Bi-directional Relationships between Exports and Growth: A Panel Data Approach

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Abstract

This paper uses panel data analysis to test the validity of the "export-led hypothesis" in seven countries, members of SAARC (India, Bangladesh, Sri lanka, Pakistan, Nepal, Bhutan and Maldives). Fixed effects model leads to conclusion that there is no significant relationship between GDP and Export for these countries. On the other hand Random effects model leads to conclusion that there is no significant relationship between GDP and Export for these countries. Panel unit root tests imply that there is strong evidence of stationary process for both GDP and Export at level that is I(0). However, the panel co-integration test indicates there is co-integrating relationship between export and growth for these countries. As a conclusion, the export could be seen as the engine of growth in these countries. In other word, the empirical findings did provide sufficient evident to support the : export-led hypothesis" in the area.

Keywords: *Export-led Growth, Fixed effects estimator, Random effects estimator, Hausman test.*

Introduction

An economy is said to grow when the country's *gross domestic product* (GDP) rises. Economic growth is of fundamental importance for all economies. Since virtually all countries experience growth in population over time. So GDP growth is a prerequisite for maintaining current standard of living. In fact, if standards of living are to rise over time, then GDP must grow faster than population.

Economic growth is also critical for **economic development.** Economic development is characterized by such things as high levels of consumption, broad-based educational achievement, adequate housing and access to high-quality health care etc. These goals may be achieved only after long periods of sustained high levels of economic growth.

International Trade can affect the level of economic growth of an economy. An increase in export sales may lead to an overall expansion in production and accompanying fall in unemployment rate. International trade also allows for purchase of capital goods from foreign countries and exposes an economy to technological advances achieved round the globe.

Conversely, economic growth may affect the types of goods which a country is able to trade. A technological advance in a country's import-competing sector could lead to an overall reduction in the volume of trade of a country. Thus, international trade and economic growth are closely related.

Literature Survey

Author Laszlo Konya in his paper 'Export-led growth, growth driven export, both or none? Granger Causality Analysis on OECD Countries' investigates the possibility of export-led growth and growth driven export by testing for Granger Causality between the logarithms of real exports and real GDP in twenty-five OECD countries. Two complementary testing strategies are applied. First, depending on the time series properties of the data, causality is tested with Wald tests within finite-order vector autoregressive (VAR) models in levels and/or in first differences. Then, with no need for pre-testing, a modified Wald procedure is used in augmented level VAR systems. In both cases we experiment with alternative deterministic trend degrees. The results indicate that there is no causality between export and growth in Luxembourg and in the Netherlands, exports cause growth (ECG) in Iceland, growth causes exports in Canada, Japan and Korea, and there is two- way causality between exports and growth in Sweden and in the UK. Although with less certainty, we also conclude that there is no causality in Denmark, France Greece, Hungary and Norway, ECG in Australia, Austria and Ireland, and GCE in Finland, Portugal and the USA. However, in the case of Belgium, Italy, Mexico, New Zealand, Spain and Switzerland the results are too controversial to make a simple choice.

Author Afzal, Mohammad , Gomal University, D.I Khan, Pakistan in his paper 'Causality Between Exports, World Income And Economic Growth in Pakistan' investigates the direction of causation between GDP representing economic growth, exports and its different categories, imports and world income . After experiencing vigorous import- substitution in the past decades, Pakistan adopted outward-looking strategy in the late 1980s with emphasis on export promotion. Strong and stable relationship between GDP and exports and bi-directional causality between manufactured exports and GDP has been found. Export promotion policy is pursued consistently with emphasis on manufactured exports and this is most likely to contribute adequately to economic growth in the long run.

Murat Doganlarin his article 'Export-led Growth Hypothesis in Asian countries' investigates the causal relationship between export and economic growth for eight Asian countries for the period before the 1997 Asian crisis.. The countries are India, Pakistan, Philippines, Singapore, Sri Lanka, South Korea, Thailand, and Turkey. The empirical methodology involves investigating a co integration relationship between export and output growth and specifying an error correction mechanism to detect a causal relation between these two series. This study finds evidence of bi-directional causality for Turkey, S.Korea , Singapore, Philippines and India. However, the causality runs from ex-port to output growth for Thailand and from output to export growth for Pakistan and Sri Lanka.

