Determinants of Bilateral Trade Between BRICs and South Africa: What the Gravity Model Tells Us?

Nahla Aboulezz

Institute of African Researches and Studies, Department of Economic and Political Science, Cairo University.

Abstract:

This study examines the fundamental determinants of bilateral trade flows between South Africa and BRIC countries. This is done by exploring the magnitude of exports among these countries. The Gravity model approach is used as the preferred theoretical framework in explaining and evaluating successfully the bilateral trade flows between South Africa and BRIC countries. The empirical part of this study uses panel data methodology covering the time period 2000-2013 and incorporates the five BRICS economies in the sample. The results of the regressions are subject to panel diagnostic test procedures. The study reveals that, on the one hand, there are positive and significant relationships between South African export flows with the BRICs GDP, the South Africa GDP, the population of south Africa, The distance, the language dummy, and South Africa and the BRIC openness .On the other hand, the BRICs' population the real exchange rate, are found to be negatively related to export flows.

Key words: South Africa, BRICs, BRICS performance, bilateral trade flows, Gravity model, Panel data.

1- Introduction:

The role in the global economy of the five BRICS (Brazil, Russia, India, China and South Africa) has become increasingly important in the last few years. The BRICS make up more than 40 per cent of the world's population and had a combined gross domestic product (GDP) of over $15 trillion in 2011, more than one fifth of the global total. Some $281 billion in foreign direct investment (FDI) flowed to the BRICS in 2011, accounting for nearly 20 per cent of global FDI flows (UNCTAD Stat, 2013). Despite the global financial crisis, the BRICS have maintained fairly stable growth.

BRICS total trade with Africa is more than trade between BRICS countries. In 2012, for example, BRICS total trade with Africa was $340 billion, while trade between BRICS countries for the same period amounted to $310 billion. By the end of 2012, South Africa's trade with BRICS countries represented 19 per cent of the country's total trade. By the end of 2011, South

Africa recorded R4.2 billion ($504m) in trade with Russia, R55billion ($6.6bn) with India, R18 billion ($2.2bn) with Brazil and R188 billion ($22.6 bn) with China. South Africa ran a trade surplus with Russia of R1 billion ($120m) in 2011. South Africa ran a trade deficit with China of R18 billion ($2.2bn) in 2011; in the same year, the trade deficits with Brazil and India were R6.1 billion ($732m) and R4.9 billion ($588m) respectively.

International trade has always been a key factor in the economy of South Africa as well as the BRIC nations. However, although many studies examine South African export flows and potential with its major partners of trade applying the gravity model, only few studies has centered on the investigation and expansion of trade flows between South Africa and the BRIC economies by means of trade indicators or indices. It follows that the gravity model of trade has been used substantially in literature which explores bilateral trade flows between countries. This study fills the lacuna that exists in the existing literature review by employing a gravity model framework to scrutinize the impact of the economic integration of South Africa into the BRIC, with a specific focus on the magnitude of export flows between South Africa and the BRIC countries. In addition, this study conducts an econometric analysis by using panel data from the period of time 2000-2013. This specific sample period is of great importance because it includes years of the BRIC's creation and South Africa's inclusion into this group. The country sample thus contains the five BRICS countries.

The rest of this paper is structured as follow: Section 2 looks at the economic growth and trade flows performance of the BRIC nations compared with South Africa. Section 3 reviews the existing literature in bilateral trade flows' assessment between two or more countries. Section 4 exposes the gravity specifications and the estimation methods retained. Section 5 shows and discusses the results. Section 6 concludes.

2- The Performance of BRICS: A Comparison with South Africa

2-1 BRICS Economic Growth Performance:

BRICS economies represent significant regional and global economic players and have a great emerging prospective, given a combined GDP of more than 15 trillion US dollars (International Monetary Fund, 2013). In addition, they are all considered to be the most rapidly growing or newly industrialized nations of the world, with a greater number of important resources. South Africa is seen as one of the leading countries, as it drives growth and development in the African continent (Arora and Vamvakidid, 2005). South Africa accounts for almost 25 % of Africa's Gross Domestic Product, and 5 % of the continent's population (OECD,

2013). Table (1) presents a summary of national accounts of the BRICS countries:

Table (1) : Summary of national accounts of the BRICS

Gross domestic product (GPD) [current prices/billion US$]

