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Does Foreign Aid Increase External Debt Burden in Bangladesh? A Dynamic Causality and Cointegration Analysis

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Abstract: *This paper investigates the impact of foreign aid, amongst other determinants, on the long-term external debt of Bangladesh using time series data. Long-run causality from external debt to foreign aid is observed. Bidirectional causalities exist between external debt and government spending, between external debt and trade openness, and between government spending and economic growth. Unidirectional causalities are observed from government spending to domestic investment, trade openness to government spending, and economic growth to external debt, foreign aid and trade openness. The short-run and the long-run effects of foreign aid on external debt are positive which indicate that massive aid inflows in Bangladesh increase the external debt trap but significantly increase in the short-run. The long-run and short-run effects of domestic investment on external debt are significantly positive while trade openness and economic growth are insignificantly negative. It is found that when external debt level is above or below its equilibrium level it adjusts by almost 18.98% within the first year. The full convergence process to its equilibrium level takes about 5.27 years.*

JEL Classification: C23, C32, C33, O50, O55, O57, Q40

Keywords: Cointegration, Granger Causality, Short-Run and Long-Run Elasticities

1. Introduction

The nature of relationship between foreign aid, economic growth, trade openness, domestic investment, government spending and external debt is very important for macroeconomic long-run and short-run policies. As a poor country, foreign aid has been the primary source of foreign capital for economic growth and development in Bangladesh. According to UNCTAD Statistics, during the period 1972-2010, average annual overseas development assistance (as percentage of GDP) received by Bangladesh was 5.005. During the same period, average annual long-term external debt (as percentage of GDP) was almost 29.227%, which is almost 6 times of foreign aid while

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during this period the average annual growth rate of GDP is 4.42% and the annual average growth rate of per capita real GDP is 2.13%. During the time period which indicates that the standard of living of the people of Bangladesh is not increasing at a satisfactory level. A report published by the World Bank in March 2012 revealed that 43.3% of the population of Bangladesh is still living below the poverty line was still living below the poverty line (less than 1.25 $ a day at 2005). Thus an important question arises about the effectiveness of the amount of foreign aid that Bangladesh has received from the external sources over a period of times as a means of attaining sustainable economic growth and development. Therefore, research of this aspect becoming more importance for the developing and poor countries. Now-a-days, studies draw a greater attention for the researchers to investigate the cointegrating and causal relationships between long-term external debt, foreign aid, and economic growth including other control variables. The enormous amount of empirical works to examine the causal relationship between external debt and foreign aid fall into four categories; (i) no causal relationship between external debt and foreign aid, (ii) unidirectional causality from external debt to foreign aid, (iii) unidirectional causality from foreign aid to external debt, and bidirectional causality between them. Therefore, this paper investigates the cointegrating and causal relationships between long-term external debt, foreign aid, government spending, domestic investment, trade openness (all measured as a percentage of GDP) and economic growth using the times series data from 1972-2010. The paper is organized as follows: Section II presents a review of empirical literature, Section III discusses the data sources and the methodology used, Section IV discusses the empirical analysis, and Section V presents the concluding remarks.

2. Literature Review

Most of the empirical studies provide mixed evidence of growth effectiveness of foreign aid. Although Levy (1998), Gounder (2001), Murty, Ukpolo and Mbaku (1994) found positive effects of foreign aid on economic growth, White (1992), Boone (1994, 1996), Lal (1996, 2005), Nyoni (1998) Martens *et al*. (2002), Easterly (2003), Rajan and Subramanian (2005), Djankov et al. (2006), Mallik (2008) and Hossain and Mitra (2010) reported a negative impact of foreign aid on economic growth. Esterly, et. al (2004) reported lack of any relationship between foreign aid and economic growth. Burke and Ahmadi-Esfahani (2006) also observed an insignificant relationship. Most of the studies reporting an absence or even negative growth effects of foreign aid consider large and persistent external debt burden as the primary reason for slow economic growth (Aluko and Arowolo, 2010). Factors such as “debt overhang” and loan conditionalities lead to an accumulation of foreign debt that curbs economic growth of the heavily aid-dependent

countries like as Bangladesh. Other recent studies on the determinants of external debt include Awan et al. (2011), Seetanah, Padachi and Durbarry (2007), Lane (2004) and Kemal (2001). Most studies have looked at the effect of foreign aid on the external debt burden of Asia primarily through country-specific analyses. This paper examines the direct link between external debt and foreign aid in case of Bangladesh through a dynamic cointegration and causal analysis. This has important policy implications for the receiving of foreign aid toward attaining sustainable economic growth and development in Bangladesh.

