

Quantitative dynamics of intra-BRICS trade

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Abstract

The study uses an augmented gravity model to analyse intra-BRICS trade flows and the potential for establishing economic cooperation. It examines trade relations between BRICS with the help of the gravity model of international trade. Panel data from 2000 to 2017 were reviewed for bloc analysis of 20 trade partners. The analysis of the intra-BRICS trade flows is based on the Heckscher-Ohlin model. The results obtained confirm that the intra-BRICS trade relations have a sound positive impact on economic performance in these countries. Market size and economic index have a beneficial effect on the intra-BRICS trade flows. Market size is very elastic to trade, while trade tariffs and taxes within BRICS are manageable. Hence, the intra-BRICS trade has the potential to create strong economic ties within the member countries, and cooperation between the BRICS countries can have a significant influence on the globalisation of the world economy.

Keywords: BRICS, gravity, trade, Heckscher-Ohlin model, Linder hypothesis.

JEL: C01, C54.

Introduction

Trade is a phenomenal component of economic analysis at the national and international levels. It occurs because all factors of production are not collectively available at the place of production. Manufacturing, investment, and consumption activities do not

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occur in one place, but are dispersed all over the globe. Every producer must borrow the required resources from a place where it is available in abundance. It also helps in reducing the disadvantages of an unbalanced geographical distribution of productive resources (Ohlin, 1952). Therefore, variability of productive resources determines international trade and plays a vital role in a country's economic growth and development (Krueger, 1980). Consequently, every nation is engaged in international trade to meet the needs and requirement of its economy, so that to establish strong trade relations among states.

In the current scenario, given the growing need and importance of trade, international trade relations have become an indicator of globalisation. The existence of different trade blocs is evidence of the rapid globalization of the world. The BRICS nations are among the novices and represent an emerging trade bloc in this globalised era, which adds new dimensions to enhancing international trade relations. However, the question of whether BRICS is technically a bloc or not remains debatable (Iqbal & Rahman, 2016). BRICS is an acronym that refers to the association of five emerging countries, and the impact of this conglomeration was suggested by O' Neill (2001). He mentions that Brazil, Russia, India and China are emerging giants that are able to compete with advanced nations and should provide a way out of the world political and economic crisis. Each of these countries specializes in different areas. For example, Brazil is of global importance as a raw material base, Russia is recognized mostly for oil and gas, India is well known as a service provider, China dominates the manufacturing sector, and South Africa is valuable in terms of resource reserves (Kumar, 2013). Collectively, they make up 30% of the Earth's land mass and cover 45% of the world's population (Mazenda, 2016). According to a Goldman Sachs report, the economic and demographic influence of China and India indicate that their middle-class populations are increasing. This will increase consumer activities that will help the BRICS countries expand their economic activities and develop trade relations. Likewise, they are all among the emerging and dominating superpower economies of their respective regions (Przygoda, 2015). They are dynamic and charismatic rulers of their continents — Asia, Latin America, Europe, and Africa. Once interaction and negotiations with these countries have started, it becomes easy to spread and create trade relationships with other regions of the continent. Subsequently, their emerging economic cooperation qualities have a significant impact on the world economy. They are the major contributors to the world economy through their participation in international trade relations, international migration of human resources, and international investments (Nayyar, 2016). Therefore, trade is one of the main rationales for encouraging and smoothing international relations around the globe, as well as between the countries of the bloc. It also helps in earning customer feedback and gratification, which ultimately enhances the country's productivity. In the context of trade relations, there is a need to assess different factors responsible for intra-BRICS trade and measures to strengthen trade relations between the BRICS countries. Generally, the gravity model is used to study the bilateral trade flows between the trading countries. However, this study uses a modified gravity model analysing the BRICS countries' trade flows, which means that the model is specified, restructured and reparametrized in accordance with time series, cross-sectional or panel data series framework. The aim of the study is to examine the intra-BRICS

trade flows and trade potentials for the development of strong economic cooperation. This is an important topic, because these countries want to establish an economic bloc, for which they need economic cooperation, and trade can help in establishing strong relations within BRICS. Therefore, the article uses a modified gravity model to study intra-BRICS trade linkages.

1. Literature review

Exchange of goods is necessary at a time when all factors of production are not readily available due to geographical limitations, and producers must depend on supplier countries where resources are available in abundance. As a result, trade originates to meet the needs of consumers. This means that international trade helps in solving economic problems of a country.

The theory of comparative advantage states that a product should be sold from a country where the opportunity cost of a factor of production is lower compared to another trading country. As a result, all trading countries can enjoy trade benefits through trade relation. In 1930, Heckscher and Ohlin denounced Ricardo's views and developed the factor endowment theory of trade. They assert that every nation has a different factor endowment, and it can enjoy a comparative advantage in its specialised factor of production. An exporting country should produce a commodity that requires cheap factors of production and is relatively abundant in nature, whereas import is a relatively scarce and expensive factor (Clements, 2007). Therefore, every trading nation can simultaneously profit from trading.

