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Export Performance and Economic Growth in East Asian Economies – Application of Cointegration and Vector Error Correction Model

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Abstract

East Asian Economies are considered to be most successful economies in the world. Following the footsteps of other East Asian economies such as Japan and South Korea, China also shifted towards export-led growth strategy in 80s. This study analyzes the effect of export performance on economic growth of three major East Asian economies i.e. Japan, South Korea, and China. This study has conducted the econometric analysis of macro data under multivariate framework for the period 1980-2012. In order to examine the causal relationship between exports and economic growth, the study has applied time series techniques such as Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests to check stationarity of variables, Johansen cointegration test for long run relationship, vector error correction model (VECM) for short run dynamics and for estimating speed of adjustment towards long run equilibrium. The analysis also made use of techniques Impulse Response Function (IRF) and Variance Decomposition Analysis (VDA) to investigate the interrelationships within the system. The estimated results suggested that all variables were cointegrated for East Asian economies. The study concluded that export-led growth (ELG) was only long run phenomenon in China and South Korea. The results for Japan supported growth led exports (GLE) particularly for short run.

Keywords: *Export-led Growth, Southeast Asia, time series, cointegration, VECM, impulse response function, variance decomposition analysis*

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1. Introduction and Background

After Second World War, Japan focused on industrialization and expansion of exports which led to rapid economic growth of the economy. Later on, Japan's export-led growth model was adopted by four Asian tigers or first tier of newly industrialized economies (NIEs) namely Hong Kong, South Korea, Singapore and Taiwan in the 1960s. After the success of four Asian tigers since 1970, second tier of newly industrialized economies (NIEs) of Southeast Asia namely Indonesia, Malaysia, Thailand and Philippines replicated this strategy. Finally China and India gradually followed this strategy. Hence, rapidly growing economies of Asian region have widely followed export-led growth strategy as an effective tool for development (Page, 1994; Kokko, 2002; Chow, 2012).

East Asia is considered as most successful sub region of Asia. China is the largest country in terms of geographic and demographic features. China's population is ten times more than Japan's population and twenty seven times that of South Korea. Japan and South Korea are located just off the coast of mainland China. In 2012, China, Japan and South Korea together constituted about 20 percent of world economic output in nominal terms. Moreover, China was also the largest trading partner of both Japan and South Korea in the same year. Industrialization was the main reason behind the economic development of these economies (Berglee, 2012; O'Reilly, 2012; Park & Patrick, 2013).

The compound growth rates of exports, imports and trade for East Asian economies have been reported in Table 1. Table indicates remarkable exports performance of China and South Korea during 1981-2012. However, Japan's export performance was low during 80s and further declined during later decades. In case of GDP, only China was able to secure double digit growth throughout the study period. Growth rates of exports and GDP are relatively lower for Japan, which is due to Japan being a mature developed economy as well as slowdown in developed world.

Table 1. Growth performance of East Asian Economies (Compound Growth Rates)

	China			Japan			South Korea		
Year	Export	Import	GDP	Export	Import	GDP	Export	Import	GDP
1981-1990	14.14	19.70	10.46	4.47	6.74	4.72	11.67	11.93	9.18
1991-2000	22.01	22.05	10.42	4.30	4.69	0.92	16.44	9.50	5.46
2001-2012	13.03	11.08	10.73	4.23	2.04	0.67	10.56	8.47	3.86
1980-2012	18.73	18.52	10.02	4.64	4.36	1.93	12.34	10.33	6.15

Source: Calculations based on data from World Development Indicators (WDI), online database.

The purpose of this study is to empirically investigate export-growth relationship for major East Asian economies namely China, Japan and South Korea by using time series data analysis including structural breaks under multivariate framework. The methodology used in this study is little improvement over previous studies as it

includes structural breaks, diagnostic tests and forecasting methods such as impulse response function (IRF) and variance decomposition analysis (VDA). The first section includes introductory part and brief background of East Asian economies. The next section reports review of literature. Further, methodology and empirical results have been given. Final section presents conclusions and also contains comparison of our results with previous studies.

2. Review of Literature

The literature reviewed indicates that comprehensive studies based on rigorous statistical analysis comprising forecasting methods and identifying structural breaks are lacking (Table 2). Therefore, the present study has made an attempt to analyze the relationship between exports and economic growth by adopting above mentioned methods. The evidence for export-led growth hypothesis is inconclusive as the results provided by these studies are not unanimous. Hence, in the light of above facts, the study takes into account these issues in further investigation.