Boriss Siliverstovs and Dierk Herzerin in their economic paper 'Manufacturing exports, mining exports and growth: co integration and causality analysis for Chile (1960-2001)' investigate the export-led growth hypotheses using annual time series data from Chile in a production function frame work. It addresses the problem of specification bias under which previous studies have suffered and focuses on the impact of manufactured and mining exports on productivity growth. In order to investigate if and how manufactured and mining exports affect economic growth via increase in productivity, the study uses Johansen co integration technique. The estimation results can be interpreted as evidence of productivity- enhancing effects of manufactured exports and of productivity- limiting effects of mining exports.

Xiaming Liu, Haiyan Song and Peter Romilly in their article investigate the causal relationship between openness and economic growth in China.

The integration and co integration properties of the data are analyzed and the models of Granger, Sims, Geweke and Hsiao are used to identify a bi-directional causal relationship between GNP and exports plus imports. This bi-directional causation is consistent with China's development strategy of protected export promotion.

Jacint Balaguer and Manuel Cantavella-Jorda. 2004 : The Spanish Export-led growth hypothesis is reexamined from the trade liberalization process initiated four decades ago. For this purpose both the export expansion and the progression from 'traditional' exports to manufactured and semi manufactured exports are taken into consideration. A new evidence is reported for the above period. Alongside a feedback between aggregate exports and real output, it has been proved that the structural transformation in export composition has also become a key factor for Spain's economic development.

Muhammad S. Anwar and R. K. Sampath have sampled 97 countries for research study on Export and economic growth. While determining the stationary of the two variables and their orders of integration, they found that GDP and export are integrated of different orders for 36 countries. Among the other 61 countries, for 17 countries there was no long run relationship between the two variables; 35 countries show causality at least in one direction with unidirectional causality from GDP to export for 10 , from export to GDP for 5 and bi-directional causality for 20 countries; and 9 countries do not show any causality between GDP and exports. With or without co-integration including unidirectional and bi-directional causality there are 30 out of 97 countries which show positive impact of economic growth on exports and 29 countries show positive impact from export to GDP but the positive sign is statistically insignificant for 12 countries each case.

M. A. B. Siddique (The University of Western Australia) and E. A. Selvanathan (Griffith University, Australia) have concluded in their research on 'export Performance and Economic Growth: Co integration and causality Analysis for Malaysia, 1966-1996' that the Granger-causality tests did not produce any evidence to support the export-led growth economic growth in Malaysia for both total and manufactured growth. That is, no Granger causality was running from total exports to economic growth and from manufactured exports to economic growth. However, they found evidence of a one way Granger causality running from economic growth to manufactured exports.

Peter M. Summers has conducted a research on Trade and Growth in Settler Economics: Australia and Canadian Comparisons. He used data over 100 years for each country. He found no evidence to support the export-led growth hypothesis for Australia, but strong evidence for this hypothesis in Canadian data in the period 1915-1938: exports as well as imports appear to lead growth during this period. In addition, import growth tends to be causally prior to export growth in both countries, but at different times. The strength of relationship between trade and economic growth is generally comparable across countries. And, finally there is little evidence on unidirectional causality in either country, there is substantial evidence of bi- directional causality.

Nasim Shah Shirazi and Turkhan Ali Abdul Manap, in their paper "Export-Led Growth Hypothesis: Further Econometric Evidence from South Asia," examine the export-led growth (ELG) hypothesis for five South Asian countries through cointegration and multivariate Granger causality tests. Strong support for a long-run relationship among exports, imports, and real output for all the countries except Sri Lanka were found. Feedback effects between exports and GDP for Bangladesh and Nepal and unidirectional causality from exports to output in the case of Pakistan were found. No causality between these variables was found for Sri Lanka and India, although for India GDP and exports did induce imports.

A feedback effect between imports and GDP was also documented for Pakistan, Bangladesh, and Nepal, as well as unidirectional causality from imports to output growth for Sri Lanka. These and other findings are discussed from the stand point of the export-led growth hypothesis.