After World War II, there was a further evolution in trade theory, and major contributions were introduced by Vernon, Linder, and Samuelson, as they explained that international trade was based on comparative advantages, technical soundness of the industry, and demand for a product. In addition, Faderer (1982) mentioned that exports contributed to the growth and development of a country that depended on economies of scale and adequate allocation of resources. He failed to explain the long-term impact of exports on the economy of a country. Likewise, economic integration allows a country to benefit from scale of production and helps in the value chain process, reducing the burden of trade competition with developed countries (Foxley, 2010). The BRICS countries are still developing and following the traditional behavioural patterns mentioned in the classical theory of trade (Mazenda, 2016). The BRICS conglomerate, based on economic cooperation, stability, and security, aims to achieve market efficiency, FDI inflows, effective economies of scale, and better trade relations. In the era of globalisation and with the increasing number of trade blocs, new trade theories demonstrated (in addition to two-factors and two-country models) that trade could also depend on increasing the return to scale, imperfect competition, and product differentiation. Multilateral institutions have also played an important role in merchandise trade of BRICS (Rahman, 2016). Climate change issues in the BRICS countries are also relevant to the trading environment (Rahman & Turay, 2018).

We emphasize the importance of using the gravity model to study regional trading groups, currency union, economic union, political union, and other trade associations. The Regional Trade Agreement (RTA) helps in bilateral trade (Carrere, 2004; Vicard, 2011) and trade growth through free trade agreements (FTA) (Anderson & Yotov, 2013). Besides, empirical evidence indicates a positive impact of the RTA on intra- and inter-trade blocs in developed countries (Martinez-Zarzoso et al., 2009). The gravity model is used for trade creation and trade diversion effect of the RTA (Ekanayake et al., 2010), as well as in economic integration studies (Porojan, 2001; Martinez-Zarzoso & Nowak-Lehmann, 2003). It is also used in the analysis of the Andean Community, MERCOSUR (Frankel et al., 1994; Carrillo & Li, 2004), and the Preferential Trade Agreement (PTA) of various blocs (Martinez-Zarzoso, 2003). The gravity model is used several times to study trade preferences between two ASEAN and three RTA countries, EU trade preferences and other FTA countries. Similarly, it was used to check the involvement of the RTA in promoting international trade of OECD countries and non-OECD countries. The results show that there is a significant impact of the RTA on OECD in comparison to non-OECD countries (Kurihara, 2011).

Recent trade activity revealed the entry of the BRICS countries into the FTA and other regional trade agreements that are influenced by political and economic factors of their countries (Sharma, 2014). Regional introversion indices indicate that the BRICS countries are strongly influenced by global integration rather than regional integration. According to Jim O'Neill (2001), BRICS are emerging economies aiming to create a new world order. They have the potential to expand world trade by bringing regional countries to international markets. Mishra et al. (2015) provide a theoretical and applied framework for studying trade relations of the BRICS countries with the help of the gravity model. It is established that Russian trade integration is based on the Heckscher-Ohlin framework, while other BRICS members adhere to the Linder hypothesis of trade pattern (Rasoulinezhad & Jabalameli, 2018). On the other hand, Besada and Tok (2014) argue about the importance of South Africa for the BRICS alliance. Its inclusion creates neoliberalism across the African continent that opens the gate to a broad market, trade, and investment for other members of BRICS. The concept of a soft balancing strategy unites them and helps to increase the focus on collaborative areas such as trade, security, stability, infrastructure development, and country representation. The alliance of these developing countries creates a platform for multilateral trade and regional economic cooperation between the BRICS countries. This strategic alliance focuses on sectoral cooperation, foreign policy instruments, and common interests of these countries, because they need economic cooperation, not a political forum. These countries need export reorientation that will help them in transforming their export from low value added production and basic processing of raw materials into more sophisticated merchandise goods (Kocourek, 2014).

The NTT doctrine states that strategic trade helps in the continuation of trade practices and an uneven power balance between rich and poor countries of the world (Sen, 2010). In 1991, Krugman gave a new dimension to trade relation and suggested that the increasing return to economies of scale and economic geography was an important consideration

for international trade. This implies that transportation cost is incurred to reach an efficient market location and provide resources for production. The gravity model helps in estimating general trade functions (Davidova, 2015). Bilateral trade between India and other BRICS nations is studied using the gravity model which shows that there is a positive relationship between GNP and volume of trade between the nations, but transportation cost shows negative influence in the context of trade (Mishra et al., 2015). Similarly, the panel data technique is used to study trade relations between Bangladesh and BRICS with the help of a modified gravity model in which GDP, per capita GNI, and real exchange rate are used as variables for drawing significant inferences (Kundu, 2015). Another study states that there is a slight drop in export activities as the distance between trading countries increases, and the greater the distance between them, the greater the drop in exports (Baha et al., 2015). Therefore, it is imperative to study the intra-BRICS trade flows and determine whether it is beneficial for economic cooperation or not.

2. Conceptual framework

The concept of BRICs dates back to 2001 when O'Neill, as chief economist at Goldman Sachs, weaved an acronym for four prominent emerging economies of the world: Brazil, Russia, India, and China. With the acronym modified, South Africa merged as the fifth developing country in 2010. BRICS has been outpacing other conglomerates across the globe in the recent years, strengthening economic ties among its members without challenging their idiosyncratic variations. These variations in trade activity and factor movement between economic entities depend on the economic mass of the entities in question. The gravity model of mapping economic liaison between two countries, even several subjects in some cases, derive its content from Newton's law of gravitation. Newton's proposition of universal gravitation provided the basis for the gravity model of economic interaction. First used by Tinbergen in 1962, the gravity model of economic integration rests on the assumption that the link between economies is a direct proportion of the economic mass and an indirect proportion of the distance between the economies investigated. The model extends assistance in searching for evidence in trade conglomerates, as well as in other characteristics such as migration, investment, etc.

