

AN EXAMINATION OF FDI AND GROWTH NEXUS IN BANGLADESH: ENGLE GRANGER AND BOUND TESTING COINTEGRATION APPROACH

Shafiun Nahin Shimul
*James P Grant School of Public Health
BRAC University, 66, Mohakhali C/A
Dhaka-1212, Bangladesh*

and

S. M Abdullah and Salina Siddiqua
*South Asian Network on Economic Modeling (SANEM)
House 13, Road 108, Gulshan 2
Dhaka 1212, Bangladesh*

ABSTRACT

This paper attempted at finding the long run relationship or cointegration between foreign direct investment and economic growth for Bangladesh using time series data of 1973-2007. For testing cointegration, the two modern time series econometric approaches- bound testing Autoregressive Distributed Lag (ARDL) Model and Engle Granger two step procedures - were executed and this study found that FDI and GDP was not cointegrated. Moreover, using Granger Causality test it was shown that the FDI and openness were not significantly causing the GDP per capital both in the short and long run. The study suggested adopting appropriate steps so that FDI can be used as a contributing factor to the economic development.

Keywords: Foreign Direct Investment, Growth, Cointegration, Bound testing, Engle Granger, Causality.

Introduction

Over the years it is acknowledged by many development experts across the countries that one of the most feasible ways of poverty reduction is to achieve and sustain higher economic growth rate with some level of equity. Day by day, countries are becoming more and more integrated and opened to free trade due to globalization. Hence countries are implementing liberal economic policies and such liberal policies, especially in LDCs, are encouraging huge capital inflows from first world countries. Over the last decades, the remarkable increase in FDI inflows to developing countries demand an analysis of the impact of FDI on economic growth.

Apparently it may seem that FDI will foster economic growth because of many reasons. Firstly, it will bring the technological improvement in the

host country and this technology will be transferred into the other sectors of the domestic economy which will foster the export and thus development. Secondly, for the import substitution firms, it will enhance competition and thus will increase efficiency and productivity. Thirdly, it will create the employment opportunity for the host country which will increase the GDP directly through factor income and indirectly through multiplier effect. However, the opposite arguments are also not uncommon. Firstly, it may reduce the savings (Razzaque and Ahmed, 2000) and thus less domestic investment which may result in reduction in growth. Secondly, it may crowd out domestic investment which may result into reduction in the economic growth.

The issue on the ground that FDI enhances economic growth does not have a unanimous support. A positive effect of FDI and trade on

economic growth may simply reflect the fact that FDI is attracted to countries that are expected to grow faster and follow open-trade policies. The interrelationship among FDI, trade, and economic growth is therefore, important to examine. As theory is not clear, this issue has been the subject of empirical studies. Hence, the study on FDI is imperative to reach in any conclusion.

In this paper, we aim at investigating whether there is any long run relationship between FDI and growth of the economy using cointegration estimation technique. Different time series econometric techniques were used to validate the result, where every technique has some pros and cons relating to estimation and using different methods in same study can bring a robust answer.

Literature Review

The rapid growth of FDI and its overall magnitude had sparked numerous studies about the issue whether FDI really fuel up the economic growth. Bashir (1999) examined the empirical relationship between FDI and per capita GDP growth in selected six (Algeria, Egypt, Morocco, Tunisia, and Turkey) MENA (Middle East and North American) countries for the years 1975–1990 using a growth model in which production was dependent on an exogenous state technology, human and physical capital and the study concluded that the larger the number of foreign firms operating in the economy and the higher the level of human capital, the higher the growth rate of the economy. The study also argued that though the effect varies across regions and over time, FDI by and large led economic growth.

Using time series data for the period 1975- 2001 in Senegal, Quattara (2006) estimated a neoclassical production function in the long run as well as in the short run. They used Autoregressive Distributed Lag (ARDL) approach for testing cointegration and found that FDI had a significant impact on economic growth in Mauritius.

Agrawal (2000) scrutinized the economic impact of Foreign Direct Investment in South Asia by undertaking time- series, cross- section analysis of panel data from five South Asian countries; India, Pakistan, Bangladesh, Sri Lanka and Nepal, and concluded that there existed complementarily and linkage effects between foreign and national

investment. However, using time series data from the Sri Lankan economy, Athukorala(2003) showed that FDI inflows did not exert an independent influence on economic growth and the direction of causation was not towards from FDI to GDP growth but GDP growth to FDI.

