps to import the goods which have strategic importance in efficient industrial growth but cannot be produced domestically in the early stages of industrial development (Chenery

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and Bruno, 1962). It also contributes to growth by providing skilled manpower, technical skills and organizational ability. Furthermore, "when growth in output is limited by failure in increasing skills, domestic saving and foreign exchange simultaneously, there is likely to be underutilization of other factors such as labour, natural resources and specific type of productive capacity. By relieving these constraints, foreign assistance can make possible fuller use of domestic resources and hence accelerate growth because these bottlenecks can be temporarily relaxed by adding external resources for which current payment is not required. More efficient use can then be made of other resources, so that the growth of total output may be substantially higher than would be permitted by the rate of increase of the most restrictive domestic factor"(Chenery and Strout, 1966). Thus, foreign aid positively contributes to economic growth (Papanek, 1972).

However, foreign aid seems not to promote economic growth of developing countries. This is because aid-receiving countries were seen as engaging in aid switching, increasing their government consumption expenditures and reducing their effort to collect taxes (Rahman, 1968, Chenery and Eckstein, 1970, Weisskopf, 1972). Bowles (1987) applied the Granger-causality between aid and savings in time series data for 20 countries. He found that aid does not systematically influence savings. Rana and Dowling (1988) found foreign aid has tended to reduce investment efficiency because foreign aid may have been used to finance capital-intensive projects. It may have introduced inappropriate technology. So, Asian developing countries should rather attempt to attract foreign private investment, improve their export performance, and rely relatively less on aid because foreign private investment and export performance have contributed more than aid. Snyder (1990) analysed the effect of foreign aid on savings of 50 low-and middle-income countries from 1960s through 1980s. Aid is found to have relatively little influence on domestic savings. Boone (1995 and 1996) has concluded that aid has not significant positive impact on growth. Foreign aid has not raised growth rates in the typical poor country. Burnside and Dollar (2000) found that aid has a positive impact on growth in developing countries only with good fiscal, monetary, and trade policies but has little effect in the presence of poor policies.

Mahat (1983) finds that increasing availability of foreign aid has inhibited increasing mobilization of domestic resources. Therefore, it is necessary that the increasing external assistance be matched with the mobilization of internal resources at an even higher rate. Khadka (1996) examines the role of aid on Nepal's economy during 1961-1990. He concluded that despite Nepal's heavy dependence on foreign aid, the role of aid in improving the level of incomes, investment and savings has not been significant. Although aid has created socio-economic overheads at a high economic cost, it has failed to generate enough domestic savings. The failure of aid is also evident in agricultural sector where despite significant amount of aid invested, Nepal has turned from a net exporter of food grains to a net importer. Despite the growing dependence on foreign aid both in agriculture as well as on overall economy, an increase in dependence is associated with declining trend in food production and self-sufficiency.

Methodology and Data

Unit Root Test

Up to the present days, regression analysis based on time series data assumes that most macroeconomic time series are stationary. But it is now a well-known fact that most macroeconomic time series are non-stationary (Dickey-Fuller, 1979, Gujarati, 1995:729). In such a case, applying standard regression models to non-stationary data is inappropriate because of the possibility of obtaining spurious relationship which makes hypothetical test results unreliable. Hence, to avoid a spurious relationship, detecting the stationary or non-stationary of time series is crucial. For this purpose, augmented Dickey-Fuller unit root test and Phillips-Perron unit root test has been conducted on each variable. The Augmented Dickey-Fuller Test is as follows:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \sum_{i=1}^{n} \theta \ \Delta Y_{t-i} + \varepsilon_t \qquad \ldots (1)$$

Where Δ is the first difference operator, t is the time trend, ε is the stationary random error, and n is the maximum lag length.

