LONG TERM CAUSALITY OF GDP LED EXPORT (GLE) USING VECM MODEL WITH REFERENCE TO INDIA

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ABSTRACT

The aim of this paper is to study the long term and short term relationship between GDP and Export. Various statistical tests like Johansen Co-integration Test, Vector Error Correction Estimates, Wald test, ARCH Test and Serial Correlation Test have been performed. The data was collected from the website of World Bank for a period of 41 years i.e. 1970 to 2011. It was observed that the data shows co-integration between the variables but long term association was not found.

Key words: GDP, Export, Co-integration, VEC Method, ARCH Test, Serial Correlation, Wald Test.

INTRODUCTION

Indian Policy makers should be concerned about improving the quality of life of its citizens and this involves macroeconomic development in a highly competitive and globalised world. For Policy makers, creating wealth and/or increasing Gross Domestic Product (GDP) are of prime importance for any economy. Exports are believed to be crucial in providing the impetus for economic growth in developing countries. Consequently, the export-led growth (ELG) strategy has been put forward as an alternative to the inward oriented strategy of development. There is considerable debate on the ELG and growth-driven export (GDE) hypotheses to decide the development policies and, of course, their implications for international trade. Indian policy makers had an inward-looking trade and investment policy, which included import substitution, resulting in the country to be self-sufficient but the costs of many goods for consumers were high because the industries did not face competition from abroad and multinational companies (MNCs). During 90s, we began to follow economic liberalization approach wherein tariffs and import and export controls were relaxed. This reduced the costs to import inputs and further reduced the costs of some consumer goods. Thus the economic reforms resulted into real GDP growth, export growth, productivity increases, along with increased government borrowing and spending and an ever-expanding fiscal deficit.

This paper is divided in three sections: first section covers review of literature, second section deals with research methodology and the third section includes results and conclusion.

REVIEW OF LITERATURE

Ghosh and Ostry (1995) used vector auto-regression analysis to argue that current account in developing countries acts as a buffer to smooth consumption to face the shocks and capital mobility may after all be quite high in this group of countries. Jansen (1995) assessed the channels of macroeconomic impact & their intensity and suggested that export-oriented Development Financial Institutions are likely to have a positive effect on private investment and growth.

Kónya and Singh (2006) reviewed 30 export-growth time-series studies published between 1978 and 2005. Their study was based on various time-series techniques (unit-root and co-integration tests; single equation, vector autoregressive (VAR) and vector error-correction (VEC) models) and they focused exclusively either on India or on a group of countries that include India. Results of four studies found support for a significant positive correlation between exports and economic growth; eight for the ELG hypothesis; seven for the GDE hypothesis; and two for two-way causality between exports and growth.

It is Adam Smith who first studied the relationship between international trade and economic growth. According to him, the development of division is the principal factor to improve the long-time growth of productivity, and the degree of division is constrained by the scope of market. Expansion of market will naturally deepen the division and improve the productivity, and then improve economic growth. The engine theory suggests that trade growth of developing countries is correlated to their own economic growth; their export growths are constrained by the economic growth of developed countries. Irving Kravis (1970) forwarded a new viewpoint that foreign trade is a house maid of economic growth rather than an engine of growth. Classical school, Marxian school and new classical school all suggest that foreign trade has just indirect impact on accumulation and economic growth, in fact, foreign trade impacts on them through profit margin. Further, some Latin American economists have completely negative attitude on engine theory, they suggest that, in modern global economy regime, developed capitalism countries are the core which is regulating the outer consisting of developing countries, the outer countries must comply with the core countries. This kind of dependent relationship makes foreign trade the reason of weakening the economy of the developing countries rather than the reason of improving the economy of the developing countries.

Li Yuhong et. al. (2010) did co-integration analyses with the data of import, export and economic, and the results suggests that growth of import greatly promoted economic growth of China, while that of export performed an opposite one.

Giles & Williams (1999) provided a comprehensive survey of more than 150 ELG applied papers. They described that the changes have occurred in the methodologies used to empirically examine for relationships between exports and economic Growth and to provide information on

the current findings. The last decade of 21st century has seen an abundance of time series studies which focus on examining for causality via exclusions restrictions tests, impulse response function analysis and forecast error variance decompositions. Their second contribution is to examine that some of these time series methods found that the ELG results based on standard causality techniques are not typically robust to specifications or method. Their results suggest that extreme care should be exercised when interpreting much of the applied research on the ELG hypothesis.