Lan (2006) compared Vietnam to other developing countries applying a simultaneous equation model to test the relationship between FDI and economic growth whose finding was that FDI had a positive and statistically significant impact on economic growth in Vietnam over period 1996-2003, and economic growth in Vietnam was viewed as an important factor to entice FDI inflows into Vietnam. Taking account of macroeconomic environments (degree of trade openness, income per capita and macroeconomic stability in MENA countries), Jallab, Gbakou, and Sandretto (2008) assessed the growth-effect of FDI, using data from MENA countries on period 1970-2005 and summarized that there was no significant independent impact of FDI on economic growth in MENA countries. Even, the lack of growth effect of FDI did not depend on the degree of trade openness and income per capita.

Using the methodology of Granger Causality and Vector Auto Regression (VAR), the study done by Feridunm(2004) examined the relationship between Foreign Direct Investment and GDP per capita in the economy of Cyprus. Strong evidence suggested that the economic growth as measured by GDP in Cyprus was caused (Granger causality) by the FDI, but not vice- versa. Results further suggested that Cyprus's capacity to progress on economic development will depend on the country's performance in attracting foreign capital. Bornsztein, Gregorio and Lee (1998) have argued that FDI had a positive growth effect when the country had a highly educated workforce that allowed it to exploit FDI spillovers. However, Alfaro et al (2003) found that FDI promotes economic growth in economies with sufficiently developed financial markets.

Methodology and Data

Analytical framework and data

As the objective of the study is to find out whether there is any relationship between FDI and GDP growth, the aggregate production function (APF) which includes FDI and other relevant variables in

the modeling is used and the standard APF is widely used in literature (Feder, 1983; Fosu, 1990; Herzer, Nawak-Lehman and Sliverstoves, 2006; Kohpaiboon, 2004; Mansouri, 2005; Ukpolo, 1994; Fosu and Magnus, 2006) and it assumes, along with traditional input of production-labor and capital, other unconventional input like FDI, openness which can be influential to growth. Following Fosu and Magnus (2006), the APF model to be used in this study is

$$Y_t = A_t K_t^\alpha L_t^\beta \dots\dots\dots (1)$$

Where Y_t is the production of the economy which is GDP per capita at time t ; A_t , K_t , L_t are the total factor productivity, the stock of capital, the stock of labor. The impact of FDI and other relevant variables can be captured through A_t component of the APF. Moreover, in many cases it is argued that FDI's influence can be seen correctly, if another component, which goes along with this such as openness, can be included in the model. As we want to know the impact of the FDI on GDP, after including all the relevant variables, the model will be-

$$Y_t = A_t (FDI_t, OPEN_t) K_t^\alpha L_t^\beta E_t \dots\dots\dots (2)$$

Here E_t is exogenous component of growth. So the equation of the above function will be-

$$Y_t = E_t FDI_t^\delta OPEN_t^\varphi K_t^\alpha L_t^\beta \dots\dots\dots (3)$$

Here α , β , δ , and φ are constant elasticity coefficients of output with respect to K , L , FDI and $OPEN$ -trade as percent of GDP. From the equation (3) the taking log in both sides the equation will now become

$$\ln Y_t = c + \alpha \ln K_t + \beta \ln L_t + \delta \ln FDI_t + \varphi \ln OPEN_t + \varepsilon_t \dots\dots\dots (4)$$

Where all variables are as defined and c is constant term and is white noise error term; α , β , δ , and φ are expected to be positive.

From the equation (4), Y is defined as real domestic product per capita, K is real gross capital formation per capita, as data of fixed capital is not available for Bangladesh and so gross capital formation has been used as a proxy of capital (K), L is labor force, $OPEN$ is the sum of export and import values of the GDP. The world development indicator (WDI), 2008 was used and the data are ranging from 1973 to 2007.