According to Anderson and Wincoop (2003), the gravity model of economic interaction assumes the following mathematical form in the case of a two-country model:

$$X_{ij} = Y_i E_j / d_{ij}^2, \quad (1)$$

where i signifies the country of origin; j — the country of destination; d — the distance between the two countries i and j .

The X_{ij} component measures the amount of goods/labour or any other factor of production that has passed between source i and destination j , and indicates that it is positively linked to the economical mass of the country of origin and destination, while it is antagonistically related to the distance between the two economic entities. This distance can cover all the factors that restrict or minimize trade. However, it was found that the volume of the flow of goods and factors of production substantially corresponds

well to the forecast when numerous dummy variables were added in the traditional gravity model, such as common political boundaries, same dialect or language, similar trade arrangements, similar cultural and historical foundations, and much more of a similar nature. In addition, X_{ij} will only succeed in overcoming bilateral resistance and will fail to capture the overall negative impact of trade resistance on bilateral trade. For this purpose, the traditional gravity model, formally presented in equation (1), extended its scope to include a remoteness index designed to account for frictions resulting from bilateral trade. This additional component of the remoteness index $\sum_i d_{ij}/Y_i$ elaborated the ancient gravity model to constitute the average distance of entities from their associating entity in trade. This characteristic of the traditional model, which allowed to introduce the remoteness index to the original equation, took its origin from the fundamentals of the Newtonian gravity. Since each country of origin can trade with multiple destinations, similarly, any destination country can attract trade from innumerable countries of origin. This simple but noticeable debacle led to modification of the traditional gravity model into a structured gravity model that confronts the problem of general equilibrium of multiple origins and multiple destinations simultaneously.

The gravity model was first introduced by Ravenstein in 1889 to measure the movement of people from country to country; more specifically, the migration phenomenon. It was Tinbergen, who in 1962 applied this model to quantify trade flows between countries, though the fundamentals remained the same. Tinbergen's understanding of the Newtonian gravity for explaining bilateral trade movements is rooted in the profession from which Tinbergen came. His deep knowledge of physics led him to venture into the study of the economics of trade applying the laws of physics. He served econophysics by shifting the rules of physics on trade relations. The use of the gravity model for studying international trade relations was further introduced by Poyhonen in 1963. Since then, there was an extensive deviation in the contents of the model. As more and more economic substance and international trade theories were incorporated, many explanatory variables were added, depending on the similarity or variation of several institutional factors. Among those who lend a voluminous extension to the gravity equation are the studies by Anderson (1979), Bergstrand (1985; 1989), Helpman (1987), Deardorff (1998), and Anderson and Wincoop (2003; 2004). These studies differ in that they include alternative forms of market conditions, as well as production and expenditure systems. Empirical content also exists in this concept of gravity modelling, wherein explanatory variables such as a number of preferential agreements, FTAs or RTAs, and association to mutual conglomerates are included in the structure of the gravity model. It is noted that trade is a function of income, trade policy, cultural affinity, and transport costs, whereas transport cost is a function of distance, geography, infrastructure quality, trade facilitation measures, transport technology, fuel costs, and trade policy (Behr & Venable, 2010).

In functional form,

$$\text{Trade} = f(\text{income, policy, cultural affinity, transport cost}).$$

$$\text{Transport cost} =$$

$$f(\text{distance, geography, infrastructure, trade facilitation, technology, fuel costs}).$$

Therefore, it is a suitable trade model for studying the direction and magnitude of trade between BRICS. It is the task of the literature to address the issue of intra-BRICS trade, as these countries are looking for strong economic cooperation that needs a strong connection between economic conditions of the countries. To build intra-BRICS economic cooperation, it is necessary to establish trade relations, because trade is a continuous process that creates links between countries and leads to economic cooperation between them. Further, it is essential to study the factors affecting trade and the importance of distance between countries. In the gravity model, distance is considered as a proxy for trade costs.

3. Data and methodology

This study was conducted to search for empirical evidence regarding trade flows between the BRICS countries. The gravity model of international trade was used to analyse trade flows in the economic bloc. Subsequently, a panel data structure was formed to mutually capture the two-dimensional effect. It includes cross-sections, as well as a time-effect, so that trade flows between trading partners can be estimated during the period of the study. These cross-sectional units consist of 20 trade partners and cover the period from 2000 to 2017. Both time series and cross-sectional data are combined to form panel data for gravity analysis. Let X , Y , D , P and E represent such variables as export, GDP, geographical distance, population and economic index of globalization, respectively. The subscript i , j & t signifies exporting countries, importing countries, and time period of trade. The following Table 1 provides a detailed description of the variables and its source taken for the gravity analysis.