Table 2. A Brief Review of the Related Economic Literature on East Asia

Author	Period of the study	Countries / Region	Objective of the study	Methodology	Conclusions*
Fawson and Chang (1994)	Japan (1970-92), Philippines (1983-93), South Korea (1971-92), Taiwan, UK (1970-92), USA (1970-92)	Japan, Philippines, South Korea, Taiwan, UK, USA	Examined the causal relationship between exports and growth	Hsiao's Granger Causality Test	ELG- Philippines GLE- South Korea, Japan and United States BDC- Taiwan and United Kingdom
Holman and Graves (1995)	1953-90	South Korea	Analyzed the role of exports in stimulating exports	Sim's Test and Granger Causality Test	Both tests supported two way causation
Kwan and Kwok (1995)	1952-85	China	Examined the validity of export-led growth hypothesis	Granger Causality	Supported the validity of export-led growth hypothesis
Boltho (1996)	Three periods (1913-37, 1952-73, 1973-90)	Japan	Investigated export-led growth hypothesis	Granger Causality	Findings didn't favour export led growth hypothesis
Liu, Song and Romilly (1997)	1983-95	China	Examined causal relationship between economic growth and exports + imports	ADF unit root, cointegration test, Causality test based on Granger (1969), Sims (1969), Geweke et al. (1983) and Hsiao (1981) models	Feedback causal relationship was confirmed.

Table 2 (cont.) A Brief Review of the Related Economic Literature on East Asia

Author	Period of the study	Countries / Region	Objective of the study	Methodology	Conclusions*
Shan and Sun (1998)	1987-96	China	Examined the causality link between exports and economic growth	Unit Root and Causality test developed by Toda-Yamamoto (1995)	Bidirectional Causality between exports and real industrial output.
Lin (1999)	1978-1995	China	Examined the effects of exports on economic growth	Regression	Positive relationship was found between growth rate of exports and growth rate of per capita GDP
Hatemi-J (2002)	1960-1999	Japan	Investigated causal relationship between exports and economic growth	Granger causality test using bootstrap simulation technique	Bidirectional causality was observed between exports and output
Liu, Burridge and Sinclair (2002)	1981-1997	China	Investigated the causal link between trade, economic growth and inward FDI	ADF, Cointegration and Causality	Identified long run relationship between these variables. Two- way causal connect was found between economic growth and FDI, Exports.
Awokuse (2005)	1960-I to 1991-IV	Japan	Explored the causal relationship between real exports and GDP	Toda-Yamamoto approach, directed acyclic graphs (DAG), and forecast error variance decompositions (FEVD)	The study confirmed bidirectional causality in case of Japan.
Awokuse (2005)	1963:I to 2001:IV	Korea	Examined the export-led growth (ELG) hypothesis for Korea	Johansen Cointegration Test and Vector Error Correction Model (VECM) and Toda-Yamamoto approach	The study found feedback relationship between exports and growth and supported ELG hypothesis.
Yao (2006)	1978-2000	China	Examined the hypothesis both exports and FDI have positive effect on economic growth	Panel unit root & Dynamic Panel Data (DPD) estimation	Found strong and positive effect of Exports and FDI on economic growth

Table 2 (cont.) A Brief Review of the Related Economic Literature on East Asia

Author	Period of the study	Countries/ Region	Objective of the study	Methodology	Conclusions*
Mah (2007)	1980-2001	China	Examined the causality among economic growth, export expansion and export composition	Johansen Cointegration Test and Error Correction Model (ECM)	Didn't find cointegration among variables. However, ECM confirmed bidirectional causality
Ding and Knight (2008)	1978-2006	China	Explore the reason for China's growth success including degree of openness, institutional change and sectoral change	Regression	All the three were found to be important to raise the growth rate of China
Mahadevan and Suardi (2008)	Up to 2005 (more than 30 years)	Japan, Korea, Taiwan & Hong-Kong	Examined the stability of trade-growth nexus by incorporating the effects of uncertainty or volatility	ADF, KPSS tests for unit root, Cointegration, VECM	The uncertainty results revealed GDP growth was import led in Japan, both export & import led in Hong-Kong, mutually causative in Taiwan. No causation from GDP growth to exports and imports was observed for Korea (vice versa).
Herrerias and Orts (2010)	1964-2004	China	Analyzed whether growth is export- led or investment- led	ADF, VECM	Found evidence for both
Sun and Heshmati (2010)	2002-2007	China	Evaluated the effect of international trade on economic growth	Likelihood Ratio Test, One Way ANOVA, Non Parametric Test	Positive relationship was found between international trade and economic growth