Econometric Approaches

When traditional OLS is run then it is assumed that the data are stationary on their levels, but in the most of cases, time series data are not stationary rather they are non-stationary on their levels. If the variable is not stationary then it can be either trend stationary-the non-stationarity problem can be solved by detrending the variables or difference stationary- where data can be made stationary after differencing; and if it becomes stationary after taking difference in d times then it is d difference stationary and it is expressed as $I(d)$ which means that is integrated order of d . The modern time series econometrics suggests testing the stationary status of the data before running the regression and if the variables are non-stationary which is common for time series data and if with the presence of non-stationary variables, OLS method is used then the relationship will be spurious. However, if they are cointegrated, then the parameter will not spurious rather will be super consistent because in this case variables are moving together which implies that there is some long run relationship between or among the variables in the question. In this study we used two approaches of testing cointegration which are suitable for small sample data as in our case -(a) Engle Granger two step procedure Engle and Granger (1987)(b) Autoregressive distributed lag model (ARDL) by Pesaran, Shin and Smith (1997) and Pesaran et al (2001).

(a) Engle Granger (EG) two step procedures: First step is to run normal OLS on the level forms of the variables and then collect or retrieve residual from this regression and the residual are tested whether it is integrated at less order than the expected order of the linear combination of the variables. But before that it is necessary to identify the integrated order of the variables. If two variables are $I(d)$ then it is more likely that the linear combination of these variables will be $I(d)$ but if it is $I(d-r)$ where $r < d$ then it is because of the fact that there exists some long run relationship between these variables or we can say there is some cointegration. According to Engel representation theorem if there is some cointegration then there must be an Error Correction Mechanism (ECM). This process is shown by the following equations where first step is to run normal OLS as follows-

$$\ln Y_t = c + \alpha \ln K_t + \beta \ln L_t + \delta \ln FDI_t + \varphi \ln OPEN_t + \varepsilon_t \dots\dots\dots (5)$$

Now, it is necessary to collect or retrieve residual (ε_t) from the above equation then test ε_t to identify the integrated order by usual stationarity test such as ADF and other tests, and this is the second step. If ε_t is less integrated order than the integrated order of the linear combination of the variables of (4), then the variables are cointegrated i.e. there exists long run relationship. According to Granger representation theorem, if there exists a long run relationship, there will be an error correction mechanism which can be inserted in the short run equations-

$$\Delta \ln Y_t = c + \sum_{i=1}^p \delta_{1i} \Delta \ln K_{t-i} + \sum_{i=1}^q \delta_{2i} \Delta \ln L_{t-i} + \sum_{i=1}^r \delta_{3i} \Delta \ln FDI_{t-i} + \sum_{i=1}^s \delta_{4i} \Delta \ln OPEN_{t-i} + \eta_1 ECM_{t-1} + \varepsilon_t \dots \dots \dots (6)$$

(b) Bound testing Autoregressive distributed lag model (ARDL) or Unrestricted Error Correction Model (UECM): This method has some special advantage over other relevant alternatives. Firstly, this approach is simple to analyze and to run as it allows to OLS once lag order can be identified. Secondly, it can be run irrespective to the order of the variables –either I (0) or I (1). Finally, for small or finite sample data it is relatively efficient method but the limitation of this method is that this procedure will collapse in the presence of I(2) series. In this approach, the long run relationship and the short run dynamic interactions among the variables can be tested using ARDL or bound testing estimating method. The model for this approach is-

$$\Delta \ln Y_t = c + \sum_{i=1}^p \delta_{1i} \Delta \ln K_{t-i} + \sum_{i=1}^q \delta_{2i} \Delta \ln L_{t-i} + \sum_{i=1}^r \delta_{3i} \Delta \ln FDI_{t-i} + \sum_{i=1}^s \delta_{4i} \Delta \ln OPEN_{t-i} + \vartheta_1 \ln Y_{t-1} + \vartheta_2 \ln K_{t-1} + \vartheta_3 \ln L_{t-1} + \vartheta_4 \ln FDI_{t-1} + \vartheta_5 \ln OPEN_{t-1} + \varepsilon_t \dots \dots \dots (7)$$

