Short and Long Term Validity of Export-Led Growth Hypothesis in BRICS-T Countries: A Frequency Domain Causality Approach

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Abstract

In this study, we aim to investigate causation linkage between international trade and economic growth in terms of export-led growth (ELG) hypothesis for Brazil, Russia, India, China, South Africa and Turkey. The empirical results obtained from frequency domain test suggest that export-led growth hypothesis is valid in Turkey, China, Brazil and Russia in different time frequencies. On the other hand, import-led growth hypothesis is valid in India and South Africa.

Keywords: export, import, economic growth, causality
JEL Classification: F14, F43, F63

1. Introduction

The volume of world trade has been increasing because of political and technological developments in the world. The destruction of the Berlin Wall and the disintegration of the Soviet Union all closed countries to each other. On the other hand, new developments communication and transportation technologies have affected world trade positively. Beside all these change, new countries have started to take part in the world trade. These are called as emerging economies. The share of emerging economies from the world trade have been increasing by the end of 1990s, especially of the BRICS countries, namely Brazil, Russia, India, China and South Africa.

According to Purugganan et al. (2014), the share of the BRICS in total export was only 3,9 % share in 1990 and after twenty years, it is 16,9 % in 2010. Improvement in trade statistics indicates that trade appears to have played a significant role in boosting the economic growth prospects of these countries. There is evidence to suggest that trade liberalisation has seen and used as a tool for promoting economic growth in all the BRICS countries (Singh and Dube, 2011; 10). No doubt, Global Financial Crisis (hereafter, GFC) has led to the sharpest trade contraction ever and the deepest since the Great Depression of the 1930s. Between 2007Q4 and 2009Q2, world merchandise imports fell by a whopping 36 percent. Although trade levels began a modest recovery in 2009Q3, they are still far below pre crisis highs. Even though the GFC affected mainly developed countries, the BRICS countries were affected because of trade linkage with developed countries, because the main consumers of BRICS countries are United States of America (USA, hereafter), European Union (EU, hereafter) and Japan.

Rapidly industrializing countries have relied heavily on overseas import demand—especially in developed countries —to fuel growth. But in the light of the current need for global macroeconomic rebalancing, and in particular a durable contraction of the U.S. final

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consumption, concerns have emerged about reliance on exports for recovery and growth (Canuto et. al., 2010). On the other hand, BRICS have experienced low economic growth rate by the beginning of GFC. By the global recovery it seems BRICS will increase economic growth.

Among the transition countries, Brazil, Russian Federation (henceforth Russia), India and Peoples Republic of China (henceforth China) have special place in the world economy not only because of their population and land area features, also their high growth rate and economic potential. Because of their demographic and economic similarities, economists use acronym BRIC to refer these countries, initially by O'Neill (2001). Alternative acronyms are derived to extent the number of countries such as Mexico, Nigeria, South Africa, Indonesia and Turkey (Bayat et al., 2014; 97). In this study we aim to add Turkey and South Africa due to their growth performances in last decade.

Experiences especially lived after the GFC bring to mind a question "Whether the export-led growth hypothesis is valid for BRICS countries or there is another hypothesis to explain growth strategy of emerging economies". According to export-led growth hypothesis advocates, trade is the main engine of growth in South-East Asia (Medina-Smith, 2001; 2). In early studies, empirical analyses find that exports played an important role in promoting economic growth by conducting cross-country comparison or regressing GDP growth on different export variables (Yang, 2008; 3). The link between export and growth can be due to either a productivity improvement in the tradable or the non-tradable sector (Yang, 2008; 4). Export-expansion can be a catalyst for output growth both directly, as a component of aggregate output, as well as indirectly through efficient resource allocation, greater capacity utilization, exploitation of economies of scale, and stimulation of technological improvement due to foreign market competition (Sahni and Atri, 2012; 284). According to Balassa (1978) exports provide foreign exchange that allows for increasing levels of imports of capital goods and intermediate goods that in turn raise the growth of capital formation and thus stimulate output growth. By the early 1980s, policymakers took promoting export sectors into account.

In this regard, the investigation of causation linkage between export and economic growth in the 21th century plays crucial role for construction of economy policy in emerging market economies. The aim of this paper was to close a deficit the gap in the literature by investigating the role of frequency domain causality between the variables. By doing so, we will be able to investigate relations both in short run and long run.

The rest of the paper is organized as follows. The next section is devoted to summarize the existing literature investigating the ELG and ILG models. The third section, econometric methodology and the date are described. In the section four, empirical results are presented. We summarize and conclude empirical findings in the last section.