Table 1. Description of variables

Variables	Codes	Units	Sources	Details
Exports	X_{ijt}	USD	UN COMTRADE database	Bilateral trade between the BRICS countries. 20 trading partners
GDP of exporting countries	Y_{it}	Current USD	World Development Indicators	It is calculated in terms of GDP. It is the sum of the gross values of goods and services produced in the countries at the market price. It is given in current USD
GDP of importing countries	Y_{jt}	Current USD	World Development Indicators	
Distance between capital cities	D_{ijt}	Kilometres	CEPII	Trade cost is a proxy reflecting the geographical distance between the trading partners. It is calculated between the capital cities of two economic centres and the values are given in kilometers, which are extracted from the CEPII GeoDist database. It was developed by Head and Mayer (2002)

Table 1. Continued

Variables	Codes	Units	Sources	Details
Population size of exporting countries	P_{it}	Number of people	World Development Indicators	Linnemann (1966) extended the above equation to bilateral trade and introduced population size of exporting and importing countries
Population size of importing countries	P_{jt}	Number of people	World Development Indicators	
Economic index of exporting countries	E_{it}	Index	ETH Zurich Economic Indicators	The economic dimension includes trade and investment flows, and restriction policies
Economic Index of importing countries	E_{jt}	Index	ETH Zurich Economic indicators	

Source: Authors' compilation.

In Table 1, the GDP of both countries and the distance are considered from the basic gravity model. The population size is considered for the study of market size in relation to exporting and importing countries. The economic indices are proxy measures of trade and investment policies. The trade scenario and pattern of the BRICS countries are given in the Appendix. In addition, data from other variables is given in the Appendix as a graphical representation.

Table 2. Descriptive statistics

Statistics	X_{ijt}	Y_{it}	Y_{jt}	D_{ijt}	P_{it}	P_{jt}	E_{it}	E_{jt}
Mean	21.57	27.75	27.75	9.03	19.50	19.50	3.70	3.70
Median	21.63	27.90	27.90	9.05	19.08	19.08	3.73	3.73
Maximum	24.94	30.14	30.14	9.74	21.04	21.04	4.09	4.09
Minimum	15.58	25.47	25.47	8.24	17.63	17.63	2.88	2.88
Standart Deviation	1.79	1.09	1.09	0.47	1.27	1.27	0.24	0.24
Skewness	-0.44	0.13	0.13	-0.28	0.02	0.02	-0.72	-0.72
Kurtosis	3.23	2.61	2.61	2.00	1.47	1.47	3.38	3.38
Observations	360	360	360	360	360	360	360	360

Source: Authors' calculation.

Table 2 provides a statistical description of the panel data structure that is considered for econometric analysis. The log transformation was done to make the data normal and linear, and suitable for gravity analysis.

Table 3. Correlation matrix

	X_{ijt}	Y_{it}	Y_{jt}	D_{ijt}	P_{it}	P_{jt}	E_{it}	E_{jt}
X_{ijt}	1.00							
Y_{it}	0.66	1.00						
Y_{jt}	0.57	0.12	1.00					
D_{ijt}	-0.13	-0.04	-0.04	1.00				
P_{it}	0.43	0.69	-0.15	-0.19	1.00			
P_{jt}	0.41	-0.15	0.69	-0.19	-0.24	1.00		
E_{it}	-0.05	-0.18	0.09	0.33	-0.65	0.17	1.00	
E_{jt}	-0.18	0.09	-0.18	0.33	0.16	-0.65	-0.17	1.00

Source: Authors' calculation.

Table 3 presents the correlation matrix of the gravity variables. It specifies the magnitude and direction of the relationship between the series. There is an inverse relationship between geographical distance and another variable that corresponds to the gravity theoretical framework. However, some other variables also show an adverse relationship which needs to be checked by panel analysis.

4. Empirical results and their discussion

In the course of the study, the gravity model was modified to take into account the population and globalisation index in the baseline gravity model. Initially, the gravity model was used by Tinbergen (1962) to study international trade relations. In 1979, Anderson provided a theoretical background to the gravity model and validated the use of the gravity model to study trade flows and direction between the countries. In 2001, Solaaga and Winters used the model for intra- and inter-trade analysis of an economic bloc.

Equation 2 is the baseline gravity model, and a log-log specification was considered to make the model linear (equation 3). Besides, the functional form of the modified gravity model is represented in equation 4. As a result, the augmented gravity is given in equation 5.

$$X_{ij} = \frac{Y_i^{\beta_1} * Y_j^{\beta_2}}{D_{ij}^{\beta_3}}, \quad (2)$$

Taking the log of the basic gravity model (2) to make the model linear, we get

$$\ln X_{ij} = \alpha + \beta_1 \ln Y_i + \beta_2 \ln Y_j - \beta_3 \ln D_{ij} + v_{it}; \quad (3)$$

$$X_{ijt} = f(Y_{it}, Y_{jt}, D_{ijt}, P_{it}, P_{jt}, E_{it}, E_{jt}); \quad (4)$$

$$\ln X_{ijt} = \alpha_i + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln D_{ijt} + \beta_4 \ln P_{it} + \beta_5 \ln P_{jt} + \beta_6 \ln E_{it} + \beta_7 \ln E_{jt} + v_{it}. \quad (5)$$

Panel equation (5) comprise cross-sectional units such as trade between the BRICS countries in 2000–2017, where v_{it} is an error term, $IID \sim N(0, \sigma^2)$ is implied, and the results of the panel estimation are shown in Table 4.

