Dynamics of Relationship among Export, Gross Domestic Product, Foreign Direct Investment and Effective Exchange Rate in Bangladesh (Export model)

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Abstract

This paper investigates the co-integration among export, gross domestic product, foreign direct investment and effective exchange rate for Bangladesh using annual data from 1994-2013.The paper uses time series econometrics tools to investigate the relationships. The study provides the evidence of stationary of time series variables. Study findings reveal that the co integration analysis shows that all the variables of the study are co-integrated at their differences meaning that there exists long run relationship among the variables. The short term discrepancies Error correction mechanism (ECM) was used. Pair wise causality analysis has been carried out to explore the causal relationship among the variables.

Keywords: Gross Domestic Product, Co-integration, Time series

Introduction

For decades, export performance has generated interest among researchers and public makers. Increasing Gross domestic Production is the most important objective of any economy. There are different approaches to achieve this target of which one possibility is to promote exports. At this juncture, an important issue immediately cracks the minds of economists and researchers, that is, whether export promotion leads to higher economic growth or economic growth promotes exports growth. Recently endogenous growth theory has focused on the ongoing technological change that raises productivity as the main engine of growth. Now it is believed that the rapid growth of China and India is mainly due to the expansion of their exports. The success of China and India is largely caused by both the export-led growth and access to technology through globalization (Stiglitz, 2007).The relationship is shown between the exports and economic growth in India, Pakistan, Philippines, Malaysia and Thailand for the period 1973 to 1993(Vohra 2001). The empirical result indicated that when a country has achieved some level of economic development then the export have a positive and significant impact on economic growth.The importance of liberal market policies by pursuing export expansion strategies and by attracting foreign investments are observed. As a critical factor to influence economic growth, financial development has received considerable attention since the pioneer contribution of Goldsmith(1969), Mckinnon (1973) and Shaw(1973).Financial development also depend on Gross Domestic Product .Foreign Direct Investment also depends on GDP and Effective exchange rate. The attempts have been made to revisit the issue of the relationship among EXPORT, GDP, FDI and EER in Bangladesh.

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Objectives of the study

The broad objective of the study is to estimate the export supply model of Bangladesh and the specific objectives are: to show the co integration among the variables of the model and to estimate the short run and long run elasticities.

Literature Review

The speed of economic development of a nation poses one of the most essential issues in economic debate. A nation could accelerate the rate of economic growth by promoting export of goods and services. Subasat (2002) investigated the empirical linkages between exports and economic growth. The study suggested that the more export-oriented countries like middle-income countries grow faster than the relatively less export-oriented countries. The study further showed that export promotion does not have any significant impact on economic growth for low and high income countries. Shirazi(2004) studied the short-run and long-run relationship among real exports, real imports, and economic growth on the basis of co-integration. Granger causality test as developed by Toda and Yamamoto (1995) .This study showed a long-run relationship among imports, exports, and economic growth and found unidirectional causality from exports to output. But, it did not find any significant causality between imports and exports. Bhuyan (1982) examines the prospect of non-traditional exports focusing on the imports of machinery and industrial raw materials. He shows that the demands for non-traditional items have been growing and there remains scope for modernization and expansion of this sub-sector.

Roy (1991) analyses the determinants of export performance of Bangladesh using an econometric analysis. He examines the causal relationship of the determining factors and export performance for Bangladesh. Rahman (2008) analyses the composition, performance, trend and policy of foreign trade of Bangladesh using annual time series data and concludes that despite structural bottlenecks the export sector of Bangladesh performs well. He finds that the growth rate of export of Bangladesh is higher compared to other SAARC countries and even higher than the world rate. Hossain and Alauddin (2005) examined the process of Bangladesh's trade liberalization and its impact on the growth and structure of exports, imports, GDP and other relevant macroeconomic variables with particular emphasis on exports.

Dash (2009) analyzes the causal relationship between growth of exports and economic growth in India for the post-liberalization period 1992-2007, and the results indicate that there exists a long-run relationship between output and exports, and it is unidirectional, running from growth of exports to output growth.

Data and Methodology

Time series data for the period of 1994 – 1995 to 2012-2013 for the relevant variables were collected from various publications of Government of Bangladesh, World Bank, IMF etc. The study applies time series econometric techniques such as Co-integration, Error correction mechanism strategy. These techniques are chosen because they provide a formal framework for investigating the existence of long-run and short –run relationship among variables, each of which may individually be non- stationary. It is important to determine the stationary properties of time series prior to the application of multivariate co- integration analysis. So Augmented Dickey-Fuller (ADF), Phillips Perron unit root test and correlogram test are used to check the stationary properties of the series. To find out the long run relationship among the variables, the Johansen and Juselius multiple co integration tests are employed. To check short run equilibrium convergence Error Correction Mechanism are employed. Causality between the series is also has been tested by Granger Causality Test.