3. The Data and the Empirical Model

This study uses annual time series data from 1972 to 2010 of Bangladesh in order to find the long-run relationship. The variables in the model are long-term external debt stocks (EXD), foreign aid (FAID), government spending (GSP), trade openness (OPN), domestic investment (DIV) and economic growth (PGDP). External debt (EXD) is the total long-term (outstanding) debt of an economy. Foreign aid is the "net" disbursements received by an economy. Government spending is the general government final consumption expenditure. The trade openness index measuring the degree of trade liberalization of a country is constructed by dividing the sum of exports and imports by nominal GDP of that country. The variables are measured in US dollars at current prices and current exchange rates and are expressed as a percentage of nominal GDP. Per capita real GDP (constant 2000 USD) is used as the indicator of economic growth of Bangladesh. The data sources are UNCTAD Statistics and Word Bank development indicator.

The long-run impact of foreign aid, government spending, trade openness, domestic investment and economic growth is examined by estimating the following model:

$$EXD_t = A_0 FAID_t^{\beta_1} GSP_t^{\beta_2} OPN_t^{\beta_3} DIV_t^{\beta_4} PGDP_t^{\beta_5} e^{\varepsilon_t} \quad (1)$$

The logarithmic transformation of the model gives

$$\ln EXD_t = \beta_0 + \beta_1 \ln FAID_t + \beta_2 \ln GSP_t + \beta_3 \ln OPN_t + \beta_4 \ln DIV_t + \beta_5 \ln PGDP_t + \varepsilon_t \quad (2)$$

where, $\beta_0 = \ln(A_0)$; represents the time period under consideration, respectively. The parameters β_1, β_2, β_3, β_4 and β_5 are the long-run elasticities of external debt with respect to FAID, GSP, OPN, DIV, and PGDP respectively.

4. Cointegration and Causality Analysis

An investigation of the dynamic causal relationships between the variables involves three steps. The existence of a unit root in each variable is first examined. If a unit root is present, then the long run-cointegration relationships between the variables are tested. If a long-run relationship between the variables is observed, then a VECM is estimated to determine the causal relationships between the variables. The GMM technique is finally applied to examine the short-run and the long-run relationships between the variables.

4.1 Unit Root Test

It is well known that the usual techniques of regression analysis can result in highly misleading conclusion when variables contains stochastic trend (Stock and Watson (1988), Granger and Newbold (1974)). In particular if the dependent variable and at least one independent variable contain stochastic trend, and if they are not co-integrated, the regression results are spurious, (Phillips (1986), Granger and Newbold (1974)). To identify the correct specification of the model, an investigation of the presence of stochastic trend in the variables is needed. The Augmented Dickey-Fuller (ADF) test is applied in order to investigate that each of the variables contains stochastic trend or not. The estimation technique of these two tests is described below;

$$\Delta X_t = \alpha_0 + \alpha_1 t + \theta X_{t-1} + \sum_{i=1}^{m} \phi_i \Delta X_{t-i} + u_t \quad (3)$$

Here X_t is the series under investigation, Δ stands for first difference and the lagged difference terms on the right hand side of the equations are designed to correct for serial correlations of the disturbance terms. The lagged differences are selected by using AIC and SBIC criteria. If θ = 0, the series X_t contains a unit root and therefore an I(1) process governed by a stochastic trend. If a time series variable is integrated of order one, we have to investigate the 2nd order unit root and the equation is given by;

$$\Delta^2 X_t = \beta_0 + \lambda \Delta X_{t-1} + \sum_{i=1}^{m} \gamma_i \Delta^2 X_{t-i} + \varepsilon_t \quad (4)$$

where Δ^2 is the second-difference operator. If $\lambda = 0$, the series X_t is said to be integrated of order two (I(2)). Let d represents the number of times that X_t needs to be differenced in order to reach the stationary. In this case X_t is said to be integrated of order d and is denoted by I(d). Since the estimated θ does not have the usual asymptotic distribution, the values tabulated by MacKinnon (1991) are used; these values are more accurate than the ones original tabulated by Fuller (1976) and Dickey-Fuller (1987). Table 1 contains the results of the Augmented Dickey Fuller test for each variable at both cases.

