

Trade relation between India and other BRICS countries: A multidimensional approach using Gravity Model and Granger Causality

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Abstract. *The aim of the study is to explore trade relation between India and other BRICS nations in the short-run as well as in the long-run. For empirical analysis, the study first checks stationary conditions using ADF- Fisher unit root test. To estimate the association between the selected variables, this study has applied Pedroni's cointegration test. After fulfilling the two conditions (Stationary & cointegration), this study employed Granger Causality Test for short-run impact and Gravity Model using Dynamic Ordinary Least Square (DOLS) and Fully Modified Ordinary Least Square (FMOLS) for long-run impact. Granger Causality test results strongly support India's trade with other BRICS nations. The study found Bi-Directional Causality between India's Exports & other BRICS Imports and No causality between India's Imports with other BRICS Exports. Also, the study found favorable unidirectional causality between India's GDP and other BRICS nation's volume of trade. Long-run results from Gravity model using DOLS and FMOLS found highly significant for the selected variables (GDP, PCGDP, PCGDPD, Exchange Rate, Trade-GDP ratio and Distance) other than inflation and trade agreement. Except inflation, per capita GDP differential and distance, all the other variables (GDP, PCGDP, Exchange Rate, Trade-GDP ratio and Trade Agreement) has positive coefficient to the volume of trade of BRICS nations. Majority of the selected variables possesses significant and positive relations with the independent variables clearly indicate that there is a favorable impact on the Indian economy. Finally, the test results validated the appropriateness of Gravity model for trade. So this study strongly recommended that India needs to strengthen its trade relation with other BRICS nations by promoting make in India, SEZs, EOUs and aggravating second generation reforms to reap the potential benefits from the global economy.*

Keywords: BRICS, Gravity model, Granger Causality Model, foreign trade, economic integration.

JEL Classification: C51, F10, F15, F17, F19, F41.

Introduction

Developing countries have gradually emerged as a regional and global engine of growth over the last two and half decades witnessed higher growth in world trade which in turn influences major macroeconomic variables in the international arena. Since the 1950s, many regional, bilateral, multilateral and intra-regional trade agreements take place among the grouping nations. Notably, BRICS economies, an acronym for the economies of Brazil, Russia, India, China and South Africa creates a strong counterweight and alternative to the existing world powers like US, EU and Japan in both economic and political areas.

BRICS countries account nearly 41 percent of world population, 25 percent of world's GDP, 27 percent of world's land area, holds the significantly high level of forex reserves and most attractive destinations for foreign investment occupy significance in research.

Initially, Jim O' Neill former chief economist and chairperson of Goldman Sachs who conceived the idea of BRICs, compared it with G7 (so-called US, Canada, UK, France, Italy, Germany and Japan) and projected that the BRICs would represent the world's leading economies in 2050. Also, he has projected that the GDP of BRICs would be higher than the GDP of North America and China would be the largest economy in the world followed by US, India, Japan, and Brazil.

After the successor of full-fledged economic reforms, India extended furthermore reform process in the external front with other BRICS countries in the 21st century. Since 2004, India has widened its liberal trade and investment policies with Brazil, Russia, and China. Further, it has extended with South Africa since its inclusion in the group in 2010. For India, cooperation with the BRICS is more important not only in terms of exports and imports also in terms of addressing its food and energy security issues, combatting terrorism in the region and so on. Engaging with China has been one of the important mechanisms of India's foreign policy to combat terrorism in the region. The BRICS holds the promise of greater understanding and cooperation among the member states for solving bilateral issues (India's foreign policy and BRICS).

From the above background, it is clear that the BRICS all together tries to increase their dominance in world trade and India also attempts to increase its trade and economic cooperation among other BRICS countries as well as with the rest of the world. Past literature reveals that the economic reform creates a positive impact on the Indian Economy in almost all spheres. But there are no studies that clearly evaluate the impact of other countries on India's foreign trade. Similarly, impact analysis (Pre and post BRICS formation) on India's foreign trade with other countries has not yet done. Hence a multidimensional impact analysis of trade and other relation between India and other BRICS countries occupy significance.

Research issues

Against the above background, the present study has given rise to several policy issues and research questions. For instance;

- Does India's trade relation with other BRICS are favorable or not?
- Do BRICS countries reap the benefits equally or not?

- Does comparative advantage create the excessive gap between them?
- Is there any significant impact of BRICS trade on major macroeconomic variables of India?
- Does the progress of BRICS trade be in the line of Jim O'Neill's projection?