Qing Xiao; Michael Reed (Department of Agricultural Economics, University of Kentucky, USA) in their article ("Export and production growth : evidence from three major wheat exporters of Australia , Canada and United States") investigate the robustness of the relationship between export and production growth for three major wheat exporters: Australia, Canada and the United States from 1966 to 2000. Combining production, international trade and development theories, a four variable (production, exports, producer price and imports) vector autoregressive moving average (VARMA) model is developed for each country. The causality results show that the hypothesis of export-led development is supported by these three major players in the international wheat trade, though a bi-directional causality is found for Canada and the USA. Variance decomposition and impulse response functions are employed to further investigate the effects of macroeconomic shocks.

Dr. Thenuwara has gone through a deep analysis with building several theoretical models of artificial economies of different possibilities. What he concludes in his paper is that, "Empirical work on ELGH does not lead to firm conclusions on the existence of a causal relationship. The theoretical model used in the paper shows that a country could continue to grow while exports decline. Some other countries could experience diminishing growth while exports continue to grow. The relationship is not consistent especially when the true engine of growth is a third factor. Thus results provide some guidance on policy formulation. Principals of continuing growth are productivity improvement through human capital accumulation and technology spillovers."

Caudros A; Orts V. and Alguacil M.T. of Universidad Jame I de Castellon (Spain) and Institute de Economia Internacional have conducted a research on Re-examining the export-led growth in Latin America: Foreign Direct Investment, Trade and Output Linkages in developing countries. They find in their research project that the relationship is neither of the analyzed countries found any significant influence of export on out put level. Nevertheless, FDI appears to be an important factor in promoting growth.

Peter M. Summers has conducted a research on Trade and Growth in Settler Economies: Australian and Canadian Comparisons. He used data over 100 years for each country. He found no evidence to support the export-led growth hypothesis for Australia, but strong evidence for this hypothesis in Canadian data in the period 1915-38: exports as well as imports appear to lead growth during this period. In addition, import growth tends to be causally prior to export growth in both countries, but at different times. The strength of relationship between trade and growth is generally comparable across countries. And, finally there is little evidence on unidirectional causality in either country; there is substantial evidence of bi-directional causality.

As seen in the previous empirical findings, three basic possibilities have come out as following.

- Unidirectional causality from export to Gross Domestic Product (GDP).
- Unidirectional causality from GDP to export.
- Bi-directional relation between GDP and export.(Feedback effect).
- Export and GDP are independent in causality (No causality in between).

Dr. Laszlo Konya, Department of Economics and Finance, La Trobe University, Bundoora, VIC 3086, Australia. Investigated the possibility of the export-led growth and growth-driven export hypotheses in twenty-five OECD countries. The sample period is 1960-1997 for all countries, Except Hungary (1970-1998), Korea and Mexico (1960-1998).

Theoretical Background:

Some theoretical foundations are needed on the relationship between exports and output growth in econometric model speci¯cation. First, the advocates of the export-led growth hypothesis claim as follows. A rise in demand for exports fosters specialization, learning by doing, im-provements in entrepreneurial, management techniques, skill and tech-nology, and the economies of scale in the export industry and the real-location of resources from the ine±cient non-trade sector to the e±cient export sector, thereby enhancing productivity and output growth, as ar-gued by Ben-David & Loewy (1998), Giles & Williamson (2000), Kugler (1991), Lal and Rajapatirana (1987), Yaghmaian (1994), and others.

In contrast, the supporters of inward-oriented trade policy or the opponents of the export-led growth hypothesis argue that export-led growth strategy cannot succeed because of the worsening of interna-tional terms of trade (Prebisch (1962) and Emmanuel (1972)) and in-su±cient and unstable demand for developing countries' exports in the world market (Adelman (1984), Ja®e (1985)). Other dissenters of the export-led growth hypothesis insist that there are other factors to ex-plain the economic growth of developing countries more appropriate than exports. They assert that exports can be supported only by a sound domestic production basis, which is established by the growth in primary inputs and the productivity enhancement of those inputs as in Krugman (1984), Lancaster (1980), among others.

Last, the bi-directional or feedback relationship between exports and output growth could exist. That is, increased exports boost output through specialization, scale economies, and productivity improvement, and in turn output growth leads to expanded exports by promoting fur-ther specialization, scale economies, cost reduction, technical progress, and comparative advantage, creating an interactive mechanism, as ar-gued by Bahmani-Oskooee et al. (1991), Bhagwati (1988), Helpman and Krugman (1985), Konya (2006), and others.