Table 4 presents four different estimation methods along with reliable and consistent results. Firstly, pooled OLS was used to establish a linear relationship with the diagnostic test. But it turned out that the pooled OLS method is unable to capture the heterogeneity effect of the panel data. Therefore, preliminary modelling is used to capture the unobserved effect of the panel data when the fixed effect model (FEM) estimates are analogous to the standard regression method. Intercept is considered in terms of cross-section units, but it doesn't work for time-invariant cross-section unit variables. Distance is a time-invariant variable that is a vital component of the gravity estimate for the study. Therefore, a random effect model (REM) was adapted to collect distance information for analyzing bilateral trade. It is assumed that cross-section intercepts are random, not fixed. This helps to consider in this model a time-invariant variable that is omitted in the fixed effect model (FEM).

Additionally, the Hausman test was used to check which model was reliable and consistent among FEM and REM, whereas the Buresch-Pagan LM test was used to distinguish between the pooled OLS and FEM. However, it is denounced on the grounds that REM cannot identify a possible correlation between individual effects and explanatory variables (Mundlak, 1978). To minimize the relationship between V_{it} and other explanatory variables, the Hausman-Taylor model was proposed for REM. It examines the instrumental variables technique and the bidirectional relationship between trade and GDP of both exporting and importing countries. Hence, it has a significant role in the risk-averse policy-making process.

Table 4. Evaluation of the augmented gravity model of the BRICS countries (2000–2017)

Variables	Pooled OLS		Fixed effect model		Random effect model		Hausman-Taylor estimates	
C	−38.91	(0.00)	−102.39	(0.00)	−41.37	(0.00)	−94.76	(0.00)
Y_{it}	0.48	(0.00)	0.44	(0.00)	0.66	(0.00)	0.53	(0.00)
Y_{jt}	0.66	(0.00)	0.66	(0.00)	0.66	(0.00)	0.63	(0.00)
D_{ijt}	−0.22	(0.06)	omitted		−0.16	(0.72)	−1.35	(0.50)
P_{it}	0.59	(0.00)	0.89	(0.22)	0.59	(0.00)	1.26	(0.01)
P_{jt}	0.52	(0.00)	3.79	(0.00)	0.58	(0.00)	2.30	(0.00)
E_{it}	1.75	(0.00)	0.42	(0.02)	0.45	(0.01)	0.46	(0.01)
E_{jt}	0.57	(0.10)	0.17	(0.37)	−0.04	(0.79)	0.06	(0.72)
R^2 : overall	0.77		0.37		0.81			
within			0.82		0.72			
between			0.40		0.75			

Table 4. Continued

Variables	Pooled OLS		Fixed effect model		Random effect model		Hausman-Taylor estimates	
F-statistic/ Wald 2	174.12	(0.00)	260.44	(0.00)	1487.35	(0.00)	1587.50	(0.00)
Hausman test			28.29	(0.00)				
LM statistics	1575.76	(0.00)						

Note: The values in parenthesis are the p-values of the corresponding coefficients of parameters.

Source: Authors' calculation.

Table 4 presents estimates of all possible models where the Hausman and LM tests support the model consistency among the pooled OLS, REM, and FEM for gravity estimation. The Hausman test is significant at the 1% level of significance, implying that FEM is a reliable and consistent estimate, whereas the LM test is also significant at the 1% significance level, implying that REM is an appropriate model for estimating gravity. At this stage, there is a need to opt for the Hausman-Taylor estimate to overcome the difficulties in both the RE and FE models. The estimator also takes into account the endogeneity effect in the model and provides a reliable and consistent result for the gravity estimation. Consequently, the Wald test signifies that there is an overall impact of all variables on the bilateral trade in the BRICS countries. It implies that these variables affect the scale and direction of trade between the BRICS countries.

Moreover, the Hausman-Taylor estimates confirm the basic gravity framework of international trade. This means that trade between BRICS is affected by the economic sizes of both exporting and importing countries, and the geographical distance between them is inversely proportionate to the trade flow between these countries. From the results obtained, it can be concluded that if there is an increase in GDP of exporting and importing countries, this will affect the trade flow by 0.53% and 0.63%, respectively, at the significance level of 1%. However, the geographical distance is negative and insignificant for bilateral trade between BRICS. This indicates that distance is in inverse relationship with the trade flows between the BRICS countries. This also means that they are not able to reduce trade costs, thus affecting trade activities among them. The distance study is irrelevant in the BRICS context as three BRICS countries are neighbouring countries and sufficiently capable of negotiating their trade deals.

On the contrary, the population of both trading countries indicates the market size of these countries. The result reveals that it has a significant impact at the 1% level of significance. This means that the population is highly elastic and its impact on the trade flows between BRICS is relatively big. This denotes that if there is a 1% increase in the size of exporting and importing markets, then exports will increase by 1.26% and 2.30%, respectively. This implicates that trade between countries is relatively dependent on the market size of both countries. It is established that the BRICS countries have a huge

population heterogeneity, and as a result, these differences create opportunities for intra-BRICS trade.