Table 2 (cont.) A Brief Review of the Related Economic Literature on East Asia

Author	Period of the study	Countries / Region	Objective of the study	Methodology	Conclusions*
Tsen (2010)	1978-2002	China	Examined causality among exports, domestic demand and economic growth	ER and PP test for Unit root, Bound testing approach	Bidirectional causality, evidence of export-led growth, growth led exports, domestic demand led growth and growth led domestic demand
Marelli and Signorelli (2011)	1980-2007	China	Estimated the link between openness and growth of China and India	2SLS (Panel Data)	Positive growth effects after opening up.
Yin and Hamori (2012)	1970-2009	China	Compared the impact of openness on growth of China and India	ADF, FMOLS, DOLS	Increasing openness has greater impact on the growth of China as compare to India
Zhang and Baimbridge (2011)	South Korea (1963-2003), Japan (1957-2003)	South Korea, Japan	Investigated the relationship between exports, imports and economic growth	ADF, Johansen Cointegration and VECM	Negative effect from Real GDP to real exports in case of South Korea while ELG was found for Japan
Kumari and Malhotra (2014)	1980-2012	China	Analyzed trade-led growth hypothesis for India and China	ADF,PP, Johansen Cointegration and Toda-Yamamoto Approach	Trade-led Growth hypothesis was found valid for China. In case of India only unidirectional causality running from GDP to exports i.e. growth-led exports was confirmed.

*Note: BDC refers to bi-directional causality, ELG refers to export led growth, GLE refers to growth led export.

3. Model, Database and Econometric Strategy

The aggregate production function used in the study can be expressed as:

$$Y= f (K, L, X, M) \quad (1)$$

Where Y represents real gross domestic product and K, L, X, M represent capital, labour, exports and imports respectively. This model has been used to examine the

export-led growth (ELG) hypothesis for major East Asian economies. The study has used annual data at the 2005 constant US dollar prices from 1980 to 2012. Data on real GDP per capita(GDPPC), real exports(EXP), real imports(IMP), real gross capital formation(GCF) has been compiled from World Development Indicators (WDI) online database, World Bank, while data on total labour force(LAB) is collected from United Nation Conference on Trade and Development (UNCTAD) Statistics.

All the variables are taken in their natural logarithms to avoid the problem of heteroskedasticity (Gujarati 1995).For the application of multivariate econometric techniques, the above stated model can be expressed in the following linear logarithmic form:

$$LNGDPPC_t = \beta_0 + \beta_1 LNEXP_t + \beta_2 LNIMP_t + \beta_3 LNGCF_t + \beta_4 LNLAB_t + \varepsilon_t$$

The prefix 'LN' stands for natural logarithm. The study takes into account dummies for Asian Financial Crisis (1997) and Global Economic Crisis (2008). To examine the export-led growth hypothesis cointegration and VECM based causality tests have been used.

4. Estimates of Multivariate Analysis

4.1. Unit Root Results

The results in Table 3 give the summary of ADF and PP tests for East Asian economies.

Table 3. Results of Unit Root test for variables

Countries	Variables	ADF (Test Statistics)			Order of Integration	PP (Test Statistic)			Order of Integration
		Level	First Difference	Second Difference		Level	First Difference	Second Difference	
China	LNGDPPC	-2.974	-4.258**	-	I(1)	-2.215	-3.255***	-	I(1)
	LNEXP	-1.483	-5.378*	-	I(1)	-1.587	-5.378*	-	I(1)
	LNIMP	0.394	-3.942**	-	I(1)	-1.444	-3.942**	-	I(1)
	LNGCF	-3.960**	-	-	I(0)	-2.547	-3.922**	-	I(1)
	LNDLAB	-2.570	-6.371*	-	I(1)	-2.570	-6.371*	-	I(1)
Japan	LNGDPPC	-1.413	-4.893*	-	I(1)	-1.413	-4.893*	-	I(1)
	LNEXP	-2.328	-5.564*	-	I(1)	-2.416	-5.564*	-	I(1)
	LNIMP	-2.154	-4.339*	-	I(1)	-1.822	-4.379*	-	I(1)
	LNGCF	-1.153	-4.162**	-	I(1)	-1.241	-4.162**	-	I(1)
	LNLAB	-1.255	-3.111	-6.287*	I(2)	-0.934	-3.111	-6.341*	I(2)
South Korea	LNGDPPC	-0.623	-5.751*	-	I(1)	-0.623	-5.751*	-	I(1)
	LNEXP	-1.516	-4.824*	-	I(1)	-1.781	-4.824*	-	I(1)
	LNIMP	-1.630	-5.566*	-	I(1)	-1.630	-5.786*	-	I(1)
	LNGCF	-1.068	-5.673*	-	I(1)	-1.068	-5.673*	-	I(1)
	LNLAB	-0.511	-4.806*	-	I(1)	0.578	-4.806*	-	I(1)

Note: *, ** and *** indicate significance at the 1%, 5% and 10% respectively. Values in the parentheses show p-values.