There are two steps for implementing the ARDL approach of cointegration [19]. Firstly, we need to test the existence of long run relationship among the variables in the system where null hypothesis of having no cointegration or no long run relationship among the variables in system, $H_0 : \varrho_1 = \varrho_2 = \varrho_3 = \varrho_4 = \varrho_5 = 0$ is tested against the alternative hypothesis, $H_1 : \varrho_1 \neq \varrho_2 \neq \varrho_3 \neq \varrho_4 \neq \varrho_5 \neq 0$ by using F -statistic. As usual F -statistic value is not standard,

[20] suggested different critical values for this system. For each cases there are two critical values-one upper bound and a lower bound considering the integrated order of the variables, either I(1) or I(0) respectively. If the computed F -statistic is higher than the appropriate upper bound of the critical values, the null hypothesis of no integration is rejected; and if it is less than the lower bound then, null cannot be rejected; if it is within this two bounds then the test is inconclusive regarding integration between or among the variables.

Granger causality test (Granger, 1969): The regression analysis requires one variable to be specified as a dependent variable while other variable as independent but it does not necessarily imply causation rather it may imply only association where the direction of causation will not be known. Granger (1969) invented a test for causality between and among the variables. However, with the advent of co-integration analysis the test has been modified which includes the non-stationary status of the variables which is common the time series data. For the causality test in this model we will use the following procedure

$$\Delta \ln Y_t = c + \sum_{i=1}^p \delta_{1i} \Delta \ln K_{t-i} + \sum_{i=1}^q \delta_{2i} \Delta \ln L_{t-i} + \sum_{i=1}^r \delta_{3i} \Delta \ln FDI_{t-i} + \sum_{i=1}^s \delta_{4i} \Delta \ln OPEN_{t-i} + \eta_1 ECM_{t-1} + \varepsilon_t \dots \dots \dots (8)$$

In the equation (8) ECM_{t-1} is the lag of error correction term from the short run EG model. A significant coefficient of the error-correction term implies that the past errors affect the current value of the variables under consideration and it represents the long-run causality. The short run causality can be captured by the variables with difference terms. FDI will cause growth in the short run if the difference terms variables of FDI are jointly significant.

Empirical results and discussion

Unit roots test: Before we proceed to any of the methods, we test the stationary status of the variables on their level and difference form. For both Engle Granger (EG) and Bound testing ARDL model this step is necessary. In EG model it is necessary for testing the residuals and in ARDL it is necessary to make sure that no variables are

integrated of order more than 1 where ARDL is not suitable. Augmented Dickey-Fuller (ADF) test and Phillips Perron (PP) test were performed to identify the integrated order of the variables. For the unit root test it is important to identify the lag order and so Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) and other information criteria such as FPE were used to identify the exact lag order. Table 4A (presented in the appendix) shows the stationary status of the variables on their level and first difference forms. From the table, it is evident that the five variables in our model that is Ln(GDP), Ln(FDI), Ln(Capital formation), Ln(Labor force); and Ln(OPEN) are not stationary on their levels and this result is justified by the ADF test and Phillips Perron (PP) test both with and without trend terms. For some variable (such as Ln of Labor force) was not I (1) by ADF test but it was I (1) by PP test and as PP test is more robust than ADF test, so the conclusion drawn that all the relevant variables of our model are not stationary on their level but entire variables became stationary after first difference that is all variables are I (1).

Engle Granger (EG) two step procedures: Now we will perform Engle-Granger Two step procedure for testing long-run cointegration. The first step is to run the long run equation using usual OLS. EG states that if the variables are I (1) on their level (as in our study) but the linear combination is I (0) then the variables are cointegrated; and according to the EG representation theorem if they are cointegrated then there might have ECM (Error Correction Mechanism). Here, The long run OLS model is as follows-

$$\ln Y_t = 2.1052 * +0.4788 ** \ln K_t - 0.0827 \ln L_t - 0.0016 \ln FDI_t - 0.0152 \ln OPEN_t, \dots \dots (7)$$

From this model we retrieved the residual (EC) and performed the ADF test with and without trends and it is stationary as test statistic with and without trend is -4.590 (5% level critical value is 3.00) and -4.445 (where 5% level critical value is -3.60 and 10% level is -3.24 respectively) and it is also significant when we used PP test and so from these tests' result it can be said that there exists a long run relationship among these variables and according there EG representation theorem there exists an ECM in the model and it is shown in the following table:

Table1: Error correction mechanism of EG method with short run dynamics

<i>Variable</i>	<i>Coefficient</i>	<i>p-value</i>
<i>Constant</i>	-.0172509	0.489
$\Delta \ln FDI$	.0020053	0.525
$\Delta \ln K$	.5183891	0.000
$\Delta^2 \ln K$	.107379	0.116
$\Delta \ln L$	.7914309	0.458
$\Delta \ln OPEN$	-.0317909	0.559
ECM_{t-1}	-.5609978	0.10
<i>Adj. R²</i>	.84	
<i>RESET test for functional form</i>	0.56	0.65
<i>Test for Heteroscedasticity</i>	26.23	0.45
<i>JB for Normality, Chi²</i>	1.97	0.37

From above table and from the equation (7) it is evident that LnFDI is not influencing the GDP both in short and long run as this coefficient is not significant and surprisingly it assumed an unexpected sign in the long equation. Although the coefficient of lnFDI in the short run model has positive and expected sign but it is not significant. The only variable which is significant both in short run and long run in determining GDP per capita is lnK. The openness variable is significant neither in short nor in long run and it has also assumed an expected sign. The EC term is -0.56 which is negative and the absolute value is less than unity which is expected but is just significant at 10% level and it implies that 56% of the equilibrium has been corrected in one year if there is a shock. This model has also passed all the diagnosis tests as none of the relevant computed statistics is significant which implies that there is no problem of heteroscedasticity, normality, and functional form in the ECM model.

Bound testing ARDL model or Unrestricted Error Correction Model (UECM):

Before running ARDL, it is important to know the stationary status of all variables to determine the order of integration; this is needed to ensure that no variables are I (2) because in this case this model will collapse. From the table (1) it is evident that our all variables are I (1) so we can run unrestricted error correction model as follows

Table2: ARDL Model: Dependent variable is $\Delta \text{Ln}(\text{GDP})$

Variable	Coefficient	t-ratio (p-value)
Constant	0.9899	0.161
$\Delta \text{Ln}(\text{FDI})$	-0.0834	0.262
$\Delta \text{Ln}(\text{K})$	0.0099	.083
$\Delta^2 \text{Ln}(\text{K})$	-0.1881	.114
$\Delta \text{Ln}(\text{L})$	0.0259	.482
$\Delta \text{Ln}(\text{OPEN})$	-0.0073	.185
LnGDP_{t-1}	-1.222687	-4.26(.002)
LnFDI_{t-1}	0.0084935	2.25(.05)
LnK_{t-1}	.9904125	4.43(.002)
LnL_{t-1}	-.2675296	1.74(.11)
LnOPEN_{t-1}	-.3497778	4.09(.002)

*Adj R*²=0.9148 *F*=20.39 (*p* value=0.000)

Ramsey RESET test for model specification,
F=3.76(*p*=.08)

Jarque Bera test for Normality, *Chi*²=1.09 (*p*=.57)

From the result mentioned in the above table, we performed bound tested F –test for the coefficient of one period lag of lnGDP, lnFDI, lnK, lnL, lnOPEN and the F-statistic is 4.4 which is less than the upper bound of the bounded critical F-statistic suggested by ^[19] which indicates that the test is inconclusive and we can say that there is no clear evidence of having any long run relationship among these variables. The model does not suffer from the problem of specification as Ramsey's RESET *F* statistic is insignificant which implies it cannot reject the null of no model specification problem. On the other hand, there is no problem of normality in this model as *p* value for Jarque-Bera χ^2 test is .57 (see the table 2). For robustness of the result ECM-t test, where all the lagged terms are replaced by the error correction term of short run equation, that was used in EG model, were also performed and it was found that (not shown) it was insignificant indicating that there was no cointegration.