Table 1: The Augmented Dickey-Fuller (ADF) Test Results

Variable	Case 1: [Level Form]				Case 2: [Level Form]			
	Test	Lags	AIC	SBIC	Test	Lags	AIC	SBIC
lnEXD	-0.8662	2	-4.9175	-4.9175	-1.59663	1	-4.8452	-4.7159
lnFAID	-3.1785	1	-3.0447	-2.8724	0.2479	1	-2.7501	-2.6209
lnGSP	-2.9555	4	-6.0084	-5.6973	-0.7670	4	-5.7938	-5.5272
lnOPN	-2.6998	1	-3.9249	-3.7525	-0.6804	4	-4.8481	-4.5815
lnDIV	-3.0249	3	-4.4501	-4.1862	-2.1458	3	-4.3738	-4.1539
lnPGDP	1.2688	3	-8.6924	-8.4285	2.9046	3	-8.7391	-8.5191
Variable	Case 1:[Differenced Form]				Case 2: [Differenced Form]			
ΔlnEXD	-7.2756**	1	-4.9476	-4.7735	-6.3899**	1	-4.8233	-4.6927
ΔlnFAID	-7.0573**	2	-3.2152	-2.9952	-6.8676**	2	-3.2083	-3.032
ΔlnGSP	-3.9094*	1	-3.2585	-3.0844	-3.7129**	1	-3.2705	-3.1399
ΔlnOPN	-5.6206**	2	-4.0484	-3.8285	-5.6257**	2	-4.0446	-3.8687
ΔlnDIV	-3.8991*	2	-4.2314	-4.0115	-4.2953**	2	-4.2866	-4.1106
ΔlnPGDP	-7.6408**	1	-8.5464	-8.3722	-1.2612	2	-8.5468	-8.3709

Case 1 : Constant and trend terms one included in the model.

Case 2 : Only constant term is included in the model.

The results indicate that all the variables are integrated of order one.

4.2 Cointegration Test

To investigate the cointegrating relationship, I also applied the Johansen and Juselius's, (JJ, 1990) test. Since the Johansen and Juselius's (1990) multivariate cointegration methodology is fairly well documented, a brief reminder of this method is given below

$$\Delta X_t = B_0 + \Pi X_{t-p} + \sum_{i=1}^{p} B\Delta X_{t-i} + \eta_t \quad (5)$$

where X_t represents a vector of endogenous I(1) variables, B_0 represents a vector of constant terms, B is a matrix of coefficients, η_t is a vector of residuals, and p denotes the lag length. All variables in equation (5) are deemed to be potentially endogenous. The

long-run equilibrium relationship among X_t is determined by the rank of Π (say r). If r is zero, the variables in level form do not have any cointegration relationship and the equation (5) can be transformed to VAR model of pth order. If 0<r<n, then there are $n \times r$ matrices of α and β such that

$$\Pi = \alpha\beta' \tag{6}$$

The strength of cointegration relationship is measured by α, β is called cointegration vector and $\beta' X_t$ is I(0) although X_t are I(1). The cointegrating rank can be found via the trace and the maximum eigenvalue tests. The lag length of the unrestricted vector autoregressive (VAR) model in equation (5) is determined on the basis of AIC and SBIC criteria and the adjusted likelihood ratio (LR) test is most commonly used. The test results are reported in Table (2).

Table 2 Results of the Johansen and Juseliues's cointegration test

Hypothesized No. of Cointegrated Equation(s)	Trace Statistic	5% Critical Values	Max-Eigen Statistic	5% Critical Value
None	221.2572*	95.7536	91.1041*	40.0776
At Most 1	130.1531*	69.8189	77.5232*	33.8769
At Most 2	52.6299*	47.8561	28.9320*	27.58434
At Most 3	26.6980	29.7971	20.1569	21.1316
At Most 4	6.5410	15.4947	6.3019	14.2646
At Most 5	0.2392	3.8415	0.2392	3.8415

Model: Intercept and no trend in cointegration equation and VAR:

The trace and max-eigen value tests results support that there exist 3 cointegrating equations at 5% level.