2. Litareture Review

There is a vast literature investigating validity of export-led growth hypothesis. Initial studies belongs to Emery (1967), Ram (1976), Tyler (1981), Feder (1983) and Kavoussi (1984) find positive relationship between export and economic growth. These analyses focus mainly developed countries. Marin (1992) establishes a causation linkage between exports, productivity, terms of trade and world output exists for four developed OECD economies based on cointegration and Granger causality. So, export-led growth cannot be rejected for the United States, Japan, United Kingdom and Germany. Zeren and Savrul (2013) examine the export-led growth hypothesis for 15 selected European countries between 1970 and 2011. The results support that there is hidden cointegration in panel, thus there exists a long-term relationship between economic growth and exports.

There is a vast literature developing countries also. Biyase and Zwane (2011), Shan and Jusoh (2012), Siddiqui et. al. (2008), Waithe et. al. (2011), Maneschiold (2008), Jordean

and Eita (2009), Boriss and Herzer (2005), Alimi and Muse (2013), Dreger and Herzer (2012), Hamdi (2013), Tabrizy and Trofimenko (2010) and Lopete. (2006). According to these papers' result, export growth affect the economic performance positively. In this context, Biyase and Zwane (2011) test the export led growth hypothesis using panel data analysis in 30 African Countries over the period 1990-2005. So, export-led growth hypothesis support for African countries. Shan and Jusoh (2012) investigate that GDP, export, import and exchange rate in Malaysia between the period of 1970-2011 via cointegration and Granger causality. According to test results, exports and imports have a positive relationship with economic growth in the long run while exchange rate showed negative. And also, all the variables Granger cause economic growth in the short-run, except exchange rate. So, export-led growth hypothesis is valid both long and short term in Malaysia. Siddiqui et. al. (2008) investigate the export-led growth hypothesis in Pakistan by using exports, imports, terms of trade, and the labour force participation and gross domestic product between the period of 1971-2005 with ARDL method. export-led growth hypothesis is valid both long and short run in Pakistan. And also, economic growth is accompanied by fluctuations in exports and imports both in the short and long run, but the labour force participation rate has a negative effect only in the short run. The terms of trade has the same effect in the short and long run. Waithe et. al. (2011) test export-led growth hypothesis for Mexico over the period of 1960-2003 with Johansen co-integration and Granger causality. So, the hypothesis is valid short run in Mexico, but not long run. Maneschiold (2008) analyze export-led growth hypothesis in Argentina, Brazil and Mexico with co-integration and techniques. Co-integration and causality relationship is found for Argentina and Mexico. Jordean and Eita (2009) investigate the relationship between export and economic growth for Botswana over the period of 1996-2007. The results show that there is bi-directional causality relationship between export and economic growth. Sliverstovs and Herzer (2005) examine the export-led growth hypothesis for Chile over the period of 1960-2000 with VAR and causality techniques. The estimation results support the export-led growth hypothesis for Chile. Alimi and Muse (2013) test the relationship between total export, oil export and non-oil export for Nigeria over the period of 1970-2009 with Johansen cointegration, VAR and Granger causality methods. The results show that cointegration test confirmed between economic growth and export (include total and oil export), but there is no evidence of cointegration between non-oil export and economic growth. In addition, uni-directional causality between export and economic growth in Nigeria in three measures of exports. Dreger and Herzer (2012) examine the export-led growth hypothesis for 45 developing countries with panel cointegration techniques. The results show that exports have a positive effect on non-export GDP in short-run and the long-run effect of exports on non-export output. Lastly, there are large differences in the long-run effect of exports on non-export GDP across countries. Hamdi (2013) examine the export-led growth hypothesis for Tunisia and Morocco using Toda and Yamamoto (1995) procedure over the period of 1961-2011. According to the result export-led growth support for Tunisia while Morocco reveal an import-led growth. And, there is no evidence of bidirectional causality between import and export. Tabrizy and Trofimenko (2010) examine the export-led growth hypothesis in India over the period of 1998-2008. According to the result of this paper, export-led growth the first prong of India's economic development. Sinoha L. (2006) examine the validity of the export-led growth hypothesis in 9 Southern African economies using VAR and Granger techniques. So, results implying that expanding exports can contribute to economic growth, poverty reduction, and job creation in Botswana, Lesotho, and Swaziland. Even though some countries have adopted export-friendly policies, the long-term impact of such policies is yet to be observed for most countries.