Augmented Dickey- Fuller (ADF) test and Phillip-Perron (PP) test (including constant with trend) for five variables namely LNGDPPC, LNEXP, LNIMP, LNGCF &LNLAB have been applied to check whether series are stationary or not. The results revealed the presence of unit root for all series at levels. After differencing, all series were found to be stationary except the series LNLAB for Japan. The variable integrated of order two or I(2) was dropped from the model in case of Japan.

4.2. Chow Test Results

Time series plotting of the variables indicated the presence of structural breaks. Hence, Chow breakpoint test has been used to identify and confirm structural break in dataset. This test analyzes the null hypothesis of no structural break.

The results in Table 4 clearly indicate the absence of structural break in dataset as the null hypothesis of no structural break can't be rejected for China. For Japan and South Korea, the results affirmed the presence of structural break in dataset. Asian crisis of 1997 had severe impact on South Korea's economy. The results showed the presence of structural break for Japan and South Korea's dataset for 2008.

Table 4. Results of Chow Breakpoint Test

China			
Chow Breakpoint Test: 2008			
Null Hypothesis: No breaks at specified breakpoints			
Equation Sample: 1981 2012			
F-statistic	0.230	Prob.F	0.945
Log likelihood ratio	1.634	Prob. Chi-Square	0.897
Wald Statistic	1.152	Prob. Chi-Square	0.949
Japan			
Chow Breakpoint Test: 2008			
Null Hypothesis: No breaks at specified breakpoints			
Equation Sample: 1981 2012			
F-statistic	2.460	Prob.F	0.064
Log likelihood ratio	14.212	Prob. Chi-Square	0.014
Wald Statistic	12.300	Prob. Chi-Square	0.030
South Korea			
Chow Breakpoint Test: 1997 & 2008			
Null Hypothesis: No breaks at specified breakpoints			
Equation Sample: 1981 2012			
F-statistic	10.408	Prob.F	0.000
Log likelihood ratio	39.023	Prob. Chi-Square	0.000
Wald Statistic	52.040	Prob. Chi-Square	0.000
F-statistic	4.637	Prob.F	0.004
Log likelihood ratio	23.007	Prob. Chi-Square	0.000
Wald Statistic	23.187	Prob. Chi-Square	0.000

4.3. VAR Lag Order Selection Criteria

The next step involves investigation of the long run relationship among variables. Before applying Johansen cointegration procedure appropriate lag length must be set. In Table 5, the results of VAR lag order selection criteria have been presented. Schwarz information criterion was adopted to estimate cointegration and unrestricted VAR.

Table 5. Results of VAR Lag Order Selection Criteria

China					
Endogenous variables: LNGDPPC LNEXP LNIMP LNGCF LNDLAB Exogenous variables: C Sample: 1980 2012					
Lag	LR	FPE	AIC	SC	HQ
0	NA	2.21e-08	-3.440	-3.204	-3.366
1	235.495	4.56e-12	-11.955	-10.541*	-11.512
2	40.505*	3.19e-12	-12.481	-9.888	-11.669
3	35.946	1.84e-12*	-13.522*	-9.750	-12.341*
Japan					
Endogenous variables: LNGDPPC LNEXP LNIMP LNGCF Exogenous variables: C DUMMY Sample: 1980 2012					
Lag	LR	FPE	AIC	SC	HQ
0	NA	1.51e-08	-6.656	-6.467	-6.596
1	249.127	1.43e-12	-15.932	-14.989*	-15.637
2	27.590*	1.17e-12*	-16.208*	-14.511	-15.677*
3	9.649	2.33e-12	-15.708	-13.256	-14.940
4	16.891	2.59e-12	-16.012	-12.806	-15.008
South Korea					
Endogenous variables: LNGDPPC LNEXP LNIMP LNGCF LNLAB Exogenous variables: C DUMMY1 DUMMY2 Sample: 1980 2012					
Lag	LR	FPE	AIC	SC	HQ
0	NA	1.09e-13	-15.659	-14.959	-15.435
1	192.166	9.90e-17	-22.727	-20.859*	-22.130
2	38.459*	6.94e-17	-23.323	-20.287	-22.352
3	27.603	6.88e-17*	-23.957*	-19.753	-22.612*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

4.4. Cointegration Results

To analyze long run relationship Johansen cointegration procedure has been employed. The results of both trace and max eigen value tests indicated that there was long run equilibrium relationship among variables namely LNGDPPC, LNEXP, LNIMP, LNGCF & LNLAB. Therefore, the results of both tests confirmed the existence of long run relationship in all the selected countries (Table 6).