It will be scholastically significant and academically expedient exploration to evaluate credible and reasonable responses to the above inquiries. The relevance of the answer lays in providing the intra-regional trade relations with both growth foundations and justifications in the Indian contexts. The basic stimulus of the present paper is to arrive at intraregional trading inferences. In this context, the present study challenges;

Objectives of the study

- To examine the impact of major macroeconomic variables that influence trade of BRICS nations.
- To evaluate the short run causality between India's foreign trade with other BRICS nations.
- To analyze the long run relationship between India's foreign trade with other BRICS nations.
- To suggest suitable policies to promote India's foreign trade with other BRICS nations and the rest of the world.

Period of the study and sources of data

To test the selected variables using the appropriate econometric technique with more observations, this study chooses twenty-six years of data from 1991 to 2016. The reason for choosing the study period is to compare the performances of external sector variables during pre and post one decade of the official meetings of BRICS nations. The study uses only time series secondary data collected from the Handbook of statistics of Indian Economy (Reserve Bank of India), World Integrated Trade Solution Statistics (WITS), World Bank Data and BRICS Joint Statistical Publication.

Limitations

1. The present study is restricted to analyze trade relations of BRICS nations only. This study will not compare BRICS trade with any other countries or global trade.
2. This study uses only secondary data and limited for the period of twenty-six years.
3. This study compares India's trade relation with Russia and China for the selected study period. To compare India's Trade relation with Brazil and South Africa, the study period is reduced to seventeen years from 2000 to 2016 due to non-availability of data and petty terms of trade (Unbalanced panel data).
4. Other than trade, the study is limited to analyze few macroeconomic variables like GDP, per capita GDP, Inflation and exchange rate which are closely correlated to foreign trade.

Research methodology

The present paper uses two pioneering model to analyze the influence of other BRICS countries on India's foreign trade. First, the study uses Tinbergen's reformulated Gravity model of Trade from Newton's law of universal gravitational, in order to assess the impact

of other BRICS countries in influencing the volume of trade of India. To regress gravity equations, this study will employ Dynamic Ordinary Least Square (DOLS) method and Fully Modified Ordinary Least Square (FMOLS) Method. The traditional OLS method struggle with serial correlation and heteroscedasticity problems. DOLS and FMOLS are usually better at considering endogeneity by adding leads and lags. Secondly, the study uses Grangers causality test to forecast future trade relations between India and other BRICS countries. All the estimates and analysis will be done by using Eviews 10 SV software.

The gravity model

This model originates from the Newtonian physics popularly known as Newton's gravity law in mechanics proves that two bodies attract each other proportionally to the product of each body masses divided by the square of the distance among the relevant centers of gravity.

$$F = G \frac{M_1 M_2}{D^2} \quad (1)$$

Where:

F is the force between the masses;

G is the gravitational constant;

M_1 is the first mass;

M_2 is the second mass, and

D is the distance between the centers of the masses.

The gravity model for trade is similar to the Newtonian law. The similarity is as follows: the trade movements between two countries is proportional to the product of each country's "economic mass", generally measured by GDP (national income) and inversely proportional to the distance between the countries respective "economic centers of gravity", generally their capitals. This formulation can be generalized to

$$VOT_{ij} = \alpha \frac{(Y_i Y_j)}{D_{ij}} \quad (2)$$

Where:

VOT_{ij} represents the volume of trade from country to country,

Y_i and Y_j typically represent the GDPs for countries i and j,

D_{ij} denotes the trade costs incurred due to distances between the respective destinations.

The traditional approach to estimate this equation takes log values of both the sides which led to a log-log model in the following form;

$$\ln(VOT_{ij}) = \beta_0 + \beta_1 \ln(Y_i) + \beta_2 \ln(Y_j) - \beta_3 \ln(D_{ij}) + \varepsilon_{ij} \quad (3)$$

The comprehensive gravity model of trade expresses the volume of trade/ exports/imports between two nations (groups/nation), populations, distance (a proxy of transportation costs) and set of dummy variables either facilitating or restricting trade between two groups.

As the gravity model is initially expressed in a multiplicative method. From which, this paper linearises the model by taking the usual logarithm of many macroeconomic variables related to trade. So the model in log-linear form can be expressed as,

$$\ln X_{ijt} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln y_{it} + \beta_4 \ln y_{jt} + \beta_5 \ln D_{ijt} + \sum S_{ijht} + U_{ijt} \quad (4)$$

Where:

y_i and y_j are per capita GDP of country i and country j;

S_{ijh} is a summation of superior (preferred) trade dummy variables. Dummy variable proceeds the significance one when a certain state is fulfilled, if not, considered as zero.