We have a single equation model for real export

REXP = f (GDP ,FDI, EER)

REXP - Volume of export in real term

GDP- Real Gross Domestic Production at current market price

FDI - Foreign Direct Investment

EER - Effective Exchange Rate

Specification of Model

Export Supply Model of Bangladesh

$$\mathbf{REXP_t = \alpha + \beta_1 GDP_t + \beta_2 EER_t + \beta_3 FDI_t + \varepsilon_t \ ; (\varepsilon_t \sim N(0, \sigma^2))}$$

[εt = Error Term, **α = intercept, β_1 , β_2 and β_3=** regression Coefficients]

Estimation Procedure

Stationary Analysis: A time series is said to be stationary if both its mean (the value about which it is oscillating) and its variance (amplitude) remain constant through time. Regression estimation using non-stationary time series leads spurious or nonsense result. So regression estimation is to be done using stationary data. A time series data has a unit root meaning that the data is non-stationary or the data has random walk. To avoid spurious regression the author checks a unit root process by integrating procedure. A linear combination of individual non-stationary

variables may be stationary when they are co-integrated. In order to test the stationary of a time series, the Unit Root test is performed for a univariate time series and the Co-integration test is utilized for a multivariate time series.

There are three tools for the presence of unit root.

- Testing the order of integration of the series of the selected variables. If a variable is found I(0) at its level form then the variable is considered as stationary.
- If a variable is not found I(0) at its level form then the variable is considered as non-stationary. But if the first difference of non-stationary variable is found I(0) then it is of I(1) and it becomes stationary.
- The stationary of the time series of a variable can be examined by Dicky Fuller (DF) unit root test , Augmented Dickey Fuller (ADF) Unit root test or by Philips- Perron (PP) unit root test.

Unit Root Test

For a univariate time series, the Unit Root test is frequently employed for testing the stationary. The test first poses the *null hypothesis* that the given time series has the unit root which means that the time series is non-stationary and tests if the null hypothesis is to be statistically accepted or rejected in favor of *alternative hypothesis* that the given time series is stationary.

The Unit Root test estimates the following autoregressive model

$x_{(t)} = \rho x_{(t-1)} + u_{t\,(1)}$ ----------[1]

where , x(t) is an observation value at time t.

u_t is a sequence of independent normal random variables with mean 0 and variance σ2 .

The time series $x_{(t)}$ converges, as $t \rightarrow \infty$, to a stationary time series if $|\rho| < 1$. If $|\rho| = 1$, the time series is not stationary and the variance of x(t) is tσ2 .

The Unit Root test subsequently tests the following one-sided hypothesis

H0 : $\rho = 1$

H1 : $\rho < 1$

The name unit root comes from the fact that the coefficient of $x_{(t-1)}$ is unity, if the time series is non-stationary and the Unit Root tests as the name suggests, tests if ρ is unity or not. Note that the autoregressive model in Equation (1) is a simple form; the most common unit root test .the augmented Dickey-Fuller (ADF) test, employs an autoregressive model that contains the *trend* and *drift*.

The Augmented Dickey- Fuller test (ADF) is superior to Dickey Fuller (DF) test as it can remove the serial autocorrelation successfully. In this study Augmented Dickey- Fuller (ADF) statistic will be used to trace out whether the time series has a unit root or not. Philips –Perron (PP test) is another technique to identify whether there is a Unit root or not. To test stationary, both ADF

and PP test can be conducted. If any contradiction arises then ADF results are preferred over Phillips-Perron test(Cambell and Perron 1991)

Co-integration Analysis

The concept of co-integration was developed by Engle and Granger in 1987. As we have mentioned earlier that stationary in time series data is necessary to have a valid t statistics and F statistics. But it has been identified that two or more time series data can be co- integrated although each of which is individually non-stationary or random walk. Co-integration tells us about the presence of long run relation among two or more variables. When we go for running co-integration analysis, we assume that all variables are non-stationary. Secondly they are all integrated of the same order. Even, if the variables are not integrated in the same order, we still can continue with co- integration analysis.

There are indeed two tools to identify whether a long run relation among variables are existing or not. They are Engel-Granger's Residual based test and Johansen-Juselius (JJ) test. Since Engel-Granger's Test suffers from some shortcomings, Johansen-Juselius test is preferred for co-integration analysis.