Table 6. Johansen Co-integration Test Statistics for the variables

Countries	Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
	Hypothesized No. of CE(s)	Eigen value	Trace	Critical Value 0.05	Prob.**	Hypothesized No. of CE(s)	Eigen value	Trace	Critical Value 0.05	Prob.**
China	None *	0.772	104.707	88.803	0.002	None *	0.772	44.425	38.331	0.008
	At most 1	0.579	60.281	63.876	0.096	At most 1	0.579	26.024	32.118	0.230
	At most 2	0.450	34.256	42.915	0.276	At most 2	0.450	17.970	25.823	0.379
	At most 3	0.287	16.286	25.872	0.469	At most 3	0.287	10.162	19.387	0.601
	At most 4	0.184	6.124	12.517	0.444	At most 4	0.184	6.124	12.517	0.444
Japan	None *	0.627	63.226	47.856	0.001	None *	0.627	30.624	27.584	0.019
	At most 1 *	0.509	32.601	29.797	0.023	At most 1 *	0.509	22.073	21.131	0.036
	At most 2	0.240	10.528	15.494	0.242	At most 2	0.240	8.537	14.264	0.326
	At most 3	0.062	1.990	3.841	0.158	At most 3	0.062	1.990	3.841	0.158
South Korea	None *	0.830	139.287	88.803	0.000	None *	0.830	55.065	38.331	0.000
	At most 1 *	0.671	84.222	63.876	0.000	At most 1 *	0.671	34.525	32.118	0.024
	At most 2 *	0.532	49.696	42.915	0.009	At most 2	0.532	23.554	25.823	0.096
	At most 3 *	0.442	26.142	25.872	0.046	At most 3	0.442	18.117	19.387	0.075
	At most 4	0.228	8.025	12.517	0.249	At most 4	0.228	8.025	12.517	0.249

Note: * indicate significance at the 5% level respectively

The normalized cointegrating equation for GDP per capita has been given in Table 7. The equation shows that in long run exports affect positively GDP per capita in China. The impact was also significant. Studies like Shirazi and Manap (2005), Aktar (2008), and Husein (2010) also found positive association between exports and economic growth on the basis of normalized cointegrating equations. However, gross capital formation was found to be positive and significant too. Both imports and labour were found to be negative. However, former was significant and later was found to be insignificant in the equation. The equation for Japan indicates that

imports growth and gross capital formation have positive and significant effect on GDPPC. Although the variable exports hold positive sign but it was found to be insignificant. For South Korea, the normalized cointegrating equation indicated that in the long run all variables except imports have positive and significant impact on GDPPC.

Table 7. Normalized Cointegrating Coefficients for GDPPC Equation

China				
LNGDPPC(-1)	LNEXP(-1)	LNIMP(-1)	LNGCF(-1)	LNDLAB(-1)
1.000	-0.100*(0.058)	0.223*(0.044)	-0.222* (0.065)	0.026 (0.024)
Japan				
LNGDPPC(-1)	LNEXP(-1)	LNIMP(-1)	LNGCF(-1)	-
1.000	-0.059 (0.042)	-0.272*(0.032)	-0.311*(0.037)	-
South Korea				
LNGDPPC(-1)	LNEXP(-1)	LNIMP(-1)	LNGCF(-1)	LNLAB(-1)
1.000	-0.262* (0.025)	0.093* (0.029)	-0.248* (0.031)	-0.984* (0.140)

Note: * indicate significance at the 1% level.

4.5. VECM Short Run Causality Results

VECM results comprise the estimate of the speed of adjustment coefficients and short run properties of series. Table 8 reports the short run causality results obtained from VECM. For China, the coefficients of error correction terms (ECT) with GDPPC and exports as dependent variable were negative but former was statistically significant at 5% level of significance indicating there is convergence from short dynamics towards long run equilibrium. The adjustment coefficient was found to be 0.33 percent implying that speed of adjustment was 33 percent towards long run equilibrium in case of disequilibrium situation. However, short run coefficients of first difference of LNEXP lagged one period for GDP per capita as dependent variable and first difference of LNGDPPC lagged one period for exports equation were found to be statistically insignificant which indicates the absence of short run causality in any direction.