Countries	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Brazil	657	892	1108	1396	1695	1666	2209	2613	2412	2391	2346
Russia	260	764	990	1300	1661	1223	1525	1907	2001	2080	1881
India	477	834	948	1239	1226	1366	1708	1843	1863	1875	2069
China	1205	2269	2269	3525	4561	5060	6040	7496	8461	9495	1036
SA	136	258	258	299	287	279	375	417	397	366	350

Share of primary industry to GDP(%)

Countries	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Brazil	5.5	5.5	5.1	5.2	5.4	5.3	4.9	5.1	5.30	5.6	5.6
Russia	-	5.0	4.6	4.4	4.4	4.6	3.8	4.4	3.9	4.0	4.2
India	25.3	21.6	21.0	21.0	20.4	20.3	21.0	21.6	21.1	20.8	19.5
China	14.7	11.7	10.7	10.4	10.3	9.9	9.6	9.5	9.5	9.4	9.2
SA	10.7	10.0	10.7	11.3	12.4	11.8	11.9	12.1	11.6	11.3	10.9

Share of secondary industry to GDP(%)

Countries	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Brazil	26.5	28.6	27.8	27.1	27.4	25.7	27.4	27.2	25.4	24.4	23.4
Russia	-	5.0	4.6	4.4	4.4	4.6	3.8	4.4	3.9	4.0	4.2
India	23.7	25.3	26.1	26.3	25.7	25.2	24.3	29.9	28.9	27.9	27.5
China	14.7	11.7	10.7	10.4	10.3	9.9	9.6	9.5	9.5	9.4	9.2
SA	24.5	23.0	21.3	21.3	22.1	21.6	20.9	20.3	20.5	20.9	21.0

Share of tertiary industry to GDP(%)

Countries	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Brazil	68.0	65.9	67.1	67.7	67.2	69.1	67.8	67.7	69.4	70.0	71.0
Russia	-	57.0	58.2	59.2	59.7	61.7	61.4	58.2	59.1	60.0	60.0
India	51.0	53.1	52.9	52.7	53.9	54.5	54.6	48.5	50.0	51.3	53.0
China	39.8	41.4	41.9	42.9	42.9	44.4	44.2	44.3	45.5	46.9	48.2
SA	64.8	67.0	68.0	67.4	67.4	66.6	67.2	67.5	67.9	67.8	68.0

Source : Rosstat, Statistics of Russia, **BRICS Joint Statistical Publication 2015**, p.43.

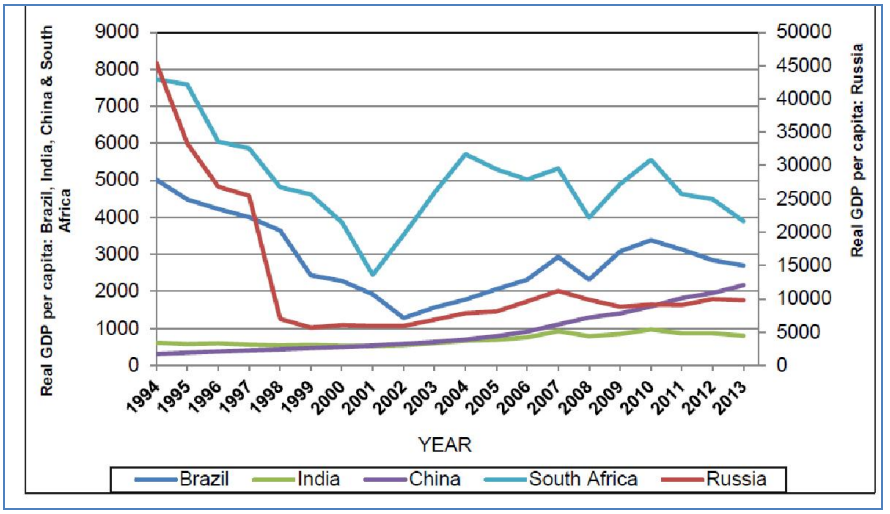
From table (1) we notice that the increase in China's GDP is very impressive, from 1205 billion $ in 2000 to practically 10361 billion $ in 2014. India has also reached global growth of GDP by increasing from $477 billion in 2000 to $2069 billion in 2014. Robust growth has been observed in Brazil over the last twenty years and, currently, the share of GDP accounts for 2366 billion. The trend of the Russian growth has been unpredictable with no consistency; however, Russia's GDP has also risen from $260 billion in 2000 to 1881 $ billion in 2014. South African economic growth shows a positive trend as well GDP has more than doubled. It increases from $136 billion in 2000 to $350 billion in 2014. But the growth in this country still remains the lowest of the BRICS economies.