Research Methodology

A panel data analysis is used to examine the relationship between GDP growth and Export growth in the seven SAARC countries (i.e. India, Bangladesh, Srilanka, Pakistan, Nepal, Bhutan, Maldives) for period 1971 to 2011. It is hypothesized that size of Gross Domestic Product (GDP) is influenced by the amount of export.

Following methods are used to analyse the model,

1. Unit root test,
2. Cointegration test,
3. Pooled Ordinary Least Squares,
4. Fixed Effects Approach,
5. Random Effects Approach,
6. Hausman test.

In order to examine the determinants of size of national income without taking into account country and time effects, a pooled OLS regression model is could be:

$GDP_{it} = \alpha + \beta_1 Export_{it} + u_{it}$ ---------- (1)

Where GDP_{it} is size of Gross Domestic Product in country *i* in year *t*, $Export_{it}$ is the amount of export in country *i* in year *t*, α is the intercept, β_1 is slope parameters and u_{it} is the error term. To incorporate country effects, one way fixed effects model could take a form:

$GDP_{it} = \alpha_i + \beta_1 Export_{it} + u_{it}$ ---------- (2)

Where α_i is recipient-effects. Finally, the Random effects could take a form:

$GDP_{it} = \alpha + \beta_1 Export_{it} + w_{it}$ ---------- (3)

Where w_{it} is a composite error term,i.e., $w_{it} = \varepsilon_i + u_{it}$ (where ε_i denotes cross section error and u_{it} denotes time series error).

The usual assumptions of Random effects model are that

$\varepsilon_i \sim N(0,\sigma^2_\varepsilon)$

$u_{it} \sim N(0,\sigma^2_u)$

$E(\varepsilon_i u_{it}) = 0$; $E(\varepsilon_i \varepsilon_j) = 0$ $(i \neq j)$

$E(u_{it} u_{is}) = E(u_{it} u_{ij}) = E(u_{it} u_{js}) = 0$ $(i \neq j; t \neq s)$

That is, individual error components are not correlated with each other and are not autocorrelated across both Cross-section and time series units.

Variants of Hypotheses

The relation between export and economic growth is really complex and economists differ among themselves on this issue. There are five schools of thought regarding the relationship between export growth and income growth. These are as follows:

(i) Export-Led Income Growth Hypothesis: It is argued that export growth leads to income growth. Consequently, this hypothesis indicates *Uni-directional Granger Causality running from export growth to income growth.*

(ii) Income-led Export Growth: This view postulates that income growth is the main source of export growth in any economy. Consequently, *there exists Uni-directional Granger Causality running from income growth to export growth*.

(iii) Income-Led Export Growth Led Income: This hypothesis holds that, there exists a '*Two-Way Linkage'* between income growth and export growth. In such relationship the income growth occurs initially and then it leads to export growth. Export growth subsequently leads to further growth in income. Thus there exists a *Bi-directional Granger Causality between income growth and export growth where initial causal impulse comes from income growth.*

(iv) Export Growth-Led Income Growth-Led Export Growth: This hypothesis states that there exists a '*Two-Way Linkage'* between export growth and income growth. In such relationship export growth occurs initially and then it leads to income growth. Income growth, in turn, causes further growth in export. Thus, *there exists a 'Bi-directional Granger Causality between export growth and income growth where initial causal impulse comes from export growth.*

(v) Independence: This hypothesis holds that *there exists no Granger Causality between export and economic growth.* Consequently, these variables are *independent* of each other.

This paper attempts to investigate the validity of the above five hypothesis based on the theoretical arguments presented above.

Objective of the Study

Under this controversial theoretical framework, we seek to enquire empirically into the relationship between income growth and export growth in the member countries (India, Bangladesh, Srilanka, Pakistan, Nepal, Bhutan, Maldives) of the SAARC. Export promotion exercises constitute a noticeable economic program for this country. This perspective of the economy fascinates the imagination of researchers to enquire into the contribution of export growth into its economic growth and vice versa. I, therefore, seek to study the relation between economic growth and export growth in the economy of SAARC.

Specific Issues Under Study

The present study seeks to enquire into
(i) the existence of long-run equilibrium relationship between income growth and export growth in SAARC countries.