In case of Japan, the results exhibit that coefficient of error correction term (ECT) was not significant in any of two cases for GDPPC and exports. However, the sign was negative (correct) for exports equation. Further, short run coefficient of first difference of LNGDPPC lagged one period for exports equation was found to be positively significant which indicated unidirectional short run causality from GDPPC to exports or growth led exports. The short run coefficient of first difference of LNEXP lagged one period for GDPPC equation was found to be negatively significant. Dummy variable was found to be negative in both cases.

The results for South Korea depicted that coefficient of error correction term was not significant for GDPPC equation however the sign was negative (correct) whereas for exports equation, the error correction term was significant but the sign was positive (incorrect). Thus, the results indicated lack of significant adjustments

towards long run equilibrium in any disequilibrium situation. Further, short run coefficients of first difference of LNEXP lagged one period for GDPPC equation and first difference of LNGDPPC lagged one period for export equation were negative and insignificant.

Table 8. Short Run Causality Results VECM

	China		Japan		South Korea	
Variables	D(LNGDPPC)	D(LNEXP)	D(LNGDPPC)	D(LNEXP)	D(DGDPPC)	D(LNEXP)
ECT	-0.330*	-0.665	0.043	-0.260	-0.558	1.953**
	(0.000)	(0.287)	(0.808)	(0.787)	(0.199)	(0.048)
D(LNGDPPC)	0.853*	2.714	1.191**	4.681***	-0.318	-2.073
	(0.000)	(0.105)	(0.024)	(0.094)	(0.646)	(0.185)
D(LNEXP)	0.043	0.018	-0.148*	-0.270	-0.057	0.226
	(0.271)	(0.948)	(0.008)	(0.342)	(0.699)	(0.491)
D(LNIMP)	-0.049	0.064	0.192**	1.331	-0.156	0.251
	(0.260)	(0.840)	(0.052)	(0.015)	(0.471)	(0.601)
D(LNGCF)	0.016	1.370***	-0.392***	-3.096**	0.199	0.135
	(0.871)	(0.075)	(0.084)	(0.014)	(0.444)	(0.813)
D(LNLAB)	0.016	0.129	-	-	0.010	2.313
	(0.391)	(0.344)			(0.986)	(0.128)
DUMMY 1997	-	-	-	-	-0.066**	-0.113***
					(0.025)	(0.076)
DUMMY 2008	-	-	-0.015	-0.081	-0.019	-0.051
			(0.156)	(0.164)	(0.238)	(0.172)

Note: *, ** and *** indicate significance at the 1%, 5% and 10% level respectively.

Thus, the results indicated the absence of short run causality between these two variables. Thus results are similar to those reported in the study by Lawrence and Weinstein (1999). Dummy variable for Asian crisis 1997 was found to be negative and statistically significant implying the negative impact of crisis on Korean economy. However, dummy variable for Global crisis 2008 was also found to be negative but statistically insignificant.

Table 9. Summary of Results

Country	Cointegration Results	VECM Results (For Short Run Causality)	Impact of Dummies
China	Cointegrated	No short run causality	-
Japan	Cointegrated	GLE	Significant
South Korea	Cointegrated	No short run causality	Significant

4.6. Diagnostic Tests

The models were tested for normality, heteroskedasticity and serial correlation. Diagnostic tests were carried out on the data revealed that models were well specified (Table 10). Diagnostic tests also indicated that the residuals were normally distributed, homoskedastic and serially uncorrelated. However for South Korea, Jarque- Bera normality test depicted non normality. Mcdonald (2014) noted

that deviation from normality in case of parametric tests is not very sensitive. Wooldridge (2012) pointed out that non- normality of errors is not a serious problem with large sample size. Ghasemi and Zahediasl (2012) also suggested that with large enough sample sizes (> 30 or 40), the violation of the normality assumption should not cause major problems this implies that we can use parametric procedures even when the data are not normally distributed.

Table 10. Results of Diagnostic Tests

	China	Japan	South Korea
Jarque-Bera Normality Test	5.870(0.053)	0.312(0.855)	45.049(0.000)
ARCH Heteroskedasticity Test	0.030(0.861)	0.290 (0.589)	0.032(0.857)
Breusch-Godfrey LM test	0.498(0.480)	2.184 (0.139)	02.129(0.144)

Note: p-values are reported in parentheses.