Similarly, the index of globalization has a positive influence on trade between the BRICS countries. This economic index is comprised of policies related to trade taxes and tariffs. It is found that the economic index of exporting countries has a significant impact at the 1% level of significance, whereas the economic index of importing countries has a minor impact on the trade flows of these countries. This means that both countries' economic indexes are directly proportional to the trade flows of the BRICS countries. It follows that a change in the trade policy of exporting countries increases the direction of trade between the BRICS countries by 0.46%. However, the economic index of importing countries has an insignificant impact on the trade flows over the sample period.

Table 5. Residual diagnostic test of the panel model

Test	Statistics (p-value)	Results	Decision
Breusch-Pagan / Cook-Weisberg test for heteroscedasticity	25.94 (0.00)*	Heteroscedastic	To make the series homoscedastic, vce robust will be used in estimation (2)
IM White's test	147.69 (0.00)*	Heteroscedastic	
Multicollinearity test	3.34 (mean VIF)	No multicollinearity	-

Note: * indicates the 1% level of significance. p-values are given in brackets.

Source: Authors' calculation.

Table 5 presents the residual diagnostic test of the panel model. The Breusch-Pagan and IM White's tests were used to check the heteroscedasticity where it fails to reject the null hypothesis, i.e. model has a constant variance. Besides, there is no multicollinearity between the regressors since the average value of the VIF is below 10. This means that the model is fit for further estimation. Therefore, this parameter will provide a correct estimate of the gravity model. This implies that the modified gravity model is valid for the trade flow between the BRICS countries.

5. Summary of the empirical research

The literature survey reveals that trade between BRICS follows a combination of both the Linder hypothesis and the Heckscher-Ohlin trade model. According to the Linder hypothesis, countries with similar per capita income will trade homogenous commodities, while the Heckscher-Ohlin theory states that trade can occur between heterogeneous countries. In this research, the empirical results imply that trade between the BRICS countries plays a significant role in developing economic cooperation since the results of the gravity model show significant value. As far as trade is concerned, the BRICS countries follow the Heckscher-Ohlin trade model, because these countries are heterogeneous

and have different per capita incomes. In the Heckscher-Ohlin trade model, countries exchange not only products, but also factors of production. Therefore, it is evident from the empirical research that the BRICS countries have a heterogeneous set of economic, social, and political systems in which they create trade for economic cooperation. As for the distance, it is insignificant in the BRICS context, because India and Russia are the neighbours of China who is a major exporter in BRICS. Besides, BRICS economic policies play a significant role in promoting trade among themselves as they have to build strong economic cooperation to make an impact of the BRICS cooperation at the global level.

Conclusion

Economic development is the prime concern of every nation, regardless of whether it is developed or developing. Trade is one of the economic indicators that deals with the exchange of goods and services to reduce the disadvantages of countries. To strengthen international relations, countries create economic blocs for better economic cooperation. The study attempts to investigate trade components that directly or indirectly influence trade flows between the BRICS countries. The gravity model was used, and a reparameterization was done in order to modify the gravity model according to the objectives of the study. The empirical research confirms the basic gravity model, according to which economic size is directly proportionate to trade, whereas geographical distances are inversely proportionate to the trade flow between the BRICS countries. This implies that exports between the countries are highly influenced by the economic size. The countries participate in international trade, because they have substantial effective economic structures. They can produce goods and services to meet national and international demand for products. However, trade costs are one of the impediments to the trade flows between BRICS. The result reveals that it is insignificant during the period of study. It tends to provide information that BRICS are able to manage their trade cost incurred due to the geographical distance between the countries, and it is not more cumbersome for trade. This is an opportunity for the intra-BRICS trade flows. The market size of both exporting and importing countries has a direct influence on the scale and direction of trade between BRICS. The population size of exporting countries reflects national consumption, whereas the population size of importing countries reflects the market size of its trading partner. This means that the market size indicates demand for a product which is highly elastic in the context of the intra-BRICS trade flows. Similarly, trade policy also matters in international trade relations. It is reflected in the economic index which considers policies related to trade taxes and tariffs. In the context of the BRICS countries, exporting countries' trade policies have a significant impact on the trade flows between them. This means that not only economic size and distance, but also market size and trade policies play a significant role in establishing strong trade relations between countries.

Policymakers should consider trade as an important component of sustainable economic cooperation between the BRICS countries. The study reveals that BRICS

have the potential to establish international trade among themselves. They have significant economic dimensions and market potentials for trade flows. They are able to manage trade costs, taxes, and tariffs, which contributes to the prosperity of the intra-BRICS trade flows. This means that gravity estimate contributes to establishing a risk-averse policy for the BRICS countries. As confirmed by the empirical evidence, they can manage their trade costs, which is difficult when trade takes place on different continents and countries are diverse in terms of economic, social, and political structure. Therefore, international trade will be a great initiative for the BRICS alliance in terms of economic cooperation and establishing strong relations in the economic bloc.