Konya (2000) investigated the possibility of Granger causality between the log of real exports and real GDP in 25 OECD countries, between 1960 and 1998. They have applied two complementary testing strategies. First one was 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. Their study illustrates how sensitive the Granger causality test results can be to different methods and model specifications. With limitation in mind, they claimed that there is no causality (NC) between exports and growth in the Netherlands, export causes growth (ECG) in Belgium and Iceland, growth causes export (GCE) in Canada and Japan, and there is two-way causality (TWC) in Sweden and in the UK. They also suspected that there is NC in Hungary, France, Greece and Luxembourg, ECG in Australia, Austria, Denmark, Ireland, Spain and Switzerland, GCE in Finland and Korea. However, in the case of Italy, Mexico, New Zealand, Norway, Portugal and the USA the results are too controversial to make a simple choice.

Altaf et al. (2012) determined the significance of macroeconomic variables on Pakistan's economic growth with the application of VAR modeling using annual time series data. Their quantitative evidence showed that real per-capita income growth is caused by money-supply. They concluded that exchange rate policies, government spending and money supply are significant in the regression of Investment. Similarly they found that exports and exchange rate policies affect the growth of real per-capita money supply.

Feasel et al. (2001) used the impulse response analysis & variance decomposition and suggested that the investment rates & growth rates of exports had significant short run effect on the growth rate of per capita output. They employed VAR analysis on the data of Korea for the period 1956-1994 and found the dynamic relationships among investment rates, output growth and export growth. Shan (2003) used Vector Auto-Regression technique to examine the impact of financial development on economic growth in china. He found that after contribution of labor input financial development came as the second force in leading economic growth in China.

Kandil and Mirzaile (2004) used the data of 9 developing countries in the Middle East and applied the empirical model that included three policy variables: government spending, the money supply and the exchange rate. They found that there was asymmetry in the cyclical behavior of private consumption. They also suggested that to maximize the policy effect on desired private

consumption, the policy stance should be carefully designed which is the largest growing component of aggregate demand in many developing countries. They found that highlighted importance of country specific studies and observed that the result obtained from cross country analysis were not able to address this issue. The results supported the view that output growth caused financial depth in long run in contrary to conventional findings.

OBJECTIVES OF THE STUDY

The primary objective of this paper was to study the long term and short term relationship between Growth in economy and Export. The secondary objectives were:

1. Whether any long term association is there between GDP and Export

2. Whether any shot term association is there between GDP and Export.

RESEARCH METHODOLOGY

The Study

Co-integration analysis, which is mentioned above, with time-series was adopted in this study for testing whether there exists long term or short term stationary causality between foreign trade and GDP growth, and for testing the unit root of each variable to confirm their stationarities. The following was the desired time-sequence data model,

$yit = \rho i\, yi,t - 1 + Xit\delta i + \varepsilon it$

Where $i = 1,\ldots, N$ represent the number of time-series data; $t = 1,\ldots,T$ represents time span; xit are the exogenous variables in the model including fixed effect or time trend of each time-series unit; ρi is autoregressive coefficient, suppose that disturbance terms εit are mutual independence.

If $| \rho i | < 1$, yit represents the stationary process;

if $| \rho i | = 1$, yit represents the process of unit root.

Logarithms values of the gross domestic products (GDP) & total export value (EXP) were computed, and were denoted by LnGDP, & LnEXP. Their logarithm values and first difference values were tested through time series unit root. Logarithm values cited here were computed or convenience to get stationarity more easily; the method was helpful in eliminating the

heteroscedasticity of time series while the characteristics of time series and relationships did not change.

The relationships between relevant indexes were tested in this study by using three steps. First of all, unit root was applied on the time-series data[8]; then, the two-step method put forward by Engle and Granger (1987) was used to test the mutual long term causalities of relevant indexes; if the long term causality existed, then their short term causalities were tested.