From the tradition gravity model, this study reformulates traditional equation into a dynamic equation with more variables relating to Volume of Trade, Exports, and Imports of India and other BRICS countries.

The gravity model for volume of trade

$$\begin{aligned} \log (VOT_{ijt}) = & \alpha_0 + \alpha_1 \log (GDP_{it}) + \alpha_2 \log (GDP_{jt}) \\ & + \alpha_3 \log (PCGDP_{it}) + \alpha_4 \log (PCGDP_{jt}) + \alpha_5 \log (D_{ijt}) \\ & + \alpha_6 \log (PCGDPD_{ijt}) + \alpha_7 \left(\frac{VOT}{GDP_{it}} \right) + \alpha_8 \left(\frac{VOT}{GDP_{jt}} \right) + \alpha_9 (INF_{it}) \\ & + \alpha_{10} (INF_{jt}) + \alpha_{11} (EXC_{ijt}) + \alpha_{12} \log (TA_{ijt}) \\ & + \delta_{ijt} \end{aligned} \quad (5)$$

Where:

i – India;

j – Brazil, Russia, China and South Africa;

t – time (study period from 1991 to 2016);

VOT_{ij} – Volume of Trade between country i (India) and country j (BRCS);

GDP_i – Gross Domestic Product of Country i;

GDP_j – Gross Domestic Product of country j;

$PCGDP_i$ – Per capita GDP of Country i;

$PCGDP_j$ – Per capita GDP of Country j;

D_{ij} – Distance between country i and country j;

$PCGDPD_{ij}$ – Per capita GDP differential between country i and j;

INF_{it} – Inflation of Country i;

INF_{jt} – Inflation of Country j;

EXC_{ijt} – Exchange rate of country i and j;

VOT/GDP_i – Trade- GDP ratio of country i;

VOT/GDP_j – Trade- GDP ratio of country j;

TA_{ij} – Trade Agreement between country i and j (dummy variable);

α 's – parameters and

δ – error term.

Per capita GDP provides a good proxy for the level of development and infrastructures that are essential to conducting trade, and as such the more developed the countries are, the more would be the trade between the pairs of countries (Frankel, 1993).

TR/GDP variable indicates the openness of the country. The more open the country is the more would be the trade.

Granger causality test

In the Granger Causality test, the directional relationships between two variables are very sensitive which can be used efficiently by using the optimal number of lags in the model. It can be inferred from the computed statistical values, based on the given equations, if the beta coefficients become zero or less than the conventional value of 0.05 and the computed F statistic is low for the first hypothesis in the equation (1) indicate that the lagged IGDP do not possess in the regression (Accepting null hypothesis). This means India's GDP does not Granger cause Volume of trade of other BRICS countries, similarly for other beta coefficients in the first hypothesis of the rest of equations. When we move to the second hypothesis which states that the BRCS volume of trade does not Granger cause India's GDP if the computed F statistic is low or P value is less than the conventional value, we can reject hypothesis and infer that BRCS volume of trade does cause India's GDP.

Similar results can be derived for other beta coefficients in the second hypothesis of the rest of equations.

Causality test for trade flows between India and other BRICS countries

To test causality between India's GDP, Exports, Imports and Volume of Trade with other BRICS countries Exports, Imports and Volume of Trade, the following model developed by Engel and Granger, (1987) will be used. The models are:

(a) GDP of India and Volume of Trade of other BRICS countries

$$\begin{aligned}
 IGDP_t &= \beta_0 + \sum_{i=1}^n \beta_{1i} IGDP_{t-i} + \sum_{i=1}^n \beta_{2i} BVOT_{t-i} + u_{1t} \\
 BVOT_t &= \beta_3 + \sum_{i=1}^n \beta_{4i} BVOT_{t-i} + \sum_{i=1}^n \beta_{5i} IGDP_{t-i} + u_{2t}
 \end{aligned} \tag{6}$$

(b) Exports of India and Imports of other BRICS countries

$$\begin{aligned}
 IX_t &= \beta_0 + \sum_{i=1}^n \beta_{1i} IX_{t-i} + \sum_{i=1}^n \beta_{2i} BM_{t-i} + u_{1t} \\
 BX_t &= \beta_3 + \sum_{i=1}^n \beta_{4i} BM_{t-i} + \sum_{i=1}^n \beta_{5i} IX_{t-i} + u_{2t}
 \end{aligned} \tag{7}$$