The Phillips-Perron test (Phillips and Perron, 1988) gives robust estimates in comparison with the ADF test. Hence, Phillips-Perron test has also been used in addition to the conventional ADF test. The test detects the presence of a unit root in a series, say Y_t, by estimating,

$$\Delta Y_t = \ + \ *Y_{t-1} + e_t \qquad \ldots (2)$$

The PP test is the t-value associated with the estimated coefficient of *. The series is stationary if * is negative and significant.

Johansen Co-integration Test

After confirming the non-stationary of time series in their levels, the next step is the investigation of presence of co-integration between GDP and foreign aid. It is used to ascertain the long run relationship between GDP and foreign aid. For this purpose, Johansen co-integration procedure has been utilized (Johansen, 1988, Johansen and Juselius, 1990). Co-integration and Error Correction techniques are suitable for investigating the statistical relationship among non-stationary data and help exploring the dynamics of short run changes and the long run equilibrium relationship of time series variables (Ahmed et al., 1993). The OLS regression, which is called the co-integrating regression, tests the co-integration between the two series, Aidt and GDP:

The Johansen procedure analyses the relationship among stationary or non-stationary variables using the following equation:

$$Xt = \sum_{i=1}^{p} \prod_i Xt-1 + \varepsilon_t \qquad \ldots (3)$$

This function can be presented according to the following VAR system:

$$\Delta Xt = \prod Xt-1 + \sum_{i=1}^{r-1} \phi \Delta Xt-1 + \mu + \varepsilon_t \quad ...(4)$$

In which X_t is an n × 1 random vector, ε_t is NIID (0, Σ_ε), and μ is deterministic terms. The long-run relationships are captured in the coefficient matrix of ", denoted by r, is between 0 and n. Then there are r linear combinations of the variables in the system that are I (0) or co-integrated. Under Johansen (1991), and Johansen and Juselius (1990) procedures, two tests are available for the determination of co-integrating vectors and for the estimation of their values. These tests are the trace test and the eigen value test. In Johansen's method, a two-stage testing procedure has been implemented. In the first stage, the null hypothesis of no co-integration is tested against the alternative that the data are co-integrated with an unknown co-integrating vector. If the null hypothesis is rejected, a second stage test is implemented with co-integration maintained under both the null and alternative.

Vector Error Correction Modeling

If the variables are co-integrated or if the null hypothesis of no co-integration is rejected, the residuals from the equilibrium regression can be used to estimate the error correction term. Simple contemporaneous correlation based tests assume that the causation is unidirectional—from aid to GDP. This is, as a matter of fact, unrealistic since the causation may even be bi-directional—from GDP to aid and aid to GDP—given the level and degree of economic structure. A necessary precondition to causality testing is to check the co-integrating properties of the variables under consideration, since standard tests for causality are not valid if there exists co-integration (Granger, 1988, Bahmani-Oskooee and Alse, 1993). Standard tests for causality (i.e.Granger/Sims tests) are only valid if the original time series, from which growth rates are obtained, are not co-integrated (Ghatak et al., 1997). So, the relevant error correction term is included in the standard causality tests, if the variables are found to be co-integrated. The causal relationship between these variables is examined through Vector Error Correction Model (VECM), which may take the following form:

$$\Delta Y_t = \alpha_1 + \rho_1 z_{t-1} + \sum_{j=1}^{r} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{s} \delta_j \Delta Aid_{t-j} \quad ... (5)$$

$$\Delta Aid_t = \alpha_2 + \rho_2 z_{t-1} + \sum_{j=1}^{r} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{s} \delta_j \Delta Aid_{t-j} \quad ... (6)$$

Where, z_{t-1} is an error correction term, representing the long run relationship. If both coefficients (ρ_1 and ρ_2) are significant, this will suggest the bi-directional causality. But, if only ρ_1 is significant, this will suggest a unidirectional causality from aid to GDP, implying that foreign aid drives economic growth toward long run equilibrium. If only ρ_2 is significant, this will suggest a unidirectional causality from GDP to aid, implying that economic growth drives foreign aid toward long run equilibrium. The ECM allows for the finding that foreign aid cause economic growth as long as the error correction term ρ_1 carries a significant coefficient with a negative sign.