Co-Integration Analysis of Time-Series Data and Long Term Causality Test

In order to test the long term causations between variables, two-step test method put forward by Engle and Granger (1987) was used. When measuring the long term causalities between GDP and relevant indexes of foreign trade, the measured variables were mutually simple integrated, and then the regression through the following time-series Equation (1) was processed. Further, residual errors Eit comes out and it's tested through unit root to determine their stabilities. If Eit is stationary, the mutual long term causalities are proved to exist.

$$\text{Ln}(*) = \alpha + \beta \text{ Ln}(**) + \varepsilon it \quad (1)$$

Where (*) and (**) separately represent GDP, IE, EXP and IMP.

Time-Series Data Error Correcting Model and Short Term Causality Test

Co-integration relationships reflected the long term balanced relationship between relevant variables. In order to cover the shortage, correcting mechanism of short term deviation from long term balance was adopted. At the same time, as the time series had limited number of years, the above test results could cause disputes. Therefore, under the circumstances where long term causalities existed, short term causalities were also tested. The error correcting models shown below was used,

$$d\,\text{LnGDP}it = \eta i + \Sigma \alpha 1 d\,\text{LnGDP}i,\ t-1 + \Sigma \beta 1 d\,\text{LnEXP}i,\ t\text{-}1 + \lambda\ \text{ECM}it + \varepsilon it \quad (1)$$

Where *t* represents year, *d* represents first difference calculation, ECM*it* represents the errors of long term balance. If $\lambda = 0$ is rejected, error correcting mechanism happens, and the tested long term causality is reliable, it could be unreliable. If $\beta 1 = 0$ is rejected, and then the short term causality is not proved to exist.

The Sample

The data was collected for a period of 41 years i.e. 1970 – 2011. The Indian GDP value was taken at USD rate and Indian Export value was also taken at USD rate. The data was time series in nature and hence we needed to check the stationarity of data. Johansen Co-integration Test was applied to test stationarity of data.

RESULT AND ANALYSIS

Null Hypothesis Ho1: There is no Co-integration between the variables. The null hypothesis was rejected because the probability was less than 5 percent. It means there was co-integration between the variables.

Alternative Hypothesis: There is at least one co-integrating variables. The alternative hypothesis is accepted at 5 percent probability. For more information please look at **Table 1: Johansen Co-integration Test**

First Model:

The Equation for Dependent Variable will be: **D(EXP01) = C(1)*(EXP01(-1) + 0.003156181335*GDP(-1) - 6.594715829e+010) + C(2)*D(EXP01(-1)) + C(3)*D(EXP01(-2)) + C(4)*D(GDP(-1)) + C(5)*D(GDP(-2)) + C(6)**

This equation will be our Error Correction Model and export will be dependable variable. C(1) is the coefficient of the integrating equation.

(-1) + 0.003156181335*GDP(-1) - 6.594715829e+010) will be the co-integrating equation. This will be for long term causality. Table 2: Vector Error Correction Estimates

For short term causality, the equation will be: **C(4)*D(GDP(-1)) + C(5)*D(GDP(-2))**

Second Model

D(GDP) = C(7)*(EXP01(-1) + 0.003156181335*GDP(-1) - 6.594715829e+010) + C(8)*D(EXP01(-1)) + C(9)*D(EXP01(-2)) + C(10)*D(GDP(-1)) + C(11)*D(GDP(-2)) + C(12)

Null Hypothesis Ho2: There is no long term causality between GDP and Export. The probability is 0 percent which means the hypothesis is rejected but since the value of coefficient is positive, we can say that there is no long term causality. C(1) is the residual of one period lag of co-integrating vector Export and GDP. 0.266605 is one period lag and it is significant but the coefficient is not negative. It means that GDP has no long run causality on export, **see Table 3:**

Null Hypothesis $H_0$3: GDP of Lag 4 & 5 cannot jointly influence Export. Probability of Chi square statistic is less than 5% which means null hypothesis is rejected. Thus it can be jointly said that the log 4 and lag 5 of GDP jointly affect the export in short run, see **Table 4: Wald Test.**

Null Hypothesis $H_0$4: Residual is normally distributed. Results show that probability of Jarque – Bera test statistic is more than 5 percent. It means the null hypothesis is rejected. But the literature on VECM says we can accept the model if it is not normal.