The above table presents also the BRICS economies' sectoral contribution to GDP. Brazil is considered to be one of the fastest growing economies in the South America region in terms of the performance of its GDP, In 2014, 5.6 % of Brazil GDP was made up by the primary sector, and 23.4 % is attributed to the secondary sector. Tertiary sector has been a vital portion of the Brazilian GDP, owing to its contribution of 71 %. For Russia, commodities seem to determine the size of the economy in terms of fuel and energy. The secondary and tertiary sectors have also been the two of the important sectors of the Russian economy – especially the tertiary sector – which have contributed 35.8 % and 60 % respectively of Russia's GDP in 2014. As far as the growth in India is concerned, the country's economy is driven by services, which represent more than 53 % of its GDP and has been a predominant source of the Indian expansion. In addition, India's economy is more diversified, consisting of farming, agriculture, industries, and excess services. Industries such as software, IT, and pharmaceutical industries are more competitive in India. The contribution of primary and secondary sectors has also promoted rapid growth in India, accounting for 19.5 % and

27.5 % respectively of India's GDP in 2014. At the moment, China represents the second largest economy in the world (the USA is the largest). Among the BRICS countries, China is progressively becoming a leading figure in the world economic market by means of its largest population and its fastest growing economy in the world. The country's economic growth depends enormously on the secondary sector, with more than 42 % of its total GDP coming from it. Both the secondary and tertiary sectors produced around 91 % of the country's GDP, while primary sector accounted for 9 % in 2014. In terms of the economic performance of South Africa, the primary and secondary sectors appear to grow slower than other sectors, contributing about 11 % and 21 % respectively of the country's GDP in 2014. The agriculture sector appears not to be the leading sector in South Africa owing to its slight growth as the country tends to move towards the manufacturing sector. The manufacturing sector has developed, showing its flexibility and potential to take part in the global economy. South Africa's industrial and services sectors have grown immensely and are substantial contributors to the GDP and economic activities of South Africa – their combined proportion has accounted for the most economic growth. In 2014, the tertiary sector contributed about 68 % of the GDP of the country followed, by the secondary sector's contribution of 21 %.

Based on the (IMF) data, Figure 1 shows real per capita GDP in the BRICS , it indicates that the value of the real GDP per capita has been growing more rapidly in Russia than other BRICS countries after 2000 with an ascending real GDP per capita from about 5916.55 US dollars to 9773.53 US dollars in 2013, even though Russian economic performance was resilient during 1994-1999. After 2007, China real economic performance was impressive and better than Russia's, India's, Brazil's, and South Africa's; however, the figure shows again that Russia grew and continues to grow faster than any other BRICS nations, maintaining its position above all other BRICS counties. From 2007 to 2013, China real GDP per capita growth was significantly stronger than India, but lower than Brazil and even South Africa. During this period, Chinese real GDP per capita increased from approximately 1108 US dollars

Figure 1: **Real per capita (GDP), Constant Prices US $, 1994- 2013**



Source: Based on International Monetary Fund data 2013

to 2170 US dollars. Brazil and South Africa showed negative trends of real GDP per capita during 1994-2002, and their level of per capita GDP look weaker. After 2004, a positive trend occurred, and this is reflected in the fact that, during 2005-10, Brazil's real GDP per capita rose from almost 2055 US dollars to 3383 US dollars and South Africa's real GDP per capita rose from 5297.55 US dollars to 5556.38 US dollars.