This study uses annual data on foreign aid and Gross Domestic Product for Nepal. The data cover the period 1975 through 2003. All the data are collected from the Economic Survey published by Ministry of Finance, HMG/N. The data are expressed in real terms, deflated by the GDP deflator (1995=100).

Empirical Results

The results of the augmented Dickey-Fuller (ADF) Unit Root Test for aid and Gross Domestic Product (GDP) of Nepal are reported in Table 1.

Table 1: Augmented Dickey-Fuller Unit Root Tests

		ADF Test Statistic		MacKinnon Critical Values		
		ForeignAid	GDP	1 %	5 %	10 %
Without trend	Level	-2.16 (0.22)	1.43 (0.99)	-3.69	-2.97	-2.63
	1ST Difference	-6.13 (0.00)	-4.95 (0.00)	-3.69	-2.97	-2.63
With trend	Level	-1.19 (0.89)	-1.79 (0.68)	-4,32	-3.58	-3.23
	1ST Difference	-7.07 (0.00)	-5.58 (0.00)	-4.34	-3.58	-3.23

Notes: Figures in parenthesis indicate MacKinnon (1996) p-values, which indicate the level of significance.
Source: Computed by the Author Based on Economic Survey (Various Years), Ministry of Finance, Government of Nepal.

Since the computed ADF test statistic of all the variables are higher than any of these MacKinnon Critical values at level forms, the null hypothesis that these variables exhibit a unit root cannot be rejected. Because of the presence of unit roots in all the time series, they are non-stationary implying no statistically meaningful relationship between them. However, after first differencing, the null hypothesis of unit root is rejected in all of the cases since the ADF test statistic is smaller than MacKinnon critical values. That is, the first differenced aid and GDP do not exhibit a unit root, meaning that these variables are stationary.

Likewise, the results of the Phillips-Perron Unit Root statistic for aid and GDP of Nepal are presented in Table 2.

Table 2: Phillips-Perron Unit Root Tests

		PP Test Statistic`		MacKinnon Critical Values	
		Foreign Aid	GDP	5 %	10 %
Without trend	Level	-2.16 (0.22)	1.58 (0.99)	-2.97	-2.62
	1ST Difference	-6.13 (0.00)	-4.95 (0.00)	-2.97	-2.62
With trend	Level	-0.91 (0.94)	-1.77 (0.69)	-3.58	-3.23
	1ST Difference	-7.22 (0.00)	-5.58 (0.00)	-3.58	-3.23

Source: Computed by the Author Based on Economic Survey (Various Years), Ministry of Finance, Government of Nepal

Since the computed PP test statistics of aid and GDP are higher than any of these MacKinnon Critical values at level forms, the null hypothesis that these variables exhibit a unit root cannot be rejected. Because of the presence of unit roots in the variables, they are nonstationarity implying no statistically meaningful relationship between them. However, after first differencing, the null hypothesis of unit root is rejected in all of the cases since the PP test statistic is smaller than MacKinnon critical values. That is, the first differenced aid and GDP do not exhibit a unit root, meaning that these variables are stationary. Hence, both augmented Dickey-Fuller test and PP test have similar results that all the variables have unit root in level forms and no unit root in the first difference.

Having determined the non-stationary of time series in their levels and they are also of the same order of integration [2] (1), Johansen procedure has been applied to ascertain whether aid and GDP are co-integrated or not, assuming no deterministic trend in data. Because in the case of nonstationarity in the time series data, the most appropriate procedures are co-integration and error-correction models. The results of the Johansen co-integration tests are presented in Table 3:

Table 3: Johansen Cointegration Test

Eigen value	Trace Statistic	Ho	H_1	5% Critical value	1% Critical value	Max-Eigen Statistic	Ho	H_1	5% Critical value	1% Critical value
0.62	26.36**	r=0	r ≥1	12.53	16.31	26.36**	r =0	r =1	11.44	15.69
0.00	0.00	r≤1	r ≥2	3.84	6.51	0.00	r≤1	r=2	3.84	6.51

Notes: H_o = Null Hypothesis, and H_1 = Alternative Hypothesis.
Source: Computed by the Author Based on Economic Survey (Various years), Ministry of Finance, Government of Nepal.