All of the papers which are written on Turkey case have been support ELG hypothesis. The most impotant papers of these are; Halicioglu (2007), Ozcan and Ozcelebi

(2013), Taban and Aktar (2011), Temiz and Gokmen (2010) and Tastan (2010). Halicioglu (2007) investigates the validity of export-led growth hypothesis in Turkey over the period of 1980-2005 with cointegration and causality analysis. The empirical findings suggest uni-directional causation from exports to industrial production. Taban and Aktar (2011) investigate export-led growth hypothesis for Turkey over the period of 1980-2007. According to test results, there is a long and short-run bidirectional causality relationship between export and real GDP growth in Turkey. Temiz and Gokmen (2010) investigate relationship between export end economic growth over the period of 1950-2006 in Turkey with cointegration and Granger causality. According to conclusion of the paper, there is a long and short run causality relationship from the economic growth to real export. Ozcan ve Ozcelebi (2013) investigate export-led growth hypothesis for Turkey over the period of 2005-2011. In this context; they are aimed to explore the relationships between industrial production index, export, import, and real exchange rate using Johansen co-integration method. According to the result of the conclusion, export-led growth hypothesis valid in Turkey. Tastan (2010) examines the relationship between exports, industrial production and imports in Turkish economy over the period 1985-2009 using Granger causality and basic frequency-domain techniques. So, Granger-causality runs from imports to industrial production and industrial production cause on the export in the long run. These findings support "import-led growth" and "growth-driven exports" hypotheses in Turkey.

There are some other studies investigating ELG hypothesis for BRIC countries. One of them belongs to Polodoo et al. (2012). Polodoo et al. (2012) examine the relationship between international trade and economic growth over the period of 1990-2010 in BRICS countries using panel data techniques. The empirical result reveals that international trade has contributed a lot to the high economic growth rates culminated by the economies during the period. Sandalcilar (2012) analyzes the relationship between export and economic growth in BRIC countries using panel cointegration and panel causality techniques. The results of the analysis show that there is a strong causality running from export to economic growth both short and long run. In other words, export-led growth hypothesis is valid in the BRIC countries.

3. Methodology

Frequency domain causality were developed by Granger (1969), Geweke (1982), Hosoya (1991), Breitung and Candelon (2006). In his work, Geweke (1982) defined two-dimensional vector of time series $z_t = [x_t, y_t]'$ and z_t has a finite-order VAR;

$$\Theta(L) z_t = \varepsilon_t \tag{2}$$

where $\Theta(L) = I - \Theta_1 L - ... - \Theta_p L^p$ and lag polynomial with $L^k z_t = z_{t-1}$. Breitung and Candelon (2006) assume that ε_t is white noise with $E(\varepsilon_t) = 0$ and $E(\varepsilon_t, \varepsilon_t') = \Sigma$, where Σ is positive definite. Let G be the lower triangular matrix of the Cholesky decomposition $G'G = \Sigma^{-1}$ such that $E(\eta_t \eta_t') = I$ and $\eta_t = G\varepsilon_t$. If the system is stationary, let $\phi(L) = \Theta(L)^{-1}$ and $\psi(L) = \phi(L)G^{-1}$ the MA representation;

$$z_t = \phi(L)\varepsilon_t = \begin{pmatrix} \phi_{11}(L) & \phi_{12}(L) \\ \phi_{21}(L) & \phi_{22}(L) \end{pmatrix} \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix} = \begin{pmatrix} \psi_{11}(L) & \psi_{12}(L) \\ \psi_{21}(L) & \psi_{22}(L) \end{pmatrix} \begin{pmatrix} \eta_{1t} \\ \eta_{2t} \end{pmatrix} \tag{3}$$

Let we can use this representation for the spectral density of x_t;

$$f_x(\omega)=\frac{1}{2\pi}\{|\psi_{11}(e^{-i\omega})|^2+|\psi_{12}(e^{-i\omega})|^2\} \quad (4)$$

Geweke (1982) and Hosoya (1991) are defined causality;

$$M_{y\to x}(\omega)=\log\left[\frac{2\pi f_x(\omega)}{|\psi_{11}(e^{-i\omega})|^2}\right]=\log\left[1+\frac{|\psi_{12}(e^{-i\omega})|^2}{|\psi_{11}(e^{-i\omega})|^2}\right] \quad (5)$$

if $|\psi_{12}(e^{-i\omega})|^2=0$ that y does not cause x at frequency ω. If components of z_t are I(1)

and cointegrated, $\Theta(L)$ has a unit root. Breitung and Candelon (2006) investigate the causal effect of $M_{y\to x}(\omega)=0$ if $|\psi_{12}(e^{-i\omega})|^2=0$. The null hypothesis is equivalent to a linear restriction on the VAR coefficients. $\psi(L)=\Theta(L)^{-1}G^{-1}$ and $\psi_{12}(L)=-\frac{g^{22}\Theta_{12}(L)}{|\Theta(L)|}$, with g^{22} as the lower diagonal element of G^{-1} and $|\Theta(L)|$ as the determinant of $\Theta(L)$, it follows y does not cause at frequency ω if

$$|\Theta_{12}(e^{-i\omega})|=\left|\sum_{k=1}^{p}\theta_{12,k}\cos(k\omega)-\sum_{k=1}^{p}\theta_{12,k}\sin(k\omega)i\right|=0 \quad (6)$$