(c) Imports of India and Exports of other BRICS countries

$$\begin{aligned}
IM_t &= \beta_0 + \sum_{i=1}^n \beta_{1i} IM_{t-i} + \sum_{i=1}^n \beta_{2i} BX_{t-i} + u_{1t} \\
BX_t &= \beta_3 + \sum_{i=1}^n \beta_{4i} BX + \sum_{i=1}^n \beta_{5i} IM_{t-i} + u_{2t}
\end{aligned} \tag{8}$$

(d) The volume of Trade of India and Volume of Trade of other BRICS countries

$$\begin{aligned}
IVOT_t &= \beta_0 + \sum_{i=1}^n \beta_{1i} IVOT_{t-i} + \sum_{i=1}^n \beta_{2i} BVOT_{t-i} + u_{1t} \\
BVOT_t &= \beta_3 + \sum_{i=1}^n \beta_{4i} BVOT + \sum_{i=1}^n \beta_{5i} IVOT_{t-i} + u_{2t}
\end{aligned} \tag{9}$$

In the above equations, where:

IGDP is India's GDP;

BVOT is volume of trade of other BRICS countries like Brazil, Russia, China and South Africa;

IX is India's Exports;

BX is Exports of BRCS;

BM is imports of BRCS;

IM is India's Imports;

IVOT India's Volume of Trade;

BVOT is BRCS's Volume of Trade;

β and u are coefficients and error terms, respectively.

Review of literature

This study focuses blend of theoretical and empirical studies relating to the application of the most appropriate econometric technique to analyze the trade and economic relations between intra-regional countries. More specifically, the suitability of Gravity model and Granger Causality test to assess the effectiveness of India's Trade relations with other BRICS countries.

Tinbergen, Jan is the one who first applied Newtonian Gravity model in International Trade. Furthermore, studies like Anderson (1979), Helpman and Krugman (1985) and Deardorff (1998) strengthened the effectiveness of Gravity model in International Trade. Linnemann (1966) was the first one developed the most common clarification of Gravity model that was used by Aitken (1973) and Sapir (1981).

Among the past studies, the studies by Anderson and Wincoop (2003), Limao and Vinables (2001), Sohn (2005) and Nguyen (2010) are the most reputed and relevant studies occupies significance in the context of intra-regional trade.

The traditional Gravity model of international trade focused only two independent variables like Differences in GDP and distances between two respective trading centers/partners. Later many explanatory variables like per capita GDP, exchange rate, Trade GDP ratio, Inflation, Taxes are added in the equation developed in the past studies like Bergstrand (1985), Dell Arricia (1999), Frankel (1997), Limao and Venables (2001), Nguyen (2010), Mukhtar and Malik (2010), Frankel (2010) and so on. Similarly, Adrino, Mazenda (2016), Irwan Shah Zainal Abidin, Muhammad Haseeb, Lee Wen Chiat, Muhammad Rabiul Islam (2016) and others developed new dimensional intra-regional trade model using Granger Causality, Dynamic Ordinary Least Square (DOLS) and Fully Modified Ordinary Least Square Model (FMOLS).

Sahu, Pratish Kumar and Sam Yong Heng (2017) investigated India's competitive advantage and the influence of trade gravity variables in determining India's exports with its top 50 trading partners. The study has applied an augmented gravity model to India's exports and estimated the same in a panel data framework during 2000-14. The study finds that India's exports with its top trading partners were more sensitive to distance, GDP, population, and real exchange rate. However, to our surprise, we could not find a significant evidence of the effect of trade agreements on India's exports.

Aswini Mishra, Jigar N. Gadhia, N. Kubendran and Makara Sahoo (2015) delivers a detailed theoretical justification for the application of gravity model in the context of India's trade relation with other BRICS countries. Using 20 years of data from 1990 to 2010, the study found that there is a positive relationship between gross national product/per capita GNP of the nation and its volume of trade. They also found that the transport cost plays a negative role in influencing foreign trade among BRICS nations, other variables related to foreign trade like exchange rate, inflation, and import-GDP ratio does not play a major role in influencing it.

Mottet, Laetitia (2013) examined the cooperation and competition among the BRICS countries and other emerging powers. They found that the members of BRICS align periodically with the bloc to demand greater representation in the international institutions and to resist Western dominance. Despite their appearances as a unified bloc of fastest growing economies, The BRICS countries mismatch in their political setup, economic systems, huge differences in per capita incomes, geopolitical rivalries and conflicts among them that are undermining their reciprocal collaboration.