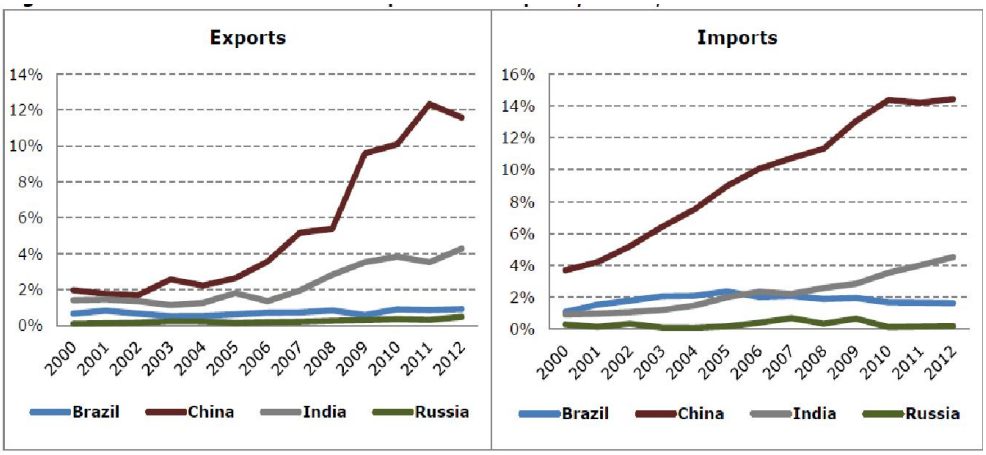
However, in India a low level of real GDP per capita was observed since 1994, and it continues to lag behind. Figure 2 reveals that Russia and Brazil have maintained higher levels of per capita GDP than the other BRICS economies since 2010, especially when these countries experienced positive and significant economic growth. However, China, India and South Africa are rapidly catching up. Thus, in 2013 the value of real GDP per capita is found to be greatest in Russia (9774 US dollars) due to its small population as compared to other BRICS economies, followed by South Africa (3890 US dollars), then Brazil (2700 US dollars), and then China (2170 US dollars). India recorded the lowest real GDP per capita (801 US dollars) in 2013.

2-2 BRICS Trade Flows Performance:

BRICS exports to the international market are significant, and not only contribute to the global development, but also play a major role in the prosperity of their respective regional economic communities (Szirmai et

al., 2012). As for the openness of trade, BRICS economies are more concerned with the growth of exports as they are also becoming dominant in international trade (Polodoo, 2012). It is from this perspective that BRICS intends to become the world economic dominant group through trade liberalization. To this extent, although, the BRICS economies are still regarded as exporters of natural resources, they are making progress in becoming exporters of manufactured goods instead of primary goods (BRICS Report, 2012). The strategy of export-led growth especially exports of manufactured goods – the key device of growth in China – is well recognized. India has been progressively adding the exports of IT services in addition to manufactured goods, while Russian and South African exports predominantly consist of resource-based goods and commodities, which have contributed to their economic development. Brazil has also exported natural resources in addition to some kinds of manufactured goods. Services also tend to play also a significant role in the economies of South Africa, Brazil, and Russia, while India's exports accelerations could be attributed to its high share of the agricultural sector (Szirmai et al., 2012). Figure 2 shows the share of exports to and imports from Brazil, Russia, India and China for South Africa from 2000 to 2012. Within the bloc and the world. Over the past 12 years, the shares of exports to China have increased from 1.4 % in 2000 to 11.6 % in 2012. The shares of imports from China have increased from 3% to 14.4 % over the same period.

Figure 2: South Africa share of BRIC exports and imports

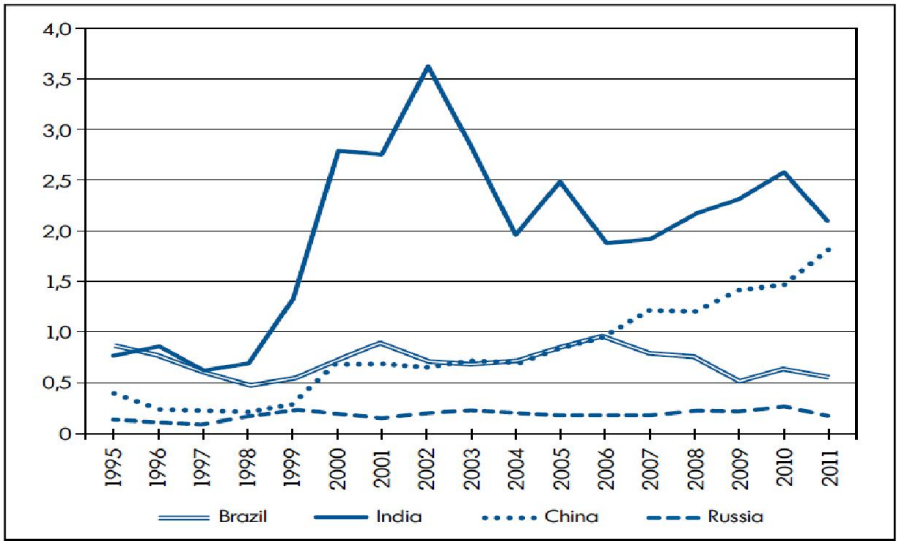


Source: Republic of South Africa, **South Africa Position's in BRICS,** Quarterly Bulletin, January to March 2013, P.24.