The Data

The relationship between Export growth and Income growth in the economy of India, Bangladesh, Sri Lanka, Nepal, Bhutan, Pakistan and Maldives is being studied for the period 1971-2011. The study involves the use of annual dataset for GDP and Export in those countries. Wholesale Price Index (WPI) of 2000 AD is used with 2000 as the base period (2000=100). The data have been taken from various issues of the IFS (*International Financial Statistics*).

Descriptive Statistics for the Data Variables

Table 1 presents the definitions, descriptive statistics of the dependent and explanatory variables used in empirical analyses for two countries.

Table 1

Panel Data (India, Sri Lanka, Bangladesh, Pakistan, Nepal, Bhutan, Maldives)		
	GDP	Export
Mean	5.450237	6.993377
Sum	1150.000	1056.000
Median	5.000000	7.000000
Maximum	29.00000	52.00000
Minimum	-9.000000	-31.00000
Sum Sq. Dev.	3020.227	19714.99
Std. Dev.	3.792365	11.46444
Skewness	1.149795	0.289680
Kurtosis	11.45830	4.902176
Jarque-Bera	675.4720	24.87681
Probability	0.000000	0.000004
Observations	211	151
Cross Section	6	6

Study of Stationarity (Panel unit root test) and panel co-integration test:

Unit root test: Here we test for both trend stationarity and mean stationarity for the two variables of GDP and Export. Also, I control for time effects common to all countries (t=1971-2011) within each model. The test is a residual based one that explores the performance of different statistics. I apply the panel unit root tests proposed by Levin, Lin and Chu(2002), Breitung (2000), Im, Pesaran and Shin (2003) andFisher-type tests using ADF and PP tests (Maddala and Wu (1999) and Choi (2001). The Levin, Lin and Chu (LLC), Breitung and hadri tests assume that the autoregressive parameters are common across cross section. Alternatively, the Im, Pesaran and Shin (IPS) and Fisher-ADF and Fisher-PP tests allow autoregressive parameters to vary freely across cross sections. Results for panel unit root tests are reported in Table-1(for levels) and Table-2(for first difference). It is found that variables are stationary at level i.e., I(0). So, the results strongly indicate the absence of a unit root in model variables for the panel of SAARC countries (India, Bangladesh, SriLanka, Pakistan, Nepal, Bhutan, Maldives).

Table-1: Panel unit root tests on the level of the variables with exogenous constant and trend.

Variables/ Unit Root Tests	GDP		Export	
	Stat	p-value**	Stat	p-value
Common Unit Root Tests:				
Levin, Lin & Chu t*	-7.08426	0.0000	-6.23369	0.0000
Breitung t-stat	-5.70824	0.0000	-5.45849	0.0000
Individual Unit Root Tests				
Im, Pesaran and Shin W-stat	-9.52322	0.0000	-2.72675	0.0032
ADF - Fisher Chi-square	98.5462	0.0000	63.8026	0.0000
PP - Fisher Chi-square	148.537	0.0000	81.3011	0.0000

**Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality

Table-2: Panel unit root tests on the 1st difference of the variables with exogenous constant and trend.

Variables/ Unit Root Tests	GDP		Export	
	Stat	p-value**	Stat	p-value
Common Unit Root Tests:				
Levin, Lin & Chu t*	-6.02539	0.0000	-8.40414	0.0000
Breitung t-stat	-6.55545	0.0000	-7.57081	0.0000
Individual Unit Root Tests				
Im, Pesaran and Shin W-stat	-14.8241	0.0000	-4.65837	0.0000
ADF - Fisher Chi-square	191.800	0.0000	127.772	0.0000
PP - Fisher Chi-square	1089.01	0.0000	815.489	0.0000

**Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality

Cointegration test

At the second step of estimation , it is looked for a long run relationship among variables using the panel cointegration technique developed by Pedroni (1995, 1999). This technique is a significant improvement over conventional cointegration tests applied on a single country series. While pooling data to determine the common long run relationship, it allows the cointegrating vectors to vary across the members of the panel. With a null of no cointegration, the panel cointegration test is essentially a test of unit roots in the estimated residuals of the panel. In the presence of a cointegrating relation, the residuals are expected to be stationary. These tests reject the null of no cointegration when they have large negative values except for the panel-v test which reject the null of cointegration when it has a large positive value.