Ang, Su (2016) did a comparative analysis of BRICS trade which mainly focuses how economic growth, budget deficit, disposable per capita income and currency affect trade in the bloc. The study found that China owns the strongest trade competitiveness compared to all other members in the group, second is Russia, followed by India, Brazil and South Africa. According to trade competitiveness based on economic growth, population and the fiscal deficit of China creates its competitive advantage and the disposable per capita income of South Africa have the advantage of foreign trade. The study also found that the exchange rate appreciation has a high level of negative effect on China's foreign trade.

Kaya, Halil D (2014) examined the relationship between exchange rates, exports and GDP for BRICS countries over a period of 26 years from 1985 to 2011. This study found that

there is no statistically significant difference between the increase in exports and increase in exchange rate, similarly increase in exports during the periods of decreasing exchange rates. Also, this study found that the BRICS countries do not increase their exports significantly when exchange rate falls. Finally, the study witnesses BRICS countries GDP per capita measures are significantly lower when their currency values are low.

Underlying the robust trend in bilateral trade between India and rest of BRICS countries has been the rising trend in India's trade deficit with the rest of BRICS increased from the US \$8.7 Billion in 2006 to \$ 58.4 Billion in 2015. India maintained its largest trade deficit with China, followed by Russia, South Africa, and Brazil. Before enhancing trade with other BRICS countries, India should address issues relating to the trade deficit and they have to focus export potential to other BRICS countries. (EXIM Bank of India, 2016).

Somesh, Mathur K., Rahul Arora, and Monika Bhardwaj (2016) investigated the impact on India aligning with RCEP (Regional Comprehensive Economic Partnership) and BRICS beneath the conjecture of free trade area. The important objective of the study is to evaluate gains and losses to Indian economy from intra-regional trade. The outcome discloses that it would be favorable for India to have trade relationships with RCEP member countries under free trade in merchandise trade. The study suggested if India wants to continue free trade with BRICS, it must negotiate for the entry of comparatively advantageous commodities into their markets for reciprocity, also it should allow other countries comparatively advantageous commodities into the domestic market.

Mazenda Adrino (2016) addresses the central issue on whether South Africa's align with BRICS has led to a sustainable growth as was predicted. The study uses Autoregressive Redistributive Econometric Modeling and quarterly data from 1990 to 2014. The study found an insignificant long-run relationship between South Africa's Trade, FDI and Economic Growth with other BRICS countries but they found a little short-run effect on South Africa's Growth. Granger Causality test result shows no causality between South Africa's Growth and its Trade with other BRICS countries.

Research gap

Oodles of research studies have been done in relation to the application of Gravity model in international trade. There are several studies in which scholars applied Gravity model and analyzed trade flows between many intra-regional groups using panel data method. Interestingly, this study found that many scholars applied either Gravity model or Granger causality model in their analysis. There is no single study that uses both the models together for analysis even though there is a significance to assess the impact of trade variable on major macroeconomic variables and predict its future trends. Similarly, all the past studies are limited to exports or imports or volume of trade with limited periods. Hence, the present study tries to fill the gap by applying both Gravity Model and Granger Causality model with more explanatory variables that are highly correlated to major macroeconomic variables. Further extent, the present study uses 27 years of data to differentiate the impact of other BRICS countries on the Indian Economy during pre and post one decade of formal meetings of BRICS.

An analysis on India's Trade relation with other BRICS Countries

To analyze trade relation between India and other BRICS nations in the short-run as well as in the long-run, this study is designed at four stages. Stage one focuses on the application of ADF-Fisher Unit Root Test to check the presence of unit root for stationary conditions. Stage two uses Pedroni's cointegration test to verify the association between the selected variables for regressions. Stage three and four employs two pioneering econometric models called Granger Causality test and Gravity model of trade for empirical results.

ADF-Fisher Unit Root Test

There are six major unit root tests can be applied for stationary conditions for panel and cross-section data's. Of which, the most important and relevant unit root test for this study is ADF-Fisher unit root test. Using ADF-Fisher unit root test, we can check stationary conditions at three levels (Unit root at Level, at first difference and a second difference).