The share of exports to India was 4.3 % in 2012 and imports had a share of 4.5 %. The shares of exports and imports to Brazil and Russia have not changed much over the past 12 years. In 2012, 0.48 and 0.92 % of South Africa's exports went to Russia and Brazil respectively. The country had 0.20 and 1.% shares of its imports from these countries. Imports from Brazil include chemicals, vehicles, machinery, iron and steel, paper, ceramics, while those from Russia include fertilizer mixture, mineral fertilizers and wheat.

As expected, after South Africa joined BRICS in 2011, the trade shares increased. In 2010, 19 % of South African exports went to the BRICS nations; by 2012 this share had increased to 20.7 %. The share of imports from BRICS increased 15.2 % to 17.3 % in the same period. China remains the main trading partner and India is showing signs of improving its trade position with South Africa. With this information in mind it makes sense why China has a strong interest in South Africa; it sees significant trade opportunity in the country. The intensity of SA exports to the other BRICS countries in the period under review is reflected in Figure 3. The export index is the highest for India, which shows that India has been South Africa's most important export destination. This perhaps reflects SA's strong historical and cultural ties with India as well as India's strong demand for gold, a major SA product. However, the intensity of SA exports to China has also grown steadily since the late 2000s and is catching up with India, reflecting the strong demand for resources connected to the expansion of the Chinese economy.

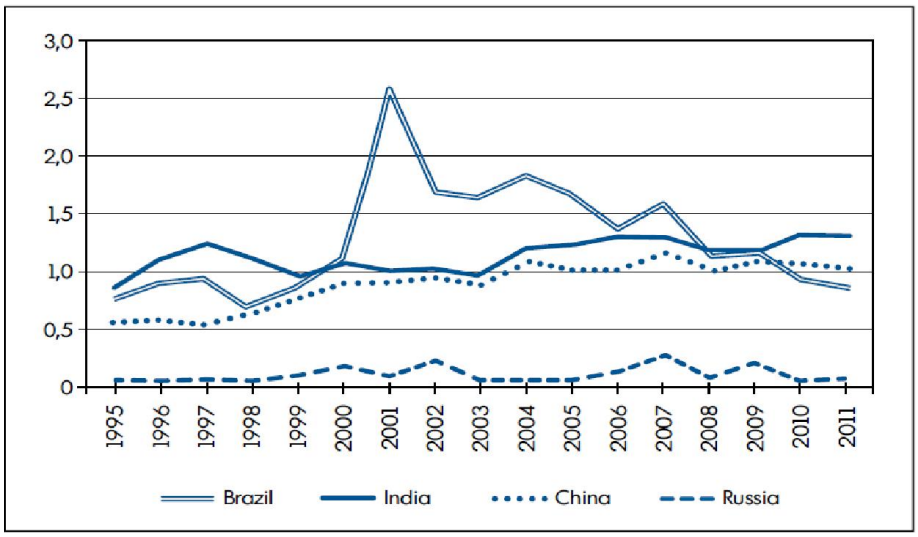
Figure 3: Intensity of SA exports to other BRICS countries, 1995–2011



Source: Chukwuka Onyekwena et al. ,**South Africa in BRICS: A Bilateral trade analysis**, South Africa institute of international affairs, occasional paper NO.181,April 2014 , p.12.

By contrast, the intensity of SA exports to Brazil and Russia remains low, and does not show any upward trend. Indeed, in 1995–2012, Brazil and Russia accounted for less than 0.4% and 0.1% respectively of SA exports**.** Figure 4 shows the intensities of imports from SA by other BRICS countries**:**

Figure 4: Intensity of imports from SA by other BRIC countries



Source: Chukwuka Onyekwena et al.,**South Africa in BRICS: A Bilateral trade analysis**, South Africa institute of international affairs, occasional paper NO.181,April 2014 , p. 14.

This shows that Brazil was the most important importer of SA goods between 2000 and 2007, but was overtaken by India in 2008. India's emergence is probably due to SA's rapidly growing demand for its pharmaceutical products. Indeed, India's share of total SA imports of pharmaceutical products rose from 6.7% in 2007 to 15% in 2011.