with $\theta_{12,k}$ denoting the (1,2)-element of Θ_k. Thus for $|\Theta_{12}(e^{-i\omega})|=0$,

$$\sum_{k=1}^{p}\theta_{12,k}\cos(k\omega)=0 \quad (7)$$

$$\sum_{k=1}^{p}\theta_{12,k}\sin(k\omega)=0 \quad (8)$$

Breitung and Condelon's (2006) applied to linear restrictions (7) and (8) for $\alpha_j=\theta_{11,j}$ and $\beta_j=\theta_{12,j}$. Then the VAR equation for x_t can be implied as

$$x_t=\alpha_1x_{t-1}+\ldots+\alpha_px_{t-p}+\beta_1y_{t-1}+\ldots+\beta_py_{t-p}+\varepsilon_{1t} \quad (9)$$

and the null hypothesis $M_{y\to x}(\omega)=0$ is equivalent to the linear restriction with $\beta=[\beta_1,\ldots,\beta_p]'$

$$H_0:\quad R(\omega)\beta=0 \quad (10)$$

and

$$R(\omega)=\begin{bmatrix}\cos(\omega) & \cos(2\omega) & \ldots & \cos(\mathrm{p}\omega)\\ \sin(\omega) & \sin(2\omega) & \ldots & \sin(\mathrm{p}\omega)\end{bmatrix} \quad (11)$$

The causality measure for $\omega \in (0, \pi)$ can be tested a Standard F-test for the linear restrictions imposed by Eq.(7) and Eq. (8). The test procedure follows an F- distribution with (2, T-2p) degrees of freedom.

4. Data and Empirical Findings

The data set contains interest and inflation rates of the BRICS-T countries. In this regard, inflation rate is proxied by quarterly changes in the gross domestic product (GDP), ratio of export to GDP (X) and ratio of import to GDP (M). Data for variables are obtained from International Financial Statistics. The descriptive statistics of variables are reported in table 1. It seems that data characteristics are slightly different in each country.

Table 1: Descriptive Statistics

Country	Date	Variable	Mean	Std.Dev.	Coef. of Var.	Skewness	Kurtosis
Brazil	1997Q1:2013Q3	**GDP**	2.991	2.67	0,89	0.052	2.434
		X	10.638	6.095	0,57	0.463	1.785
		M	9.116	5.649	0,62	0.805	2.106
Russia	1996Q1:2013Q3	**GDP**	3.732	5.227	1,40	-1.002	3.517
		X	20.975	14.079	0,67	0.517	1.759
		M	12.79	8.957	0,70	0.612	1.849
India	1997Q1:2013Q3	**GDP**	6.705	2.772	0,41	0.083	2.258
		X	10.825	8.104	0,75	0.718	2.089
		M	16.314	13.453	0,82	0.724	2.091
China	1997Q2:2013Q3	**GDP**	16.007	8.125	0,51	1.096	3.887
		X	62.877	56.709	0,90	0.794	2.238
		M	54.673	49.64	0,91	0.893	2.469
South Africa	1993Q1:2013Q3	**GDP**	3.115	1.869	0,60	-0.844	3.699
		X	4.071	2.053	0,50	0.676	1.964
		M	4.305	2.37	0,55	0.635	1.879
Turkey	1993Q1:2013Q3	**GDP**	4.132	5.789	1,40	-1.103	3.672
		X	5.554	3.958	0,71	0.593	1.857
		M	8.857	6.388	0,72	0.680	1.998

Notes: Coefficient of variation is the ratio of standard deviation to mean.

First of all, as expected, the coefficient of variation of ratio of import to GDP (M) is higher than ratio of export to GDP (X). According to Kurtosis X and M appear leptokurtic phenomena. Also it finds X and M are negatively skewed distribution.

Prior to the identification of possible causality between variables, it is necessary to determine integration degree of them. In this respect, we employ a battery of the unit root tests developed by Dickey and Fuller (1979) (henceforth ADF) and Phillips and Perron (1988) (henceforth PP).