Table 1. ADF Fisher unit root test (at first difference)

Variables	Statistic	Prob
LnVOT _{ijt}	49.4573	0.0000
LnGDP _{it}	18.9839	0.0001
LnGDP _{jt}	27.4412	0.0006
LnPCGDP _{it}	18.4207	0.0001
LnPCGDP _{jt}	27.4117	0.0006
LnExports _{it}	11.6324	0.0030
LnExports _{jt}	45.8609	0.0000
LnImports _{it}	9.74683	0.0076
LnImports _{jt}	36.7366	0.0000
LnPCGDPD _{ijt}	26.8513	0.0008
LnExchange Rate _{ijt}	47.7545	0.0000
LnInflation _{it}	28.2321	0.0000
LnInflation _{jt}	65.0289	0.0000
LnVOT/GDP _{it}	12.3983	0.0020
LnVOT/GDP _{jt}	64.8891	0.0000
LnTA _{ijt}	17.3681	0.0000
LnDistance _{ijt}	21.9461	0.0000

The null hypothesis of ADF-Fisher unit root is that the variables have a unit root. Stating that the variables are non-stationary if the probability values are more than the conventional value. Based on the above conception from Table 1, the study has applied ADF-Fisher test at the level and found Non-Stationary. Due to which, the study uses unit root at first difference and found all the probability values are less than the conventional value. So the study rejected the null hypothesis of Unit Root and accepts the alternative hypothesis and inferred that the variables are stationary at first difference.

Pedroni's cointegration test

After verifying the stationary conditions, this study examines whether there is a cointegration between the selected variables or not. For that purpose, the present study has observed three popular and essential cointegration tests. They are Pedroni's residual cointegration, Kao's cointegration, and Fisher's cointegration. Of which, the present study has applied Pedroni's cointegration test due to its significance and relevance to this study.

The null hypothesis of Pedroni's cointegration test is the variables have no cointegration. According to this test, if the probability values for the majority of the test results establish less than 0.05 led to the rejection of the null hypothesis. In such instance, the study can infer that the variables are cointegrated.

Table 2. Pedroni Residual Cointegration Test (Dependent Variable is Volume of Trade_{ijt})

Tests	Statistic	Prob	Weighted Stat	Prob
Panel V – Stat	- 0.038004	0.5152	-0.833361	0.79
Panel Rho – Stat	0.698733	0.7576	0.579800	0.71
Panel PP – Stat	-5.983097	0.0000	-7.247671	0.00
Panel ADF – Stat	-4.653448	0.0000	-4.301881	0.00
Group Rho – Stat	1.381945	0.9165	---	---
Group PP – Stat	-8.349807	0.0000	---	---
Group ADF – Stat	-4.377081	0.0000	---	---

Out of 11 test results depicted in Table 2, the probability values of 6 results are less than the conventional value. So the study rejects the null hypothesis and accepts the alternative hypothesis. Stating that there is a long run relationship exists between the selected variables (VOT_{ijt}, GDP_{it}, GDP_{jt}, PCGDP_{it}, PCGDP_{jt}, Exchange Rate_{ijt}, and Distance_{ijt}. Other independent variables are restricted from cointegration for the greater degree of freedom). From the test result, the study observed that there is a cointegration between the selected variables and exposed positive signal to run the appropriate model for analysis.

Granger causality to test short-run trade relation between India and other BRICS Nations

To assess the impact of India's trade with other BRICS countries in the short run, this study uses several major macroeconomic variables like GDP, Exports, Imports, Volume of Trade of India and Imports, Exports, Volume of trade of other BRICS nations. This study has tested eight null hypotheses using Granger Causality test and the results are given in Table – 3.

Table 3. Granger causality test result

Null Hypothesis	Lags	Obs	F-Statistics	Prob	Results
IGDP Does not Granger Cause BVOT	2	24	5.44310	0.0135	Unidirectional Causality
BVOT Does not Granger Cause IGDP	2	24	1.58698	0.2305	
IX Does not Granger Cause BM	2	24	9.56936	0.0013	Bidirectional Causality
BM Does not Granger Cause IX	2	24	6.39491	0.0075	
IM Does not Granger Cause BX	2	24	2.75588	0.0889	No Causality
BX Does not Granger Cause IM	2	24	0.99802	0.3871	
IVOT Does not Granger Cause BVOT	2	24	5.13996	0.0164	Unidirectional Causality
BVOT Does not Granger Cause IVOT	2	24	2.89502	0.0799	

India's GDP (IGDP) and other BRICS nations Volume of Trade (BVOT)

Granger Causality test results for India's GDP with BRICS nations Volume of Trade, this study has observed unidirectional causality. From the probability values in Table 3, it can be inferred that IGDP does affect BVOT but BVOT does not affect IGDP. Uttering that India's Excess GDP goes to other BRICS nations in the form of exports and creates exports earnings to India. Similarly, an increase in BVOT does not reduce GDP via increasing imports. So it creates a positive impact on India's trade balances and the economy as a whole.