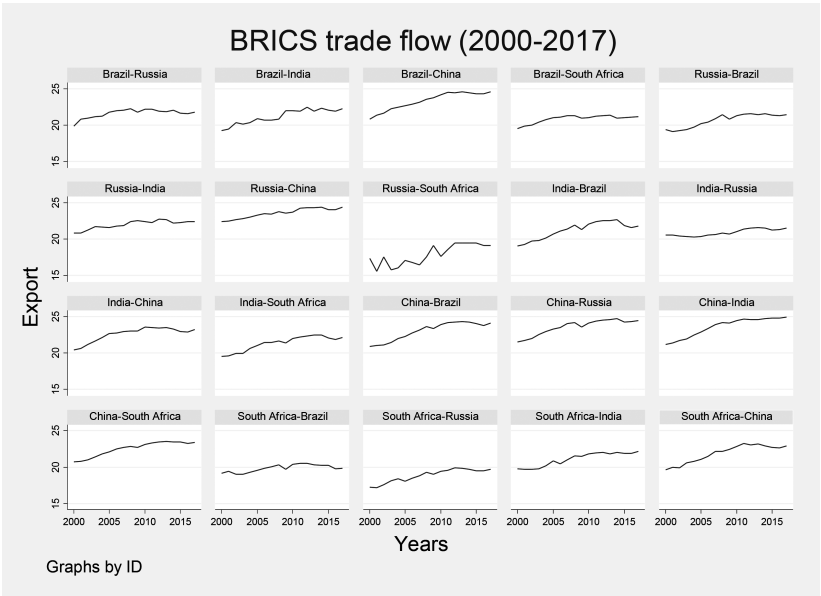
For further research, one should also consider other components of trade along with the gravity model of international trade. Theoretically, trade is an important economic indicator and depends on many economic factors. To obtain a more reliable, consistent and effective result of the empirical analysis of the gravity model, it would be more appropriate to take into account the economic, social, and political factors of the countries. This study can also be expanded to separately analyze bilateral trade flows between the BRICS countries and their trade with the rest of the world.

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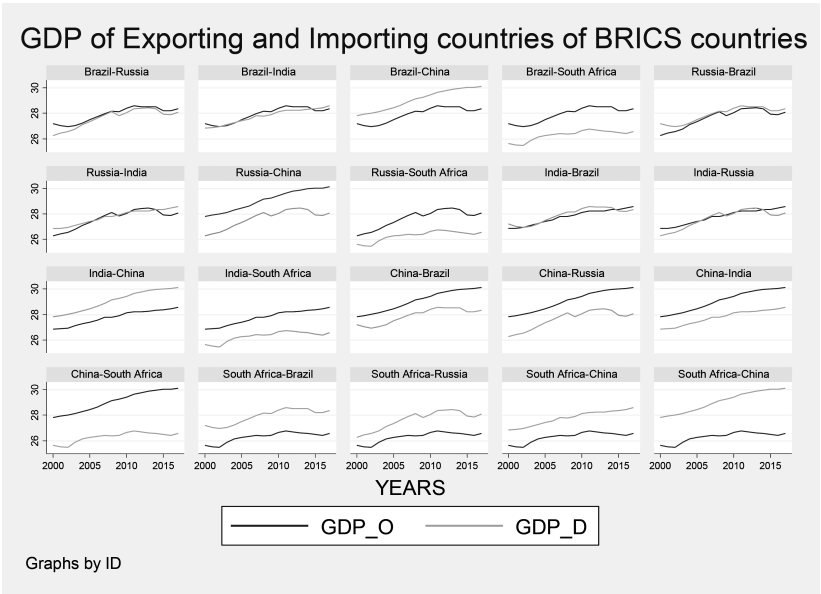
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Appendix



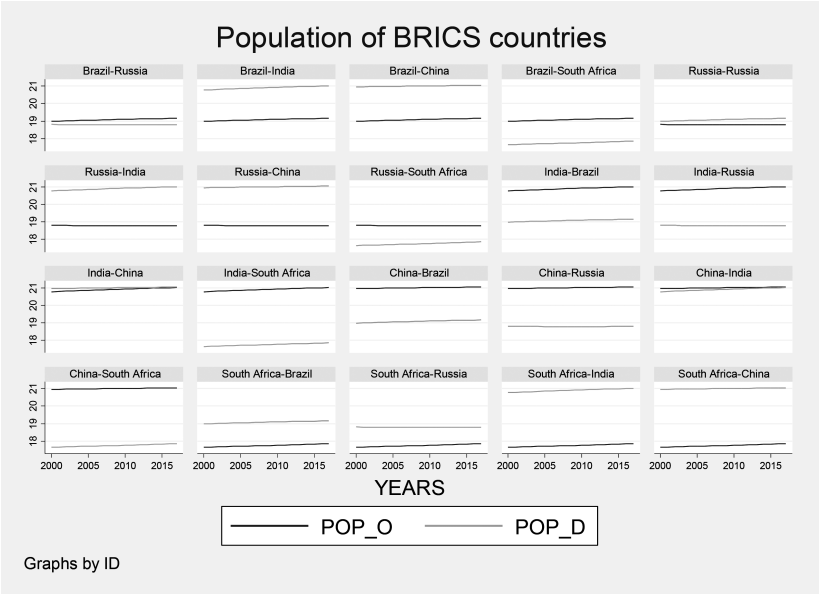
Source: Calculated by the author with UNCTAD database.