Graph 1: Histogram

Null hypothesis $H_0$5: There is no ARCH effect. The Probability value of observed R square is 2.38 percent which is below 5 percent. Hence null hypothesis is rejected. It means there is ARCH effect among variables; see **Table 5: ARCH Test.**

Null hypothesis $H_0$6: There is no Serial Correlation Effect. The Probability value of observed R square is 0.000 percent which is below 5 percent. Hence null hypothesis is rejected. It means there is Serial Correlation effect among variables; see **Table 6: Breusch-Godfrey Serial Correlation LM Test.**

CONCLUSION

The results showed that there is no long term causality between GDP and Export. But the result of Wald test shows that short term causality is there between GDP and Export. These results are in conformity of Jin & Yu (1996) in which they observed the GLE for US Economy. The result of non causality of GLE in Indian case may be possible because prior to 1991 it was pre-liberalized economy period thus export was totally controlled one. Short run causality is possible because after 1991, in short period growth in GDP may lead to increase in Export.

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ANNEXURE

Table 1: Johansen Co-integration Test

Unrestricted Co-integration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigen value	Statistic	Critical Value	Prob.**
None *	0.541824	33.28390	15.49471	0.0000
At most 1	0.050286	2.063795	3.841466	0.1508
Trace test indicates 1 co-integrating eqn (s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Co-integration Rank Test (Maximum Eigen value)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigen value	Statistic	Critical Value	Prob.**
None *	0.541824	31.22011	14.26460	0.0001
At most 1	0.050286	2.063795	3.841466	0.1508
Max-eigen value test indicates 1 co-integrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Co-integrating Coefficients (normalized by b'*S11*b=I):				
GDP	EXP01			
1.83E-12	-2.73E-11			
1.72E-11	-6.91E-11			
Unrestricted Adjustment Coefficients (alpha):				
D(GDP)	-4.81E+10	1.69E+09		
D(EXP01)	-8.57E+09	1.65E+09		

1 Co-integrating Equation(s):		Log likelihood	-1994.731	
Normalized co-integrating coefficients (standard error in parentheses)				
GDP	EXP01			
1.000000	-14.90328			
	(1.66044)			
Adjustment coefficients (standard error in parentheses)				
D(GDP)	-0.088194			
	(0.01371)			
D(EXP01)	-0.015728			
	(0.00330)			

Table 2: Vector Error Correction Estimates		
Co-integrating Eq:	CointEq1	
EXP01(-1)	1.000000	
GDP(-1)	0.003156	
	(0.03662)	
	[0.08618]	
C	-6.59E+10	
Error Correction:	D(EXP01)	D(GDP)
CointEq1	0.266605	1.077768
	(0.04354)	(0.21383)
	[6.12336]	[5.04027]
D(EXP01(-1))	-0.057030	0.597009
	(0.28252)	(1.38754)
	[-0.20186]	[0.43026]
D(EXP01(-2))	0.301538	1.481283
	(0.25057)	(1.23061)
	[1.20341]	[1.20369]
D(GDP(-1))	0.062156	-0.607263
	(0.06414)	(0.31502)
	[0.96905]	[-1.92771]
D(GDP(-2))	-0.311778	-0.840578
	(0.08648)	(0.42471)
	[-3.60535]	[-1.97919]
C	1.79E+10	8.25E+10

	(3.3E+09)	(1.6E+10)
	[5.45359]	[5.13057]
R-squared	0.857146	0.665672
Adj. R-squared	0.835501	0.615016
Sum sq. resids	2.99E+21	7.20E+22
S.E. equation	9.51E+09	4.67E+10
F-statistic	39.60097	13.14109
Log likelihood	-948.1394	-1010.209
Akaike AIC	48.93023	52.11329
Schwarz SC	49.18616	52.36922
Mean dependent	1.16E+10	4.55E+10
S.D. dependent	2.35E+10	7.53E+10
Determinant resid covariance (dof adj.)		5.52E+40
Determinant resid covariance		3.95E+40
Log likelihood		-1933.495
Akaike information criterion		99.87153
Schwarz criterion		100.4687

Table 3: D(EXP01) = C(1)*(EXP01(-1) + 0.003156181335*GDP(-1) - 6.594715829E+010) + C(2)*D(EXP01(-1)) + C(3)*D(EXP01(-2)) + C(4)*D(GDP(-1)) + C(5)*D(GDP(-2)) + C(6)