4.3 Granger Causality Test

The cointegration relationship indicates the existence of causal relationship between variables but it does not indicate the direction of causal relationship between variables. Therefore it is common to test for detecting the causal relationship between variables using the Engle and Granger test procedure. There are three different models that can be

used to detect the direction of causality between two variables X and Y depending upon the order of integration and the presence or absence of cointegration relationship. If two variables say X and Y are individually integrated of order one I(1) and cointegrated, then Granger causality test may use I(1) data because of super consistency properties of estimators. If X and Y are I(1) and cointegrated, the Granger causality test can be applied to I(0) data with an error correction term. If X and Y are I(1) but not cointegrated, Granger causality test requires transformation of the data to make I(0).

For this paper, the presence of cointegration relationship the application of Engle and Granger (1987) causality test in the first differenced variables by means of a VAR will misleading the results, therefore an inclusion of an additional variable to the VAR system such as the error correction term would help us to capture the long-run relationship. The augmented form of the Granger causality test involving the error correction term is formulated in a multivariate pth order vector error correction model given as below;

$$\begin{bmatrix} \Delta \ln EXD_t \\ \Delta lnFAID_t \\ \Delta lnGSP_t \\ \Delta lnOPN_t \\ \Delta lnDIV_t \\ \Delta lnPGDP_t \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \\ C_5 \\ C_5 \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} \beta_{11i} & \beta_{12i} & \beta_{13i} & \beta_{14i} & \beta_{15i} & \beta_{16i} \\ \beta_{21i} & \beta_{22i} & \beta_{23i} & \beta_{24i} & \beta_{25i} & \beta_{26i} \\ \beta_{31i} & \beta_{32i} & \beta_{33i} & \beta_{34i} & \beta_{35i} & \beta_{36i} \\ \beta_{41i} & \beta_{42i} & \beta_{43i} & \beta_{44i} & \beta_{45i} & \beta_{46i} \\ \beta_{51i} & \beta_{52i} & \beta_{53i} & \beta_{54i} & \beta_{55i} & \beta_{56i} \\ \beta_{61i} & \beta_{62i} & \beta_{63i} & \beta_{64i} & \beta_{65i} & \beta_{66i} \end{bmatrix} \begin{bmatrix} \Delta lnEXD_{t-i} \\ \Delta lnFAID_{t-i} \\ \Delta lnGSP_{t-i} \\ \Delta lnOPN_{t-i} \\ \Delta lnDIV_{t-i} \\ \Delta lnPGDP_{t-i} \end{bmatrix} + \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \lambda_4 \\ \lambda_5 \\ \lambda_6 \end{bmatrix} ECM_{t-1} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \quad (7)$$

where, t = p+1, p+3,……..,T; .The C's, β's and λ's are the parameters to be estimated. ECM_{t-1} represents the one period lagged error-term derived from the cointegration vector and the ε's are serially independent with mean zero and finite covariance matrix. From the equation (7) given the use of a VECM structure, all variables are treated as endogenous variables. The F test is applied here to examine the direction of any causal relationship between the variables. The FAID does not Granger cause EXD in the short run, if and only if all the coefficients β_{12i}'s $\forall$ i are not significantly different from zero in equation (7). Similarly the EXD does not Granger cause FAID in the short run if and only if all the coefficients β_{21i}'s $\forall$ i are not significantly different from zero in the equation (7). There are referred to as the short-run Granger causality test. The coefficients on the ECM represent how fast deviations from the long-run equilibrium are eliminated. Another channel of causality can be studied by testing the significance of ECM's. This test is referred to as the long run causality test. The short-run and long-run Granger causality results are reported below in Table (3).