Tabel-3: Pedroni cointegrated test results for Bivariate specification

Statistics	SAARC countries			
	Test result		Value of Statistics	Probability
Group rho statistics	H_0 hypothesis is rejected	No cointegration	-6.003051	0.0000
Group ADF statistics	H_0 hypothesis is rejected	No cointegration	**-6.898542**	0.0000
Panel rho statistics	H_0 hypothesis is rejected	No cointegration	-11.29412	0.0000
Panel pp statistics	H_0 hypothesis is rejected	No cointegration	-10.58030	0.0000
Panel ADF statistics	H_0 hypothesis is rejected	No cointegration	**-7.768132**	0.0000
Panel v-Statistic	H_0 hypothesis is rejected	No cointegration	0.453227	0.3252

All of this six statistics suggest rejection of the null of no cointegration for all countries. It is, therefore, concluded that the two unit root variables GDP and Export are cointegrated in the long run.

Results of the regression analyses of the pooled OLS model are presented in Table-4, results of the fixed effect within group estimator are presented in Table-5, results of random effects model of the GDP function with standard errors are presented in Table-6 and results of the Hausman test are presented in Table-7.

Table-4: Results of the regression analyses of the pooled OLS model

Dependent Variable: GDP?				
Method: Pooled Least Squares				
Sample: 1971 2011				
Included observations: 41				
Cross-sections included: 6				
Total pool (unbalanced) observations: 151				
Cross sections without valid observations dropped				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP?	1.000000	1.10E-17	9.12E+16	0.0000
EXPORT?	5.05E-17	5.07E-18	9.953987	0.0000
R-squared	1.000000	Mean dependent var		5.463576
Adjusted R-squared	1.000000	S.D. dependent var		2.934337
S.E. of regression	6.81E-16	Akaike info criterion		-66.99598
Sum squared resid	6.90E-29	Schwarz criterion		-66.95601
Log likelihood	5060.196	Hannan-Quinn criter.		-66.97974
Durbin-Watson stat 1.314405				

Using Eviews 7, results of Table-4 are obtained. Assuming that pooling of the data is valid, the results show that export has significant effect on GDP growth. The low Durbin-Watson in the present instance is probably more an indication of specification error than spatial or serial correlation. The possibility that the model is misspecified stems from the fact that by lumping together different individuals at different times, it is camouflaged the heterogeneity that may exist among seven individuals (countries). Perhaps the uniqueness of each individual (country) is subsumed in the composite error term, u_{it} . As a result, it is quite possible that the error term is correlated with some of the regressors included in the model. If that is indeed the case, the estimated coefficients in Table-4 may be biased as well as inconsistent.

One way in which heterogeneity that may exist among seven countries can be taken into account is to allow each country to have its own intercept, as in the following equation:

$GDP_{it} = B_{1i} + B_2 Export_{it} + u_{it}$ -------- (1) where i=1,2,…7; t=1,2,….41

It is evident from equation (1) that subscript *i* to the intercept has been added to indicate that the intercept of the seven countries may be different. The difference may be due special features of each country, such as geographical location etc. Equation (1) is known as the fixed effects regression model. The term "fixed effects" is due to the fact that each country's intercept, although different from the intercepts of the other countries, does not vary over time, i.e., time invariant.

If the OLS pooled regression results are compared with the Fixed effects regression model's results, substantial differences between the two can be seen. In the pooled regression the coefficient of export is not only positive but also statistically significant but in the Fixed effects regression model the coefficient of export is not statistically significant (it is evident from Table-5). This result, therefore, cast doubt on the pooled OLS estimate.

One drawback of the WG estimator is that in removing the fixed, or individual, effects(B_{1i}), through mean corrected variables, it also removes the effect of time-invariant regressors that may be present in the model.