A univariate time series $x_{(t)}$ is said to be integrated of order d, written I(d), if it needs to be differenced d times to make it stationary. If two series $x_{1(t)}$ and $x_{2(t)}$ are both I(d), then any linear combination of the two series will usually be I(d) as well. However, if a linear combination exists for which the order of integration is less than d say I(d - b), then the two series are said to be co-integrated of order (d, b), written CI(d, b). If this linear combination can be written in the form $\alpha^T x_i(t)$, where $x_i(t) = (x_1(t), x_2(t))$, *then the vector α is called a co-integrating vector.*

Pairwise Granger Causality Test

Pairwise Granger causality tests are conducted to examine whether an endogenous variable can be treated as exogenous. For each equation in the VAR, the output displays (Wald) statistics for the joint significance of each of the other lagged endogenous variables in that equation. The statistic in the last row is the statistic for joint significance of all other lagged endogenous variables in the equation. When we estimate a VEC, the lagged variables that are tested for exclusion are only those that are first differenced. The lagged level terms in the co integrating equations (the error correction terms) are not tested.

VECM Techniques

Generally the structural approach to time series modeling uses economic theory to examine the relationship among the variables of the model because economic theory can not sufficiently provide a dynamic specification that identifies all of these relationships. Moreover, estimation and inference are complicated by the fact that endogenous variables may appear on both the left and right sides of equations. These problems lead to alternative, non-structural approaches to modeling the relationship among several variables such as the estimation and analysis of vector auto regression (VAR) and the vector error correction (VEC) models. These models are used for testing the presence of co integrating relationships among several non-stationary variables. The

vector auto regression (VAR) is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables.

Empirical Results

Stationary Test

Unit root test for stationary were carried out on both levels and 1st differences for all variable to be used in the model. The model with constant **(C)** assumes that there are no trends in the levels of the data, such that difference series have zero mean. While the model with a constant **(C)** and linear trend **(T)** is used when linear trends in the levels of the data are observed. The results of the unit root tests are reported in Table **1.**Most of the variables are non-stationary at level but stationary at 1st difference for the model. But GDP and FDI are stationary at 2nd difference in the model.

Table1: ADF Unit Root Test Results

(Null hypothesis(H_0): the concerned variable has a unit root)

Variables	Level/ First difference		Intercept	Intercept and Trend	Conclusion
REXP	I(0)	t value	3.765280	1.532391	Non-stationary
		Pro	0.0024	0.1514	
	I(1)	t value	-3.508786	-5.447350	Stationary
		Pro	0.0035	0.0001	
GDP	I(0)	t value	2.991371	2.499338	Non-stationary
		Pro	0.0123	0.0255	
	I(1)	t value	-3.730780	-5.355618	
		Pro	0.0033	0.0017	Stationary
FER	I(0)	t value	0.866032	-1.903888	Non-stationary
		Pro	0.4001	0.0777	
	I(1)	t value	-4.832536	-4.572291	
		Pro	0.0005	0.0010	Stationary
FDI	I(0)	t value	-1.739077	-2.777706	Non-stationary
		Pro	0.1076	0.0180	
	I(1)	t value	-5.046205	-4.876007	
		Pro	0.0004	0.0006	Stationary
EER	I(0)	t value	-0.076210	-4.159231	Non-stationary
		Pro	0.9406	0.0013	
	I(1)	t value	-3.048990©	-2.946534(IC)	Stationary
		Pro	0.0003	0.0005	

As usually the case with time series data, all series were non-stationary at level form but are stationary at 1st difference as per unit root results are given in table-1.

Co-integration Analysis

The Co-integration test is conducted to examine whether there are any long run relationships among the variables of the model. Johansen and Juselius co-integration test is applied here. Two tests i.e. the trace test and the maximal eigen value test are used to determine the number of co integrating vectors. The co-integration test results are shown in Table 2.

Table 2. Johansen Co-integration Test Based on Maximum Eigen value

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.999979	192.4950	47.85613	0.0000
At most 1 *	0.963365	52.16834	29.79707	0.0000
At most 2	0.502358	9.180681	15.49471	0.3490
At most 3	0.008297	0.108306	3.841466	0.7421

Trend assumption: Linear deterministic trend Unrestricted Co integration Rank Test (trace)

The results of Johansen and Juselius multi-variable co-integration test the model, which allows for two co-integrating vectors, are reported in Table 2. Starting with the null hypothesis of no co-integration among the variable, trace statistics are above the 5 percent critical value. Hence it rejects the null hypothesis of no co-integration, in favor of general alternatives one co-integrating vector. Thus, the results implies that there exists a stable long run equilibrium relationship of real exports supply with its major determinants such as GDP,EER and FDI.

Error correction model (Short Run Equilibrium)

After determining the long run equilibrium, to analyze the short term discrepancies Error correction mechanism (ECM) was used. The results of ECM for export model are reported in table 3.