Table 3 Granger F-test results

	$\Delta \ln EXD$	$\Delta lnFAID$	$\Delta lnGSP$	$\Delta lnOPN$	$\Delta lnDIV$	$\Delta lnPGDP$	ECM
$\Delta \ln EXD$		2.1663 (0.1384)	7.3468* (0.0036)	2.6472** (0.0933)	2.2267 (0.1316)	5.4920* (0.0116)	-2.16343* (0.0416)
$\Delta lnFAID$	2.3170 (0.1223)		1.1088 (0.3477)	1.2319 (0.3111)	1.8428 (0.1819)	5.3116* (0.0131)	-0.76421 (0.4528)
$\Delta lnGSP$	3.6472* (0.0481)	0.0168 (0.9833)		4.7814* (0.0188)	0.7919 (0.4654)	10.7749* (0.0005)	-0.01277 (0.9899)
$\Delta lnOPN$	5.6112* (0.0107)	2.4579 (0.1087)	0.0461 (0.9550)		1.0759 (0.3582)	5.5155* (0.0114)	0.38335 (0.7051)
$\Delta lnDIV$	2.2483 (0.1293)	0.6127 (0.5508)	3.1674** (0.0618)	0.0406 (0.9603)		2.0343 (0.1546)	-0.24466 (0.8089)
$\Delta lnPGDP$	0.4471 (0.6451)	0.4174 (0.6638)	7.2339* (0.0038)	2.3742 (0.1165)	3.8341* (0.0372)		0.38539 (0.7036)

The reported values in parentheses are the p-values of the test. *:indicates significant at 5% level, **: indicates significant at 10% level.

The results of the Granger causality establish bidirectional causalities between external debt and government spending, between external debt and trade openness, and between government spending and economic growth. The findings also indicate short-run unidirectional causalities from government spending to domestic investment, trade openness to government spending, economic growth to external debt, foreign aid and trade openness. The error correction term indicates that existence of long-run relationship from external debt to other variables.

4.4 Short-run and Long-run Elasticity

The short run elasticities of external debt with respect to FAID, GSP, OPN DIV and PGDP, can be obtained by estimating the following error correction model

$$\Delta lnEXD_t = \alpha_1 \Delta lnFAID_t + \alpha_2 \Delta lnGSP_t + \alpha_3 \Delta lnOPN_t + \alpha_4 \Delta lnDIV_t + \alpha_5 \Delta lnPGDP_t + \lambda ECM_{it-1} + \varepsilon_t \quad (8)$$

where, ε_t is the random error term, α_1, α_2, α_3, α_4, α_5,and λ are the parameters to be estimated. The parameters α_1, α_2, α_3, α_4, and α_5 represent the short-run elasticities of external debt with respect to FAID, GSP, OPN DIV and PGDP respectively. The parameter λ represents speed of adjustment for short-run to reach in the long-run equilibrium.

For long-run elasticity, now considering the following regression equation

$$\ln EXD_t = \mu + \beta_1 \ln FAID_t + \beta_2 \ln GSP_t + \beta_3 \ln OPN_t + \beta_4 \ln DIV_t + \beta_5 \ln PGDP_t + \sum_{i=1}^{p} \lambda_i \Delta \ln FAID_{t-i} + \sum_{i=1}^{p} \delta_i \Delta \ln GSP_{t-i} + \sum_{i=1}^{p} \phi_i \Delta \ln OPN_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta \ln DIV_{t-i} + \sum_{i=1}^{p} \eta_i \Delta \ln PGDP_{t-i} + \omega_t \quad (9)$$

The equation is augmented with lead and lagged differences of the regressors to control for endogeneous feedback. The GMM is applied to estimate both equation which control the problem of endogeneity and serial correlation of regressors. The estimated results are given in Table (4)

Table 4 Long-run and short-run elasticities

Dependent variable $\ln EXD$ Long-run elasticities	Coefficient	t-tatistic	Probability
Constant	0.6897	0.2080	0.8365
lnFAID	0.1104	0.4016	0.6905
lnGSP	0.0885	0.2705	0.7884
lnOPN	-0.2785	-0.5903	0.55894
lnDIV	1.2955*	4.7526	0.00003
lnPGDP	-0.0919	-0.14892	0.8825
Dependent variable $\Delta \ln EXD$ Short-run elasticities	Coefficient	t-Test	Probability
ΔlnFAID	0.2619*	2.1264	0.0335
ΔlnGSP	-0.1396	-0.5104	0.6097
ΔlnOPN	-0.2091	-0.8796	0.3791
ΔlnDIV	1.0571	3.1926	0.0014
ΔlnPGDP	-0.38546	-0.5268	0.5983
ECM	-0.1898**	-1.9112	0.0559
Sensitivity Analysis	The Short-run Diagnostic Test Results		
LM Test for Autocorrelation	0.384625		0.53513
ARCH Test	0.070425		0.79071967
LM test for Heteroscedasticity	8.405321		0.1131

*: indicates significant at 1% level, **: indicates significant at 5% level.