3- Literature Review and Theoretical Framework:

3-1 Theoretical Framework of the Trade Gravity Model

When international trade flows are analyzed, economists usually make use of a model, known as the gravity model, which was first introduced by Tinbergen in 1962. Tinbergen (1962) and Pöyhönen (1963) initially identified specifications and assessments on how trade flows are determined, then applied gravity models to international trade. It has been extensively used for assessing trade policy implications and, particularly recently, for analyzing the effects of RTAs on trade. According to this model, trade flows can be explained by factors that capture the potential of a country to produce and export goods and services, the propensity of a country to import goods and services and factors that either attract or inhibit

trade. The basic gravity model of international trade is represented as (Keith, 2003);

$$X_{ij} = \frac{KY_i^{\alpha} Y_j^{\beta}}{D_{ij}^{\theta}} \quad \textbf{(1)}$$

Where $\mathbf{X_{ij}}$ denotes the value of exports between countries *i* and *j*, *Y* is economic size (value of nominal GDP), $\mathbf{D_{ij}}$ is the physical distance between the economic centers of countries *i* and *j*, **K** is the Gravitational constant, while α, β and θ are parameters, and a priori signs of α and β are positive while θ is negative. Equation (1) can be converted into log-linear form as:

$$\mathbf{\ln X_{ij} = \ln K + \alpha \ln Y_i + \beta \ln Y_j - \theta \ln D_{ij} + \delta Z + \varepsilon} \quad \textbf{(2)}$$

From Equation (2), δ Z denotes other factors that may positively or negatively affect export flows, while ε is the stochastic term. Equation (2) implies that exports are positively affected by the economic mass of the trading partners and inversely related to the distance between them. However, additional variables, such as population, indicators of cultural affinity, and sharing of boarders are usually added to empirical gravity models to elaborate on the economic mass and distance variables (Clarete, Edmonds & Wallack, 2002). Hence, the augmented gravity model can be specified as:

$$\mathbf{X_{ij} = \beta_0 Y_i^{\beta 1} Y_j^{\beta 2} N_i^{\beta 3} N_j^{\beta 4} D_{ij}^{\beta 5} A_{ij}^{\beta 6} e^{ym} e^{u}_{ij}} \quad \textbf{(3)}$$

From Equation (3), *X ij* is the value of exports between pairs of countries, Y_i (Y_j) represents the value of nominal GDP of the exporter (importer), N_i (N_j) is the population of the exporter (importer), *D ij* is the physical distance between the economic centers of the two countries, *A ij* represents other factors that could aid or impede exports between countries, e^{ym} is a vector of dummy variables that test for specific effects, and e^{u}_{ij} is the error term.

A higher GDP signifies greater potential supply from the exporting country and increased demand in the importing country, leading to a positive effect on exports. The impact of the size of the population on exports can be positive or negative depending on whether the economies of scale effect are bigger than the absorption effect. Distance increases transport costs thereby impeding the flow of exports across countries.

3-2 Empirical studies on the gravity model and other trade flows :

Empirical studies have shown that the gravity model has become the standard tool in explaining bilateral trade flows, not only for developed countries, but also for many developing countries and African economies, which produce homogeneous goods rather than differentiated goods (Hummels and Levinsohn, 1995). Here the study will show some studies which concentrate on the African countries by investigating the effects of trade or trade flows in a single country or between multiple countries to evaluate further prospective for trade development.

Zannou (2010) examined the key factors affecting the intra-Economic Community of West African States (ECOWAS) trade flows by the gravity model. This model was found to be important in explaining significantly intra-ECOWAS trade flows and ECOWAS' positive and considerable impact on trade flows among States of the economic and trading union. Exchange rates, population, and openness of these economies were the major factors determining the volume of the intra-community trade flows. Adekunle and Wanjiru (2013) assessed the trade flow between China and Sub-Saharan Africa (SSA) countries by detecting the impact of the variables such as Gross Domestic Product (GDP), distance, foreign direct investment (FDI), inflation, exchange rate, and GDP per capita. In addition, the examination of trade flow between China and oil-rich SSA Countries was done, using the gravity model. The result indicated that SSA countries should improve GDP, be able to manage the exchange rates correctly, and, where there is a comparative advantage, local production of goods should increase so that they will gain from the trade relationship.