4.7. Impulse response function and variance decomposition analysis results

The results of impulse response function indicated that among all variable one positive shock to gross capital formation and GDP per capita results in positive response in GDP per capita. In case of exports, one positive shock to imports and gross capital formation brings positive response for exports while positive shock to GDP per capita results in negative response of exports. Variance decomposition analysis (VDA) depicted that GDPPC shock accounted for whole variance of GDPPC in first year. After 10 years, GDP per capita (63.44 percent), imports (28.76 percent), gross capital formation (6.53 percent) and exports (1.10 percent) shocks bring variability in GDP per capita. For exports, in first year exports (81.27 percent) and GDP per capita (18.72 percent) shocks account for variance of exports in case of China. This proportion predicted to change over time as after 10 years, exports (75.80 percent), GDP per capita (8.52 percent), gross capital formation (12.17 percent) and imports (3.28 percent) shocks found to be important source of export variability for China. For Japan, impulse response function indicated one positive shock to GDPPC brings entire positive response of GDPPC. No other variable was found responsible for positive response in GDPPC. Variance decomposition analysis of Japanese GDPPC showed that GDPPC is unexpurgated source of variation in its forecast error. After ten years, variation in GDPPC is accounted for by GDPPC (53.58 percent), exports (45.30 percent) and rest of other variables contributed less than one percent. For exports, predominant source of variation are exports (61.47 percent) and GDPPC (38.52 percent). In the tenth year, exports (72.86 percent), imports (10.23 percent), GDPPC (9.58 percent) and gross capital formation (7.31 percent) contributed in exports variability. In case of South Korea, Variance decomposition analysis exhibited GDPPC as predominant source of variation in GDPPC, ranging from 100 percent to 91.11 percent. For exports, GDPPC (74.20 percent) and exports (25.79 percent) accounted for export variability. After ten years, exports (58.74 percent), GDPPC (31.11 percent), labour (4.87 percent) and imports (4.34 percent) and gross capital formation (0.92 percent) were the sources of variation in exports (see appendices Table A1, Table A2, and Table A3).

5. Conclusion and Policy Implications

In order to observe the relationship between exports and economic growth for East Asian economies during 1980-2012, this study constructed multivariate framework using the variables GDP per capita, exports, imports, gross capital formation and labour. Time series techniques such as Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, Johansen cointegration test, vector error correction model (VECM) were employed. The analysis also made use of forecasting techniques namely Impulse Response Function (IRF) and Variance Decomposition Analysis (VDA). The study also conducts diagnostic tests for normality, heteroskedasticity, autocorrelation using Jarque-Bera Normality test, ARCH Heteroskedasticity test and Breusch-Godfrey LM test.

The estimated results suggested that all variables were cointegrated for East Asian economies. The normalized equation shows that in long run exports affects positively GDP per capita in China and South Korea. The impact was also significant. The result exhibits that coefficient of error correction term (ECT) for GDPPC equation was significant only for China indicating significant adjustments towards long run equilibrium in any disequilibrium situation. No short run causality was found between GDPPC and exports in case of China. The short run coefficient of first difference of LNGDPPC lagged one period for exports equation was found to be positively significant for Japan. In case of South Korea, the results indicated the absence of short run causality between these two variables. Hence, export-led growth (ELG) hypothesis was not found valid for China, Japan and South Korea particularly in short run however, reverse causation i.e. growth led exports (GLE) was confirmed for Japan in short run. Thus, the study concluded that export-led growth (ELG) was only long run phenomenon in China and South Korea. The results for Japan supported growth led exports (GLE) particularly for short run. Although East Asian economies export performance remained exceptionally well. But the Asian Financial Crisis 1997 and Global Economic Crisis 2008 resulted in long term adverse effects excluding China.

The results of the study clearly highlight the importance of exports in the selected East Asian economies. In the long run exports are positively affecting GDP per capita in China and South Korea. Hence, these economies should continue to promote their exports. Japan is matured developed economy with high per capita income and has different structure of the economy. Japan has experienced growth led exports in short run and hence this economy will have to promote growth internally as it is suffering from past two decades of stagnation.