Table 3: Estimates for VECM Regression

Regressors	$\Delta REXP_t$	ΔGDP_t
C(intercept) [t-test statistic]	1303.034 [0.92194]	6029 [3.1259]
$EC^1_{(t-1)}$ [t-test statistic]	0.8702 [0.906]	4.2576 [3.2478]
ΔREXP(t-1) [t-test statistic]	-1.1643 [-1.3886]	-3.07159 [-2.684]
ΔGDP(t-1) [t-test statistic]	0.03307 [0.1906]	0.8958 [3.7834]
Regressors	$\Delta REXP_t$	ΔFDI_t
C(intercept) [t-test statistic)	2838.510 [1.72181]	-304.01 [-2.9843]
$EC_{(t-1}$ [t-test statistic)	-0.19989 [-1.5888]	0.0286 [3.6805]
$\Delta REXP_{(t-1)}$	-0.5103 [-0.5128]	0.1509 [2.455]
$\Delta FDI_{(t-1)}$	-7.049 [-1.3302]	0.3064 [0.9357]
Regressors	$\Delta REXP_t$	ΔEER_t
C(intercept) [t-test statistic)	3667.757 [3.035]	1.56427 [0.85501]
$EC_{(t-1}$ [t-test statistic)	0.4965 [2.9735]	-0.0003 [-1.166]
$\Delta REXP_{(t-1)}$	-1.1863 [-2.69568]	-0.0012 [1.77586]
$\Delta EER_{(t-1)}$	84.78809 [0.43185]	0.0795 [0.26767]

The coefficients of the first difference of REXP ,GDP ,FDI and EER lagged in one period in REXP equation in table (3) are statistically insignificant which indicate the absence of short – run causality from REXP to GDP ,FDI and EER based on VECM estimates.

Pair-wise Causality Analysis

Pair wise causality analysis has been carried out to explore the causal relationship between the variables. For the given data set , there exists unidirectional causality between real export production(REXP) to Gross domestic production (GDP), Effective exchange rate(EER)and Foreign Direct Investment. There also exists unidirectional causality between Gross Domestic Production to Effective Exchange rate, while there is no unidirectional or bidirectional causality between Foreign Direct Investment and Gross Domestic Production and also Effective Exchange rate.

Table 4: Direction of causality based on Granger Test

Null hypothesis	**Result**	**Conclusion**
H_0 :1	Accepted	Gross Domestic Production has no Granger Cause to Real export production.
H_0:2	Rejected	Real export production has Granger Cause to Gross Domestic Production
Direction of Causality		Unidirectional
H_0 :3	Accepted	Effective Exchange rate has no Granger Cause to real export production.
H_0:4	Rejected	Real export production has Granger Cause to effective exchange rate.
Direction of Causality		Unidirectional
H_0 :5	Accepted	Foreign Direct Investment has no Granger Cause to Real export production.
H_0 :6	Rejected	Real export production has Granger Cause to Foreign Direct Investment.
Direction of Causality		Unidirectional
H_0 :7	Accepted	Effective Exchange rate has no Granger Cause to Gross Domestic Production.
H_0 :8	Rejected	Gross Domestic Production has Granger Cause Effective Exchange rate.
Direction of Causality		Unidirectional
H_0 :9	Accepted	Foreign Direct Investment has no Granger Cause to Gross Domestic Production.
H_0 :10	Accepted	Gross Domestic Production has no Granger Cause to Foreign Direct Investment.
Direction of Causality		No causal relation.
H_0 :11	Accepted	Foreign Direct Investment has no Granger Cause to Effective Exchange rate.
H_0 :12	Accepted	Effective Exchange rate has no Granger Cause to Foreign Direct Investment.
Direction of Causality		No causal relation.

Conclusion

Many theoretical and empirical studies were conducted at national and international level related to export and few of them were reviewed in the literature. In this paper, the relationship among export, gross domestic product, foreign direct investment and exchange rate in a developing country like Bangladesh has been investigated using popular time series methodologies. The study uses co-integration and error correction (ECM) techniques to identify the long run and short run relationship among these variables. The co-integration analysis showed the existence of a stable long run equilibrium relationship among the variables of the export model. While the short term dynamics as analyzed by the error correction mechanism (ECM) revealed that the short term discrepancies were significant enough not to converge toward equilibrium and will require a longer time to adjust back. There exists unidirectional causality between real export production (REXP) to gross domestic production (GDP), Effective exchange rate (EER) and Foreign Direct Investment. There also exists unidirectional causality between Gross Domestic Production to Effective Exchange rate, while there is no unidirectional or bidirectional causality between Foreign Direct Investment and Gross Domestic Production and also Effective Exchange rate. This relationship is stable in long run. In order to achieve economic target, Government should formulate its long run policies in accordance with these findings effectively.

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