Table-5: Results of the fixed effect within group estimator

Dependent Variable: GDP?				
Method: Pooled Least Squares				
Sample: 1971 2011				
Included observations: 41				
Cross-sections included: 6				
Total pool (unbalanced) observations: 151				
Cross sections without valid observations dropped				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.78E-15	4.40E-16	13.14134	0.0000
GDP?	1.000000	7.45E-17	1.34E+16	0.0000
EXPORT?	0.000000	1.80E-17	0.000000	1.0000
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	1.000000	Mean dependent var		5.463576
Adjusted R-squared	1.000000	S.D. dependent var		2.934337
S.E. of regression	2.34E-15	Akaike info criterion		-64.48460
Sum squared resid	7.86E-28	Schwarz criterion		-64.32474
Log likelihood	4876.587	Hannan-Quinn criter.		-64.41966
F-statistic	3.36E+31	Durbin-Watson stat		1.703019
Prob(F-statistic)	0.000000			

In the fixed effects model it is assumed that the individual specific coefficient B_{1i} is fixed for each subject, that is, it is time invariant. In the random effects model it is assumed that B_{1i} is a random variable with a mean value of B_1 and the intercept of any cross-section unit is expressed as:
$B_{1i} = B_1 + \varepsilon_i$ where ε_i is a random error term with mean 0 and variance σ_ε^2.
Therefore, GDP function can be written as
$GDP_{it} = B_1 + B_2 Export_{it} + w_{it}$ -------- (1) where $w_{it} = \varepsilon_i + u_{it}$
It is evident from the Table-6 that Coefficient of export is not statistically significant.

Table-6: Results of random effects model of the GDP function with standard errors

Dependent Variable: GDP?				
Method: Pooled EGLS (Cross-section random effects)				
Sample: 1971 2011				
Included observations: 41				
Cross-sections included: 6				
Total pool (unbalanced) observations: 151				
Swamy and Arora estimator of component variances				
Cross sections without valid observations dropped				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000000	4.31E-16	0.000000	1.0000
GDP?	1.000000	6.90E-17	1.45E+16	0.0000
EXPORT?	0.000000	1.76E-17	0.000000	1.0000
Effects Specification				
			S.D.	Rho
Cross-section random			2.58E-16	0.0120
Idiosyncratic random			2.34E-15	0.9880
Weighted Statistics				
Mean dependent var	4.648380	S.D. dependent var		2.974088
S.E. of regression	0.000000	Sum squared resid		0.000000
Unweighted Statistics				
Mean dependent var	5.463576	Sum squared resid		0.000000

It is also critical to note that w_{it} is not correlated with any of the explanatory variables included in the model. Since ε_i is a part of w_{it} , it is possible that the latter is correlated with one or more regressors.If that turns out to be the case, Random effects model will result in inconsistent estimation of the regression coefficients. The **Hausman test** will show in a given application if w_{it} is correlated with regressors- that is, whether REM is the appropriate model.

Table-7: Results of the Hausman test

Correlated Random Effects - Hausman Test				
Pool: Untitled				
Test cross-section random effects				
Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random		1065.486376	2	0.0000
Cross-section random effects test comparisons:				
Variable	Fixed	Random	Var(Diff.)	Prob.
GDP?	1.000000	1.000000	0.000000	0.0000
EXPORT?	0.000000	0.000000	0.000000	1.0000

The results of the Hausman test are given in Table-7. The Hausman test strongly rejects the REM, for the *p* value of the estimated chi-square statistics is very low.

Since the computed chi-square value exceeds the critical chi-square value for given df and the level of significance, it can be concluded that REM is not appropriate because random error terms ε_i are probably correlated with one or more regressors. In this case, FEM(Fixed effects model) is preferred to Random effects model.

Conclusion

The purpose of this paper has been to investigate the export-led growth (ELG) paradigm for SAARC countries (India, Bangladesh, Srilanka, Pakistan, Nepal, Bhutan, Maldives) using panel data for the period 1971 to 2011. The paper applied pooled ordinary least square(OLS), fixed effects model (FEM), random effects model(REM) and Hausman test. Fixed effects and random effects model lead to conclusion that, there is no significant relationship between the size of GDP growth rate and export rate for these countries. On the other hand, panel unit root tests imply that there is strong evidence of stationary process for both GDP and export at level. However, the panel cointegration test indicates that there is cointegrating relationship between export and GDP for these countries. As a conclusion export could be seen as the 'engine' of growth in these countries. Findings of this paper encourage a closer look at other factors that may influence the size of GDP in SAARC countries. Future studies on this topic may want to incorporate other than the present study's variables in their research in order to capture the complex nature of development process.

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