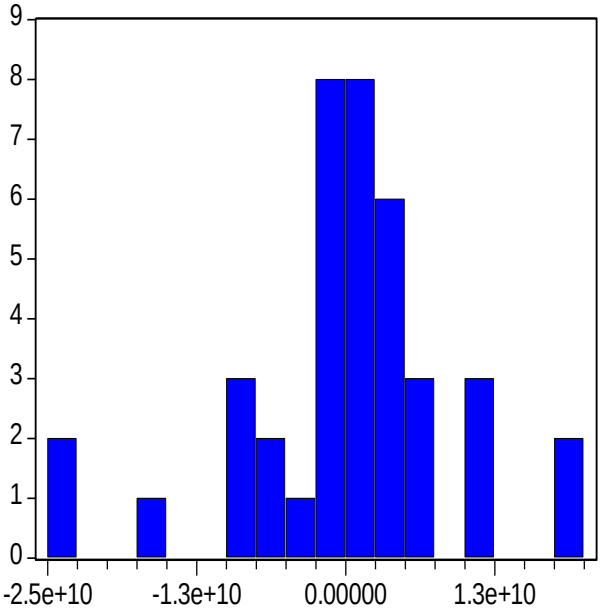
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.266605	0.043539	6.123361	0.0000
C(2)	-0.057030	0.282523	-0.201861	0.8413
C(3)	0.301538	0.250570	1.203410	0.2374
C(4)	0.062156	0.064142	0.969046	0.3396
C(5)	-0.311778	0.086476	-3.605353	0.0010
C(6)	1.79E+10	3.27E+09	5.453591	0.0000
R-squared	0.857146	Mean dependent var		1.16E+10
Adjusted R-squared	0.835501	S.D. dependent var		2.35E+10
S.E. of regression	9.51E+09	Akaike info criterion		48.93023
Sum squared resid	2.99E+21	Schwarz criterion		49.18616
Log likelihood	-948.1394	Durbin-Watson stat		1.852283

Table 4: Wald Test - Equation: Untitled			
Test Statistic	Value	df	Probability
F-statistic	24.72533	(2, 33)	0.0000
Chi-square	49.45067	2	0.0000
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(4)		0.062156	0.064142
C(5)		-0.311778	0.086476
Restrictions are linear in coefficients.			

Table 5: ARCH Test				
F-statistic	4.304473	Probability		0.021559
Obs*R-squared	7.475684	Probability		0.023805
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.96E+19	2.61E+19	1.521412	0.1374
RESID^2(-1)	0.358720	0.170273	2.106737	0.0426
RESID^2(-2)	0.155600	0.169664	0.917106	0.3655
R-squared	0.202046	Mean dependent var		8.07E+19
Adjusted R-squared	0.155107	S.D. dependent var		1.44E+20
S.E. of regression	1.33E+20	Akaike info criterion		95.58201
Sum squared resid	5.97E+41	Schwarz criterion		95.71263
Log likelihood	-1765.267	F-statistic		4.304473
Durbin-Watson stat	1.985812	Prob(F-statistic)		0.021559

Table 6: Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	14.43482	Probability		0.000037
Obs*R-squared	18.80613	Probability		0.000082
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.019068	0.040729	-0.468163	0.6429
C(2)	-0.037998	0.216491	-0.175518	0.8618
C(3)	0.562751	0.192925	2.916944	0.0065
C(4)	0.001592	0.047070	0.033823	0.9732
C(5)	-0.054661	0.063019	-0.867378	0.3924
C(6)	-1.89E+09	2.64E+09	-0.716541	0.4790
RESID(-1)	0.156938	0.156281	1.004204	0.3231
RESID(-2)	0.107416	0.164499	0.652988	0.5186
R-squared	0.482208	Mean dependent var		1.16E-06
Adjusted R-squared	0.365288	S.D. dependent var		8.86E+09
S.E. of regression	7.06E+09	Akaike info criterion		48.37461
Sum squared resid	1.55E+21	Schwarz criterion		48.71585
Log likelihood	-935.3049	Durbin-Watson stat		2.572453

Graph1: Histogram



Series: Residuals	
Sample 4 42	
Observations 39	
Mean	1.16e-06
Median	8.43e+08
Maximum	1.94e+10
Minimum	-2.39e+10
Std. Dev.	8.86e+09
Skewness	-0.485130
Kurtosis	4.326461
Jarque-Bera	4.388968
Probability	0.111416