India's Exports (IX) and other BRICS nations Imports (BM)

Granger Causality test results from table 3 gives the probability values of 0.0013 and 0.0075 for India's Exports and Other BRICS nations imports implying that India's Exports does granger cause other BRICS nations Imports, Similarly other BRICS nations imports does cause India's Exports. This Bi-Directional causality clearly indicates that India's exports will influence other BRICS nations Imports and an increase in other BRICS nation's imports will increase India's Exports, i.e., other BRICS nations receive a considerable portion of their imports from India and it creates the surplus trade in favor of India.

India's Imports (IM) and other BRICS nations exports (BX)

The probability value of 0.0889 and 0.3871 clearly stated that there is no causality between India's imports and other BRICS nation's exports. This result clearly pointed out that an increase in India's imports does not significantly affect the exports of other BRICS nations. Similarly, an increase in the exports of other BRICS nations have no significant impact on India's exports stating that the other BRICS nations exporting more to the rest of the world and not to India.

India's Volume of Trade (IVOT) and other BRICS nations Volume of Trade (BVOT)

Finally, the study observed favorable unidirectional causality between India's Volume of Trade and other BRICS nation's Volume of Trade. The probability value of 0.0164 for IVOT and BVOT proves that India's Volume of Trade enhances other BRICS nation's volume of trade. On the other hand, the probability value of 0.0799 proves that other BRICS nation's volume of trade does not enhance India's volume of trade. It can be inferred by saying when India's volume of trade increases, the majority of its exports goes to other BRICS nation's but it is not true when other BRICS nations increase its volume of trade. Based on the overall empirical results from Granger Causality test, the study has observed that India has positive and favorable trade relationships with other nations.

Panel Data Analysis on the long run output elasticity's of BRICS Trade

The trade relation between the BRICS nations is also estimated by applying Gravity model of trade using Dynamic Ordinary Least Square (DOLS) method and Fully Modified Ordinary Least Square (FMOLS) Method. The significance of DOLS and FMOLS is it rectifies serial correlation and simultaneity inaccuracies.

Table 4. Cointegration Regression for BRICS Trade using DOLS & FMOLS: Dependent Variable (VOT_{ijt})

Variables	Dynamic OLS Model				Fully Modified OLS Method			
	Coefficient	Std. Error	t-Stat	Prob	Coefficient	Std. Error	t-Stat	Prob
$\ln(GDP_{it} * GDP_{jt})$	0.5961	0.0335	17.759	0.0000	0.4823	0.0143	33.697	0.00
$\ln(PCGDP_{it} * PCGDP_{jt})$	0.3936	0.0508	7.7375	0.0000	0.5502	0.0231	23.7849	0.00
$\ln(\text{Exchange Rate}_{ijt})$	0.0558	0.0150	3.7176	0.0003	0.1042	0.0108	9.6535	0.00
$\ln(\text{Inflation}_{it} * \text{Inflation}_{jt})$	-0.0161	0.0083	-1.918	0.0577	-0.0070	0.0052	-1.3293	0.18
Openness_{ijt}	0.3047	0.0012	24.824	0.0000	0.0344	0.0006	50.240	0.00
R Squared	0.91				0.89			

According to the test results from table 4, it is clear that the selected independent variables are significant to the volume of trade of BRICS nations. Except for Inflation, all the other independent variables are significant and positive to the volume of trade of BRICS nations.

This means that the GDP, PCGDP, Exchange rate and openness of BRICS countries have a substantial impact on the volume of trade. As far as inflation is concerned, the study found an insignificant relation to VOT of BRICS nations. Other than inflation, all the independent variables have a positive coefficient, meaning that GDP, PCGDP, Exchange Rate and Openness have a significant plus positive association with VOT. Which means, 1 unit increase in GDP, PCGDP, exchange Rate and openness of BRICS nations causes the volume of trade by 0.5961, 0.3936, 0.0558, 0.3047 units, respectively.

Among all the variables, GDP has high coefficient followed by PCGDP, Exchange Rate, and openness. When the result is insignificant, doesn't matter whether the coefficient is positive or negative. Interestingly, the study found more or less similar results from DOLS & FMOLS which can be seen from flanking probability and R squared values.