Table 2: Results for Unit Root Test

Levels	Country	Vrb.	ADF	PP	First-Differences	Country	Vrb.	ADF	PP
Intercept	**Brazil**	**GDP**	-4.21 (1)***	-3.07 (0)**	**Intercept**	**Brazil**	**GDP**	-7.52 (3)***	-6.57 (2)***
		X	-0.60 (1)	-0.31 (1)			**X**	-5.41 (0)***	-5.43 (2)***
		M	0.49 (3)	0.18 (3)			**M**	-5.76 (2)***	-4.57 (11)***
	Russia	**GDP**	-4.06 (1)***	-2.70 (1)*		**Russia**	**GDP**	-7.02 (3)***	-5.11 (0)***
		X	-0.22 (2)	-0.16 (5)			**X**	-6.29 (1)***	-4.65 (10)***
		M	-0.59 (1)	0.06 (1)			**M**	-4.55 (0)***	-4.16 (7)***
	India	**GDP**	-2.47 (4)	-3.13 (4)**		**India**	**GDP**	-5.58 (3)***	-8.56 (4)***
		X	0.73 (0)	0.6 (1)			**X**	-6.56 (0)***	-6.55 (1)***
		M	-0.11 (0)	-0.06 (7)			**M**	-5.9 (1)***	-5.38 (10)***
	China	**GDP**	-2.05 (0)	-2.15 (1)		**China**	**GDP**	-7.45 (0)***	-7.45 (0)***

		X	0.72 (1)	1.27 (1)			X	-6.3 (0)***	-6.26 (2)***
		M	1.74 (0)	1.70 (4)			M	-6.82 (0)***	-6.69 (4)***
		GDP	-4.77 (1)***	-3.62 (3)***			GDP	-5.29 (3)***	-4.36 (5)***
	South Africa	X	-6.67 (1)	-0.53 (1)		South Africa	X	-6.8 (0)***	-6.66 (4)***
		M	0.05 (0)	-0.08 (1)			M	-7.22 (0)***	-7.22 (0)***
		GDP	-2.73 (4)*	-3.75 (1)***			GDP	-9.11 (3)***	-7.34 (2)***
	Turkey	X	0.36 (3)	0.25 (7)		Turkey	X	-6.26 (2)***	-8.87 (6)***
		M	-0.66 (1)	-0.19 (3)			M	-5.82 (0)***	-5.17 (10)***
		GDP	-4.36 (1)***	-3.11 (0)			GDP	-5.51 (7)***	-6.52 (2)***
	Brazil	X	-3.11 (1)	-2.45 (1)		Brazil	X	-5.37 (0)***	-5.39 (2)***
		M	-2.66 (1)	-1.85 (4)			M	-5.99 (2)***	-4.62 (13)***
		GDP	-3.98 (1)**	-2.64 (1)			GDP	-7.03 (3)***	-5.11 (0)***
	Russia	X	-3.90 (1)**	-2.7 (4)		Russia	X	-6.31 (1)***	-4.65 (10)***
		M	-3.06 (1)	-2.25 (1)			M	-4.59 (0)***	-4.05 (8)***
		GDP	-2.35 (4)	-3.06 (4)			GDP	-5.58 (3)***	-8.53 (4)***
	India	X	-2.02 (0)	-2.02 (0)		India	X	-6.71 (0)***	-6.71 (2)***
Trend and Intercept		M	-2.71 (1)	-2.24 (7)	Trend and Intercept		M	-5.9 (1)***	-5.23 (11)***
		GDP	-2.08 (1)	-2.14 (2)			GDP	-7.42 (0)***	-7.42 (0)***
	China	X	-1.81 (1)	-1.55 (1)		China	X	-6.52 (0)***	-6.3 (4)***
		M	-1.25 (0)	-1.26 (4)			M	-7.09 (1)***	-7.05 (8)***
		GDP	-4.73 (1)***	-3.54 (3)**			GDP	-5.34 (3)***	-4.32 (5)***
	South Africa	X	-2.83 (1)	-2.11 (0)		South Africa	X	-6.78 (0)***	-6.63 (4)***
		M	-2.19 (1)	-2.05 (2)			M	-7.22 (0)***	-7.23 (1)***
		GDP	-2.73 (4)	-3.74 (1)**			GDP	-9.04 (3)***	-7.30 (2)***
	Turkey	X	-2.35 (5)	-2.25 (5)		Turkey	X	-6.36 (2)***	-8.94 (7)***
		M	-3.12 (1)	-2.43 (2)			M	-5.8 (0)***	-5.09 (10)***

Notes: The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively
For the ADF test: The figures in parenthesis denote the results of Dickey Fuller test in the case of zero lag length and lag length chosen due to SIC criteria. For the ADF test, the Mac Kinnon (1996) critical values for with constant -.3.485, -2.885, -2.579 at the 1 %, 5 % and 10 % levels. The critical values for with constant and trend -4.035, -3.447 and -3.148 at the 1 %, 5 % and 10 % levels, respectively.
For the PP test: Values in the parenthesis show bandwidths obtained according to Newey-West using Bartlett Kernel criteria. For the PP test Mac Kinnon (1996) critical values for with constant -3.483, -2.884, -2.579 at the 1 %, 5 % and 10 % levels. The critical values for with constant and trend -4.033, -3.446 and -3.148 at the 1 % 5 % and 10 % levels, respectively.