Now we will execute Granger causality test as described in the equation (8)

Table 3: Granger Causality test

Causality	Null Hypothesis	<i>p</i> -value
$\Delta \text{Ln}(\text{FDI})$	$\delta_3=0, \forall i$	.525
$\Delta \text{Ln}(\text{K})$	$\delta_1=0, \forall i$	.000
$\Delta \text{Ln}(\text{L})$	$\delta_2=0, \forall i$	.4583
$\Delta \text{Ln}(\text{OPEN})$	$\delta_4=0, \forall i$	.559
Test of joint significance	$\delta_1=\delta_2=\delta_3=\delta_4=0, \forall i$	.001
Error Correction term	ECM, $\eta=0$	.10

Note: $\forall i$ means for all *i*

From the Granger causality test it is evident that the FDI is not a good predictor of GDP growth neither in short run as FDI coefficient is not significant nor in the long run as the EC term is insignificant. Here, capital is the only variable which Granger causes GDP. The causality from GDP to FDI was not performed as it was not our objective to find in this study. Besides this, when both FDI and openness were jointly tested then it was found that it was insignificant, so FDI and openness together does not cause GDP growth. Moreover, labor force does not also cause GDP growth in Bangladesh and this is mainly due to less productivity of the labor.

Using modern time series econometric approach this paper identified that there is very poor statistical indication of long run relationship between foreign direct investment and economic growth and it is observed that the relationship is not positive. This finding is similar to the findings of ^[5] for Sri Lanka; ^[7] for MENA countries. Nonetheless, this study contradicts with the findings of many literatures where it was claimed that FDI was an important predictor of GDP growth such as in ^[14] for Thailand; ^[8] for Cyprus; and ^[6] for Vietnam

Conclusion and Policy implication

Even though it is many times argued in the development arena that foreign direct investment and openness are two important contributing factors for economic development but the present study did not find any strong relationship which can be used for an evidence for this claim for Bangladesh. The gross capital formation is more important engine of growth. This finding provides

some important policy implications. Firstly, only attracting the FDI cannot necessarily bring economic development and hence Government's all out effort should not be only to attracting the FDI investments but also to ensure that this investment can be used in such a way that can contribute the economy positively. Secondly, even though FDI and openness are believed to be significant predictors of GDP but it not established by the data and so it is urgent for the government to pay attention to other factors which are necessary for supporting this variables working for the growth such increasing better and skilled workforce, creating supportive political environment etc. Thirdly, FDI as such cannot bring any positive outcome but the way it is invested and the sector in which this investment goes is also equally important. However, before taking any conclusion from this study one should consider the limitation of the study also. Firstly, due to the absence of some variables, proxies of that variables were used which might have some effect on the result. Secondly, only one model of growth or production function was used and using other model could have some impact on the result that we reached.

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Appendix

Table4A: Unit root test for the variables under study using ADF, PP tests

Variable	ADF Test		PP Test		Conclusion
	With constant (lag*)	With con and trend(lag)	With constant(lag)	Constant and Trend	
Ln(GDP)	1.025(3)	-1.048(3)	1.001(3)	-2.298(3)	I(1)
Δ Ln(GDP)	-5.773**(1)	-6.013**(1)	-7.784**(1)	-7.818**(1)	
Ln(FDI)	-0.731(1)	-3.709*(1)	-0.903(1)	-3.283(1)	I(1)
Δ Ln(FDI)	-4.875**(0)	-4.791**(0)	-5.052**(0)	-4.954**(0)	
Ln(K)	-1.069(3)	-2.846(3)	-1.16(3)	-2.309(3)	I(1)
Δ Ln(K)	-2.817**(2)	-2.784(2)	-3.871**(2)	-3.771**(2)	
Ln(L)	-0.844(2)	-1.939(2)	-1.24(2)	-1.430(2)	I(1)
Δ Ln(L)	-2.422(1)	-2.509(1)	-3.441**(1)	-3.513**(1)	
Ln(OPEN)	-0.366(2)	-1.122(2)	-0.046(2)	-2.890(2)	I(1)
Δ Ln(OPEN)	-8.043**(0)	-7.991**(0)	-8.557**(0)	-8.51**(0)	

* (Pradhan G. 2008) (Pradhan G. 2008)* The lags were determined using the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC) and other information criterion such as FPE and HQIC

Note: * denotes significant at 5% level and ** indicates significant at 1% level.