The short-run and the long-run elasticities of external debt with respect to foreign aid are positive which indicate that massive aid inflows in Bangladesh increase the external debt trap but significantly increase in the short-run. Although the short-run and long-run elasticities of external debt with respect to domestic investment are positive and are statistically significant, thereby implying that increases in domestic investment results in a long-run external debt. The short-run and long-run elasticities of external debt with respect to trade openness and economic growth are negative but not statistically significant. The long-run elasticity of external debt with respect to government spending is positive but not statistically significant. The ECM term is negative and statistically significant at 10% level. The coefficient of ECM (-1) is -0.1898 with the expected sign, suggesting that when external debt level is above or below its equilibrium level it adjusts by almost 18.98% within the first year. The full convergence process to its equilibrium level takes about 5.27 years. Thus the speed of adjustment is significantly faster in case of any shock to the external debt burden equation. The long-run elasticity of external debt with respect of domestic investment (1.2955) is higher than short-run elasticity of 1.0571. This means over time more domestic investment gives rise to more external debt in Bangladesh.

Sensitivity Analysis: Diagnostic tests results indicate that there is no evidence of serial correlation, and heteroscedasticity. Also the autoregressive conditional heteroscedasticity is not present in the short-run model.

5. Conclusion

Using dynamic cointegration and causality analysis this paper has studied the impact of foreign aid, amongst other determinants, on the long-term external debt of Bangladesh for the period 1972-2010. This paper has used the GMM approach to examine the short-run and the long-run elasticities of external debt in respect of foreign aid, government spending, trade openness, domestic investment and economic growth. The ADF unit root test results indicate that all the variables are integrated of order one. The Johansen cointegration test establishes cointegrating relationships between the variables. The Granger F-test results indicate bidirectional causalities between external debt and government spending, between external debt and trade openness, and between government spending and economic growth. The findings also indicate short-run unidirectional causalities from government spending to domestic investment, trade openness to government spending, economic growth to external debt, foreign aid and trade openness. The error correction term indicates that existence of long-run relationship from external debt to other variables. The short-run and the long-run elasticities of external debt with respect to foreign aid are positive which indicate that massive aid inflows in Bangladesh increase the external debt trap but significantly increase in the

short-run. Although the short-run and long-run elasticities of external debt with respect to domestic investment are positive and are statistically significant, thereby implying that increases in domestic investment results in a long-run external debt. The short-run and long-run elasticities of external debt with respect to trade openness and economic growth are negative but not statistically significant. The long-run elasticity of external debt with respect to government spending is positive but not statistically significant. The ECM term is negative and statistically significant at 10% level. The coefficient of ECM (-1) is -0.1898 with the expected sign, suggesting that when external debt level is above or below its equilibrium level it adjusts by almost 18.98% within the first year. The full convergence process to its equilibrium level takes about 5.27 years. Thus the speed of adjustment is significantly faster in case of any shock to the external debt burden equation. The long-run elasticity of external debt with respect of domestic investment (1.2955) is higher than short-run elasticity of 1.0571. This means over time more domestic investment gives rise to more external debt in Bangladesh. Diagnostic tests results indicate that there is no evidence of serial correlation, and heteroscedasticity. Also the autoregressive conditional heteroscedasticity is not present in the short-run model. Based on the results of the cointegration and causality analysis, diversification and restructuring of the Bangladesh economy in a manner that will channelize grants for technological development, expansion of manufacturing sector and human development (Oyejide et. al, 1983) will expectedly boost national output and income and reduce dependency on foreign-aid and, consequently, lessen long-term external debt burden and pave the way for faster economic growth.

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