Figure 1. Export between BRICS countries



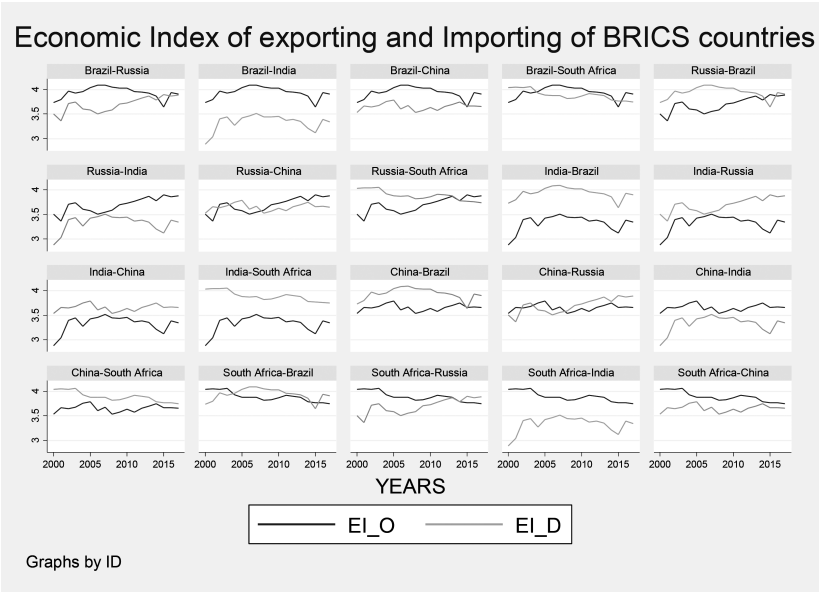
Source: Calculated by the author with UNCTAD database.

Figure 2. GDP of exporting and importing of BRICS countries



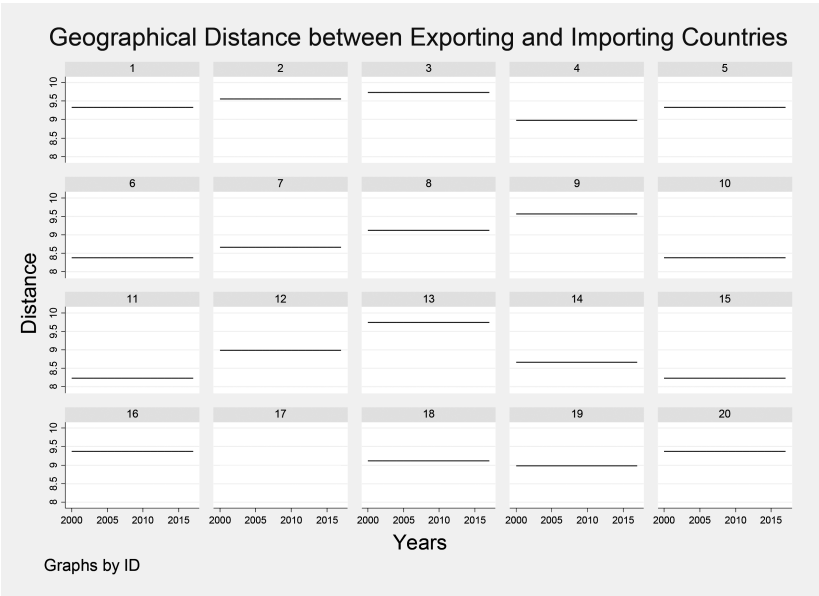
Source: Calculated by the author with UNCTAD database.

Figure 3. Population size of exporting and importing of BRICS countries



Source: Calculated by the author with UNCTAD database.

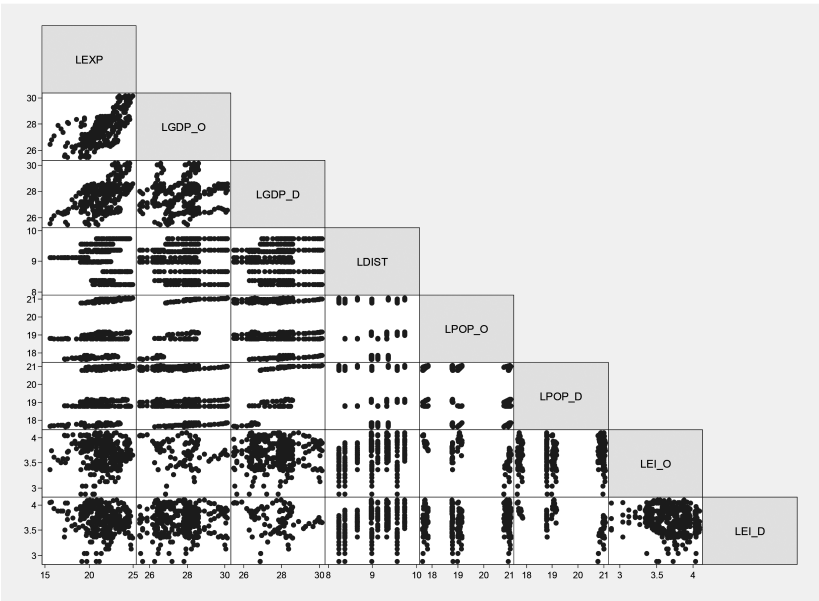
Figure 4. Economic index of exporting and importing of BRICS countries



Note: Constant during the period because time invariant variable.

Source: Calculated by the author with UNCTAD database.

Figure 5. Geographical distance



Source: Calculated by the author with UNCTAD database.

Figure 6. Graph matrix of Gravity variables