Comparative analysis of India's Trade with other BRICS nations using DOLS & FMOLS

One of the major objectives of this study is to assess the impact of India's trade relation with other BRICS nations. For that purpose, the present study uses and compares major macroeconomic variables relating to India's foreign trade with BRICS nations using DOLS and FMOLS methods. The long-run output elasticity's results are given in table 5.

Table 5. Cointegration Regression of India's Trade with other BRICS nations: Dependent Variable (VOT_{ijt})

Variables	Dynamic OLS Model				Fully Modified OLS Method			
	Coefficient	Std. Error	t-Stat	Prob	Coefficient	Std. Error	t-Stat	Prob
LnGDP _{it}	0.8620	0.0229	37.537	0.00	0.8779	0.0131	66.875	0.00
LnGDP _{jt}	0.9159	0.0046	194.98	0.00	0.9180	0.0024	372.55	0.00
LnPCGDP _{it}	1.8416	0.0186	98.601	0.00	1.8454	0.0124	47.752	0.00
LnPCGDP _{jt}	1.4916	0.0200	74.240	0.00	1.5105	0.0097	155.66	0.00
LnPCGDPD _{ijt}	-1.5158	0.0190	-79.450	0.00	-1.5465	0.0177	-87.22	0.00
LnExchange Rate _{ijt}	1.1817	0.0248	128.07	0.00	3.2801	0.6121	8.6250	0.00
LnInflation _{it}	-2.8718	0.4916	11.9421	0.14	-2.9469	0.5080	11.701	0.21
LnInflation _{jt}	-2.6211	0.6404	8.7770	0.17	-2.1088	0.5660	9.0249	0.26
LnVOT/GDP _{it}	3.7894	0.0747	50.703	0.00	3.7914	0.0654	57.886	0.00
LnVOT/GDP _{jt}	3.5961	0.0375	95.807	0.00	3.6014	0.0340	15.762	0.00
LnTA _{ijt}	1.1873	0.6481	2.4911	0.71	1.2163	0.6814	2.8142	0.75
LnDistance _{ijt}	-1.8622	0.2811	-2.4044	0.01	-1.7313	0.3100	-2.312	0.01
R Squared	0.96				0.91			

Regression results from table 5 clearly pointed out that there is a significant and positive association between GDP, PCGDP, Exchange Rate and Trade-GDP ratio of the country (i) and country (j). Whereas PCGDP differential and distance between country (i) and (j) are significant but inversely correlated to trade. Interestingly, the regression result exposes that the Trade Agreement is insignificant to the volume of trade but Inflation is the only variable which is not only insignificant also inversely related to trade between country (i) and (j). Among all the variables, GDP has high coefficient followed by PCGDP, Exchange Rate, and openness.

When the result is insignificant, doesn't matter whether the coefficient is positive or negative. So, the majority of the selected variables possess significant and positive relation indicates that there is a positive impact on the Indian Economy for trading with BRICS countries. Most of the test results validate several traditional trade theories, especially factor endowment model. The test result for inflation invalidates its importance in

international trade seems to be contradictory. This means, inflation and trade among BRICS countries are insignificant but it may occupy significance when they trade with other countries in the world. Once again, the study found more or less similar results from DOLS & FMOLS. Also, the test results validated the suitability of gravity model for international trade.

Conclusions

For the first Objective, the study found that the GDP, PCGDP, Exchange Rate and openness are significant and positively correlated to VOT of BRICS nations. Whereas the inflation rate is concerned, it has insignificant relation to VOT. When the result is insignificant, doesn't matter whether the coefficient is positive or negative.

For the second Objective, the study strongly proved that there is a positive impact on the Indian Economy for trading with BRICS countries. All hypothesis and Granger Causality test results clearly support India's Trade with BRICS countries. The study found Causality for favorable trade variables and no causality for unfavorable or trade deficit.

For the third Objective, the study found a majority of the selected independent variables are significant and positively correlated (coefficients are positive) to the dependent variable (VOT). But Inflation and Trade Agreements are insignificant to the dependent variable. Also, these two variables are negatively correlated with VOT of BRICS.

Most of the literature survey found that there is no significant gain for India and South Africa from other BRICS countries and China & Russia are the real gainers from the bloc. But this study invalidated such observations and proved that there is a significant and positive trade relation between India and other BRICS countries in the short run as well as in the Long Run. Also, this study validated Gravity model for assessing international trade between countries. Finally, the study strongly recommended that India needs to strengthen its trade relation with other BRICS nations by promoting make in India, SEZs, EOUs, and Openness to reap the potential benefits from the global economy.

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