According to ADF and PP unit root tests results it is clear that X and M are stationary in their first difference in all countries. But GDP is stationary in its level. Accordingly, the maximum integration order (d) of the variables equal to one in the TY procedure and the series in the first difference will be used in the frequency domain causality test.We used Schwartz Information Criteria (SIC) to select for Brasil (3), Russia (3), India (4), China (3), South Africa (3) and Turkey (4) as the order of VAR.

$$GDP_t = \mu_1 + \sum_{i=1}^{p} \theta_{1i} GDP_{ti} + \sum_{i=1}^{p} \alpha_{1i} X_{ti} + \sum_{i=1}^{p} \beta_{1i} M_{ti} + \varepsilon_{1t}$$

$$X_t = \mu_2 + \sum_{i=1}^{p} \theta_{1i} X_{ti} + \sum_{i=1}^{p} \alpha_{1i} GDP_{ti} + \sum_{i=1}^{p} \beta_{1i} M_{ti} + \varepsilon_{2t} \qquad (12.\ 13.\ 14.)$$

$$M_t = \mu_3 + \sum_{i=1}^{p} \theta_{1i} M_{ti} + \sum_{i=1}^{p} \alpha_{1i} X_{ti} + \sum_{i=1}^{p} \beta_{1i} GDP_{ti} + \varepsilon_{3t}$$

For the alternative hypothesis $\sum_{i=1}^{p}\alpha_{1i}X_{ti} \neq 0$ means validity of export-led growth (ELG), $\sum_{i=1}^{p}\beta_{1i}M_{ti} \neq 0$ import-led growth (ILG) in first equation. $\sum_{i=1}^{p}\alpha_{1i}GDP_{ti} \neq 0$ growth-led export (GLE) and growth-led import (GLI) in second and third equation, respectively. The asymptotic and bootstrap Granger causality tests results for the null hypothesis X does not Granger cause GDP are shown with X≠>GDP notation.

We employ Breitung and Candelon's (2006) causality analysis which permits to decompose the causality test statistic into different frequencies. We calculate the test statistics at a high frequency of $\omega_i = 2.5$ and $\omega_i = 2.00$ to examine short term causality, $\omega_i = 1.00$ and ω_i =1.50 to examine medium term causality and finally ω_i = .1 and ω_i =.5 to investigate long term causality.

Table 4 (a): Results for Frequency Domain Causality

Countries	ω_i	Long Term		Med Term		Short Term	
		0.01	**0.05**	**1.00**	**1.50**	**2.00**	**2.50**
Brazil	**GDP≠>X**	1.668	1.640	0.783	0.0230	0.650	0.384
	GDP≠>M	1.852	1.859	3.437*	0.889	4.373*	1.403
Russia	**GDP≠>X**	2.321	2.281	0.630	0.331	2.690	1.940
	GDP≠>M	11.033*	10.987*	5.967*	1.937	3.631*	1.385
India	**GDP≠>X**	9.583*	9.371*	0.385	1.104	1.127	0.087
	GDP≠>M	9.845*	9.716*	0.739	2.530	1.927	0.464
China	**GDP≠>X**	3.299*	3.403*	0.534	0.390	0.782	2.041
	GDP≠>M	4.196*	4.308*	1.780	0.930	0.291	2.266
South Africa	**GDP≠>X**	16.438*	16.190*	1.698	4.613*	2.516	0.969
	GDP≠>M	4.782*	4.679*	1.472	0.655	2.680	4.284*
Turkey	**GDP≠>X**	2.810	2.810	0.013	2.228	2.284	1.625
	GDP≠>M	3.826*	3.836*	0.190	0.596	1.056	0.628

Table 4 (b): Results for Frequency Domain Causality

Countries	ω_i	Long Term		Med Term		Short Term	
		0.01	**0.05**	**1.00**	**1.50**	**2.00**	**2.50**
Brazil	**X≠>GDP**	3.175*	3.054	3.023	2.303	0.784	4.317*
	X≠>M	5.446*	5.608*	0.378	1.483	0.188	0.689
Russia	**X≠>GDP**	5.842*	5.442*	4.166*	3.717*	1.339	1.938
	X≠>M	3.093	3.161*	1.814	0.400	3.388*	7.564*
India	**X≠>GDP**	2.477	1.835	0.529	2.445	0.405	0.286
	X≠>M	9.327*	9.059*	8.363*	0.463	1.261	0.577
China	**X≠>GDP**	0.306	0.477	6.783*	5.936*	0.591	3.028
	X≠>M	1.737	1.806	1.856	3.697*	11.156*	1.284
South Africa	**X≠>GDP**	0.432	0.563	1.260	2.837	1.466	0.186
	X≠>M	2.017	2.074	2.953	2.396	3.536*	1.535
Turkey	**X≠>GDP**	0.286	0.616	4.792*	0.527	3.401*	0.292
	X≠>M	5.082*	5.196*	0.477	2.673	5.667*	2.280