The null hypothesis of no co-integration between GDP and Aid is rejected, since both Trace and Max-Eigen statistics are larger than the critical values at 1 percent significance level. In other words, for co-integrating regression GDP = f (Aid), one can reject the null hypothesis r= 0 against the alternative hypothesis r = 1 since both Trace and Max-Eigen statistics are larger than the critical values at 1 percent significance level but cannot reject the null r≤1 against the alternative r= 2 since both Trace and Max-Eigen statistics are less than the critical values even at 5 percent level. The fact that the presence of co-integration between aid and GDP suggest (i) that there is a long run equilibrium relationship between the two time series and (ii) the existence of causality in at least one direction. All this indicates that GDP and aid is co-integrated, which is sufficed to indicate that aid bears a long run equilibrium relationship with GDP in Nepal.

After confirming that Aid and GDP are co-integrated, it is appropriate to find out the direction of causality between them through estimating the Vector Error Correction Model. The results of the Vector Error Correction Estimates are presented in Table 4.

Table 4: Vector Error Correction Estimates

GDP Equation (ΔGDP)			Foreign Aid Equation (ΔAid)		
Z_{t-1}	ΔAid (-1)	ΔAid (-2)	Z_{t-1}	ΔGDP (-1)	ΔGDP (-2)
-0.06	-3.68	-0.94	0.01	0.02	0.03
(-3.47)	(-2.99)	(0.62)	(1.81)	0.54)	(0.73)

Note: Figures in parenthesis indicate t-statistics.
Source: Computed by the Author Based on Economic Survey (Various Years), Ministry of Finance, Government of Nepal

The error correction coefficient (Z_{t-1}) indicates two things. The significance of the error correction coefficient, which is determined by the t-ratio given below the coefficient, with a negative sign indicates Granger causality in at least one direction whereas the magnitude of the error correction coefficient indicates the speed of adjustment of any disequilibrium toward a long-run equilibrium state. The results show that the error correction term in the GDP equation is statistically significant at the 1 percent level with a correct negative sign, indicating that foreign aid has significantly contributed to economic growth in Nepal. The significance in the error correction coefficient in the GDP equation implies that foreign aid in Nepal adjusts to changes in GDP. The coefficient of 0.06 in the GDP equation indicates that adjustment towards the long-run relationship is about 6 percent per annum. This suggests that any deviation from the long-run equilibrium is corrected substantially the following year. While that the error correction term in the foreign aid equation is not significant and a wrong positive sign which indicates that economic growth has not significantly contributed to foreign aid in Nepal. The error correction term of GDP equation is significant and of foreign aid equation is not significant which indicates the absence of bi-directional causality. Thus, it can be inferred that foreign aid has promoted economic growth in Nepal by supplementing domestic savings and investment by stimulating

purchase of essential imports required for industrial growth, by maintaining a minimum level of expenditure on education and health services, and by providing skilled manpower, technical skills and organizational ability.

Concluding Remarks

The unit root test indicates that foreign aid and GDP are non-stationary in level forms and stationary in first differences. The error correction term of GDP equation is statistically significant with a correct negative sign and of foreign aid equation is not significant, which indicates strong unidirectional causality from foreign aid to GDP. This means foreign aid has significantly contributed to economic growth in Nepal by supplementing domestic savings and investment by stimulating purchase of essential imports required for industrial growth by maintaining a minimum level of expenditure on education and health services as well as by providing skilled manpower, technical skills and organizational ability.

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