The present study gives strong support to the findings of Lin (1999), Yao (2006) for positive effect of exports on economic growth; Liu, Burridge and Sinclair (2002) for long run relationship while study contradicts Liu, Song and Romilly (1997) for short run results and Tsen (2010) who found bidirectional causality for China. For Japan, the study supported Fawson and Chang (1994) while it contradicts Zhang and

Baimbridge (2011) for causality results. The study partially supported Awokuse (2005) for cointegration results while it contradicts causality results given by Fawson and Chang (1994) and Holman and Graves (1995).

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Appendices

Table A1. Variance Decomposition Analysis (China)

Variance Decomposition of LNGDPPC:					
Period	**LNGDPPC**	**LNEXP**	**LNIMP**	**LNGCF**	**LNDLAB**
1	100.00	0.00	0.00	0.00	0.00
2	94.76	0.00	4.35	0.78	0.09
3	85.14	0.18	11.43	3.17	0.06
4	76.09	0.51	18.35	4.97	0.06
5	69.90	0.79	23.28	5.90	0.10
6	66.42	0.96	26.14	6.32	0.14
7	64.77	1.05	27.55	6.46	0.15
8	64.11	1.08	28.15	6.48	0.15
9	63.78	1.09	28.46	6.49	0.15
10	63.44	1.10	28.76	6.53	0.14
Variance Decomposition of LNEXP:					
Period	**LNGDPPC**	**LNEXP**	**LNIMP**	**LNGCF**	**LNDLAB**
1	18.72	81.27	0.00	0.00	0.00
2	10.42	77.47	3.59	7.74	0.76
3	7.28	77.51	3.56	11.10	0.53
4	5.90	78.32	2.95	12.39	0.42
5	6.18	77.63	2.53	13.29	0.35
6	7.32	76.58	2.39	13.36	0.32
7	8.17	75.98	2.55	12.99	0.29
8	8.53	75.75	2.84	12.60	0.26
9	8.57	75.73	3.11	12.32	0.24
10	8.52	75.80	3.28	12.17	0.22

Table A2. Variance Decomposition Analysis (Japan)

Variance Decomposition of LNGDPPC:				
Period	**LNGDPPC**	**LNEXP**	**LNIMP**	**LNGCF**
1	100.00	0.00	0.00	0.00
2	86.40	8.59	1.90	3.10
3	72.70	23.47	1.40	2.42
4	66.76	30.79	0.86	1.57
5	63.18	35.00	0.63	1.17
6	59.85	38.64	0.54	0.96
7	57.37	41.28	0.53	0.79
8	55.75	43.01	0.54	0.67
9	54.55	44.29	0.55	0.59
10	53.58	45.30	0.56	0.53
Variance Decomposition of LNEXP:				
Period	**LNGDPPC**	**LNEXP**	**LNIMP**	**LNGCF**
1	38.52	61.47	0.00	0.00
2	24.90	63.52	4.75	6.82
3	19.32	64.40	7.65	8.61
4	16.70	67.12	8.34	7.82
5	14.69	69.01	8.83	7.45
6	12.98	70.04	9.41	7.54
7	11.77	70.96	9.74	7.51
8	10.89	71.77	9.92	7.40
9	10.17	72.38	10.08	7.35
10	9.58	72.86	10.23	7.31

Table A3. Variance Decomposition Analysis (South Korea)

Variance Decomposition of LNGDPPC:					
Period	**LNGDPPC**	**LNEXP**	**LNIMP**	**LNGCF**	**LNLAB**
1	100.00	0.00	0.00	0.00	0.00
2	95.01	3.04	0.19	0.93	0.80
3	95.18	2.19	0.55	0.81	1.25
4	94.16	1.70	1.43	0.63	2.06
5	93.14	1.47	2.29	0.51	2.56
6	92.48	1.30	2.88	0.44	2.87
7	92.04	1.17	3.29	0.38	3.10
8	91.68	1.08	3.60	0.33	3.28
9	91.36	1.01	3.87	0.30	3.43
10	91.11	0.96	4.08	0.27	3.55
Variance Decomposition of LNEXP:					
Period	**LNGDPPC**	**LNEXP**	**LNIMP**	**LNGCF**	**LNLAB**
1	25.79	74.20	0.00	0.00	0.00
2	22.59	75.17	1.00	1.15	0.07
3	23.50	73.58	0.75	1.40	0.74
4	25.54	70.03	1.30	1.20	1.91
5	27.11	66.67	2.23	1.15	2.81
6	28.29	64.33	2.87	1.10	3.38
7	29.20	62.62	3.30	1.03	3.82
8	29.95	61.15	3.68	0.98	4.22
9	30.58	59.85	4.03	0.95	4.57
10	31.11	58.74	4.34	0.92	4.87