Table 4 (c): Results for Frequency Domain Causality

Countries	ω_i	Long Term		Med Term		Short Term	
		0.01	**0.05**	**1.00**	**1.50**	**2.00**	**2.50**
Brazil	**M≠>GDP**	1.852	1.859	3.437*	0.889	4.373*	1.403
	M≠>X	2.459	2.417	6.985	5.376	6.036	2.304
Russia	**M≠>GDP**	3.536*	3.243*	3.035*	5.913*	0.177	0.135
	M≠>X	0.071	0.061	2.146	2.744	1.806	2.204
India	**M≠>GDP**	0.101	0.124	0.386	3.787*	1.341	0.514
	M≠>X	4.793*	4.674*	7.818*	0.520	2.814	4.408*
China	**M≠>GDP**	1.217	1.088	6.953*	2.653	0.299	2.089
	M≠>X	3.974*	3.953*	1.079	0.133	6.224*	0.512
South Africa	**M≠>GDP**	0.638	1.049	0.502	2.436	4.849*	2.012
	M≠>X	0.049	0.040	1.890	1.596	6.575*	3.189*
Turkey	**M≠>GDP**	0.627	0.716	2.760	3.477*	3.489*	0.396
	M≠>X	3.395*	3.441*	0.296	1.356	1.122	0.172

Notes: The lag lengths for the VAR models are determined by SIC. F- distribution with (2, T-2p) degrees of freedom equals about 3.15 .For every ω_i (frequency) between 0 and π , $\omega \in (0, \pi)$.

According to frequency domain analysis results presented in table 4 (a.b.c.), there is a bi-directional causality between GDP and import variables in all countries. While the causation linkage from GDP to import is valid in Turkey, China and India in the long term, it is valid in the shorter terms in Russia, Brazil and South Africa. Shortness of the term in these countries may be because of raw material and technology need. On the other hand, causality running from import to GDP is valid in the short term in Turkey, South Africa, China, India and Brazil. In Russia, it is valid in long term. The results can be interpreted via the contents of the import variables. For instance, energy import would induce economic growth directly by increasing productivity.

Another important finding is about the import dependency of export sector. According to results there is a causality running from export variable to import variable. This result is valid for all terms in Russia, Turkey and India, for shorter term in China and South Africa, for long term in Russia. In short, all countries need to import to continue export even in shorter or longer terms. The existence reverse causality in India, China, South Africa and Turkey supports the import dependent export sector. Except for Turkey the causation linkage exists in all terms. In the case of Turkey, it exists in the long run.

When we examine the causality between GDP and export variables, results differentiate according to country. First, we find that there is a uni-directional causality running from GDP to export in India, China and South Africa in the long run. That means an increase in GDP increases also export. On the other hand, causality running from export to GDP is valid for Brazil, Russia, China and Turkey. In Brazil and Russia, the causation linkage exists in the long run. In China and Turkey, the causality exists in the short run.

With another aspect, export led growth model is valid in Brazil and Russia in the long run and in China and Turkey in the short run. On the other hand, growth led export is valid in India, South Africa and China in the long run. The import led growth hypothesis is valid in all countries in the short run except Russia. It is valid in the long run. The growth led import hypothesis is valid also in Turkey, China and India in the long run and in Russia, Brazil and South Africa in the shorter run.

5. Conclusions and Policy Implications

In this study, we aim to investigate validity of different growth hypotheses in BRICS-T countries by employing frequency domain causality analysis method. In other words, we ask whether BRICS-T countries have been growing export led growth model or import led growth model. First of all results show that BRICS-T countries could not export goods unless import. Because there is uni-directional causality running from export to import. When we take into account all results together. Export led growth model is valid in Brazil, Russia, China and Turkey. Because there is a uni-directional causality running from export to GDP. Also there is a uni-directional causality running from GDP and export to import. Lastly there is a uni-directional causality from import to GDP. An increase in export increase GDP. Both increase in GDP and export would induce to increase in import. Increasing import would increase GDP.

In the same way, when we interpret results, import led growth model is valid in India and South Africa. Because there is a bi-directional causality running from import to GDP. Also there is a uni-directional causality from export to import and import to GDP. So en increase in import would induce to increase GDP and increasing GDP would induce to increase in export and import. Increasing export would induce to increase in import and hereby GDP.

As can be seen from the results, there are some differences in both direction of causalities and time frequencies between countries. This is because of differences in institutional development differences in economic structures and natural sources economies owned. For instance, key driver of Chinese economy is manufacturing sector. The sector exports 90 % of total production. On the other hand, export of Russia consists from oil and mining. In India, Brazil and South Africa oil and mining sector is driver in export except Turkey. In Turkey, manufacturing sector is pioneer.