Studies on South Africa and its major partners of trade have usually used the gravity model to consider the potential of exports. For example, Eita and Jordaan (2011) investigated South Africa's exports of woods and articles of woods with the use of the gravity model. The paper analyzed the flows of trade between South Africa and its 68 major partners of trade for the period 1997 to 2004 within the industry of wood products. The paper also incorporated a dummy variable – the English Language – in order to encourage exports between countries that have this language in common, as well as regional trade agreement (NAFTA, EU and SADC) dummies. They adopted the methodology based upon the panel data econometric techniques in order to assess the gravity model. They found that the fixed effect model was more suitable than the random effect model when determining export flows between countries. The empirical results based on the fixed effect

model revealed, on the one hand, the positive and statistical significance of importer GDP and South Africa's population on the exports of wood and wood products. On the other hand, the relationship between South Africa's GDP, importer population, distance and exports of woods was negative and statistically significant for all variables except for distance. Additionally, the negative outcome of South Africa's GDP was inconsistent with the expected theory of the gravity model. The country's status as a member of NAFTA and EU also adversely influenced exports, yet exports of woods were growing as a result of South Africa's membership with SADC.

Much work has been done on comparative study of the trade flows between the BRICs and other countries, Moghadam (2011), for example, explored the role of BRIC countries in the development of Low-Income Countries (LIC), showing how the rapid growth of these economies' trade has a positive impact on LIC's trade flows based on the analysis of exports, trade complementarily index, and gravity model. He examined the recent progress of trade relations between LIC and BRIC economies, analyzed the exports by destination between these countries, and showed how the pattern of LIC-BRIC trade is usually explained by the revealed comparative advantage method. His paper indicated an intersection between the composition of LIC exports and those of the partner country using a trade complementarily index. The gravity model analysis appears to confirm that LIC-BRIC trade complementarily is very important for overall LIC exports. The outcome of the study revealed that LIC imports from China and India are greater than the impact of Russia and Brazil on LIC trade. Baumann and Ceratti (2012) assessed the trade flows between Brazil and the other BRICS countries by identifying the relative importance of revealed comparative advantage and the tariffs applied by many countries faced with Brazilian products. They also recognized that the tariffs applied by each BRICS country to the products of each Brazilian competitor in the neighbour country, were then applied to Brazil's products in order to provide a general image of the trade relations among BRICS countries. The paper also analyzed trade among these nations, based on the markets conditions of access to the economies, taking into account the economic influence of each BRICS country.

Only few studies have been done on the inclusion of South Africa into the BRICs, For example, Sidiropoulos (2011) acknowledged the fact that South Africa's joining with the BRIC economies implied economic opportunities for the country to play a significant role in both the African continent and at the global level. Being a member of IBSA (India, Brazil

and South Africa) and BRICS, South Africa should make use of the given opportunities. In addition, SA should also lead foreign investment in developing countries in Africa by reducing barriers of trade with the purpose of intensifying bilateral trade and investment with the other BRICS economies.

Other studies have been done on the trade linkages between BRIC and South Africa, showing how South Africa – and the growing trend of investment and trade in the African continent – does serve the BRIC economies. Çakir and Kabundi (2011) investigated the trade linkages and shock transmission between South Africa and the BRIC economies by applying a global autoregressive model and examining the response of trade and output in South Africa when shocks are created by the BRIC countries as a bloc, or individual countries. 32 countries were included in the model for the period 1995 to 2009. They found that the BRIC-SA trade flows are dominated by China, and South Africa's most important exports to the BRICs are usually basic commodities. Based on the empirical results, real exports and imports shocks from the BRIC economies positively and significantly affected the imports and exports of South Africa. However, output remained unchanged.

Despite the fact that the theory of the gravity model has been relevant for trade flows and performs successfully empirically, there are not many detailed studies dealing with BRICS' international trade flows using the gravity model in order to explain the trade patterns between South Africa and other BRICS countries. This paper thus intends to conduct the analysis of trade flows between South Africa and the BRIC economies, using a gravity model framework with a panel data econometric technique to investigate how South Africa is integrated into the BRICs.

4- Methodology and Data Framework

4-1 The Model:

The model specification adopted in this study describes the flows of trade between country *i* and *j*, which are precisely proportionate to their GDPs and indirectly proportional to the distance between them (Equation 1). Conforming to the general form of the gravity model where the volume of exports between two countries is not only elucidated by their economic extents (GDPs), distance, but also by population, and a collection of dummies, generalized gravity model of trade implemented is specified by

Equation 3 .The model in log linear form is used for estimation purposes in this study and is expressed with the following formulation:

$$\ln X_{ij} = \alpha_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln N_i + \beta_4 \ln N_j + \beta_5 \ln D_{ij} + \beta_6 A_{ij} + \varepsilon_{ij} \quad (4)$$

Where A_{ij} refers to dummy variables such as common language (Lang).