According to results, the most import policy implication is about import dependency of export. It is sure that it is valid for all countries even if it is in the long run or short run. In order to increase balance sheet surplus in foreign trade, content of import must be investigate carefully and investments must be directed to related sectors in order to reduce import dependency.

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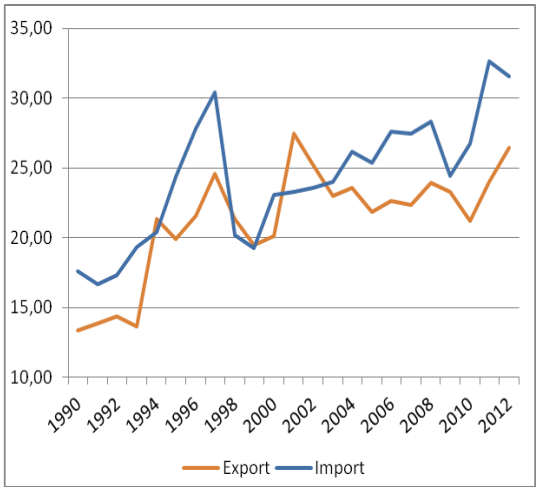
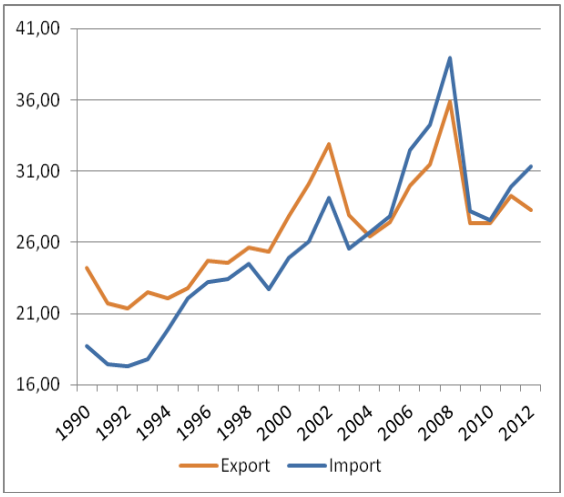
Appendix 1. Export and Import Performance of the BRICS-T Countries % of GDP

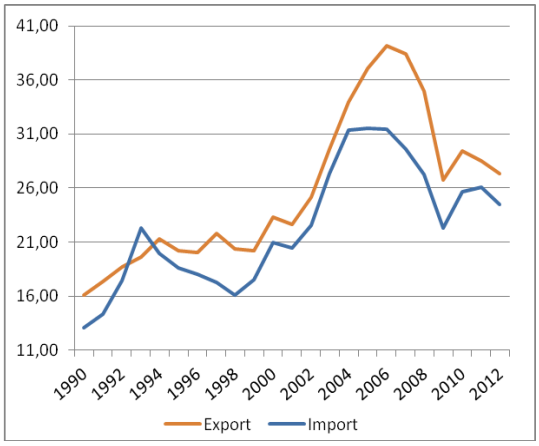
Turkey



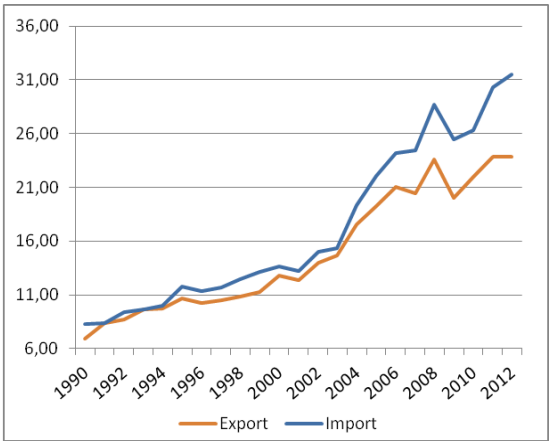
South Africa



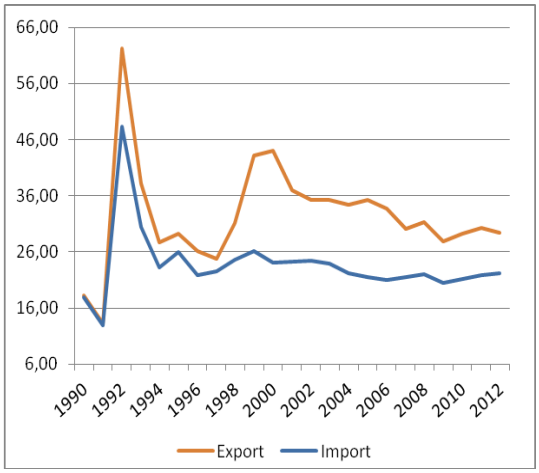
China



India



Russia



Brazil