In addition to the above generalized form of gravity model, an augmented gravity equation is also appraised in this study so that some factors or variables that may possibly influence trade flows are taken into consideration. The gravity model is then extended by incorporating some important variables such as exchange rate (ER), openness to trade (Open) and also a dummy variable for the BRICS economies sharing a common language (Lang) in order to analyze the flows of trade between South Africa and the BRIC nations. The empirical gravity model applied in this study is expected to be as follows:

$$\ln X_{ij} = \alpha_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln N_i + \beta_4 \ln N_j + \beta_5 \ln D_{ij} + \beta_6 ER_{ij} + \beta_7 open_i + \beta_8 open_j + \beta_9 lang_{ij} + \varepsilon_{ij} \quad (5)$$

4-2 Data Type and Sources:

The study used annual panel data on BRICS member countries and for the period 2000 to 2013. The use of panel data helps to capture the relevant relationships among variables over time, reduces the co- Linearity among the explanatory variables, improves efficiency of econometric estimates, and controls for unobservable individual heterogeneity and dynamics (Baltagi, 2008). The data collection consists of annual export flows, real GDPs, population, real exchange rate, distance, openness to trade, and language.

The dependent variable used in this study is the value of bilateral exports measured in U.S. dollars from South Africa to the BRIC nations. They are obtained from the. 2013. United Nations Conference on Trade and Development (UNCTAD). *(Unctad Statistics*, 2015). The gross domestic products of the BRICS economies are obtained from the UNCTAD *(Unctad Statistics*, 2015). This variable is in constant U.S. dollars. Moreover, population is also contained within the set of explanatory variables in order to estimate the market size, which is directly associated with trade. Data on BRICS' population is obtained also from the UNCTAD. The incorporation of exchange rate as an explanatory variable in this analysis is important because an appreciation of a country's currency decreases its exports by making them more expensive and increases its imports since they are

cheaper. A depreciation of the country's currency will cause the opposite effects. This variable refers to the bilateral real exchange rate between South Africa and each BRIC country, and is expected to have a positive sign. The variable distance between two counties is also included in the gravity equation, The data on distance in kilometers between South Africa and other BRICS countries was obtained from *www.indo.com/distance/index.html (2013)*. The variable openness to trade exhibits the economic integration of a country in the global economy and this is computed as the total trade (the sum of exports and imports) of a nation along with the world economy divided by its GDP. For instance, countries have a tendency to trade more with trading partners that are highly merged with the global economy, revealing an overall propensity of nations for external trade (Head and Ries, 1998). Subsequently, this variable is deemed to have a positive coefficient. Data for BRICS exchange rates and openness to trade are obtained from International Monetary Fund (IMF, 2014) and the UNCTAD*(Unctad Statistics*, 2015). The dummy variables in this study refer to the common language, taking the value of one if the same language is spoken or shared by the BRICS countries, and zero otherwise.

5- Empirical Results and Discussion

5-1Estimation Results

This part presents and analyses the estimated results of the specifications of bilateral trade flows between South Africa and other BRICS countries. This is done by conducting several diagnostic tests such as fixed effects, random effects, Hausman specification, and panel unit root for checking the adaptability and effectiveness of the gravity models estimated in this study. In addition, these tests serve to choose the most effectual methodology between the pooled, fixed, and random effects procedures, and rectify any biases faced by the models so that the estimated results from regressions carried out below are well received. Before moving on to the performance of the diagnostic tests, flows of exports' equations are first estimated using the three procedures (pooled OLS, fixed effects, and random effects).

Table 2 summarizes the empirical results obtained from estimating Equation 5 using OLS Pooled, Fixed Effect, and Random Effect Models**:**

Table 2 : Empirical Results

Random Effects Model	Fixed Effects Model	Pooled Effects Model	Variables
-90.35060 (-9.205225)	-92.37163 (-8.283282)	-107.1405 (-8.541454)	C
1.166192 (0.257755)	1.461333 (0.289029)	-0.068407 (-0.010807)	GDPSA
0.177630 (0.149938)	0.124294 (0.093960)	0.531324 (0.319343)	GDPBRIC
20.16676 (8.292752)	20.72123 (7.475386)	17.87544 (7.237796)	POPSA
0.088728 (0.191107)	-0.045789 (-0.085963)	0.825181 (1.853385)	POP-BRIC
-0.922153 (-1.290371)	-1.105348 (-1.354765)	0.135999 (0.189858)	EXCHANGE RATE
51.69071 (1.711303)	45.74525 (1.332991)	195.3140 (9.880136)	OPENBRICS
0.338073 (0.626079)	0.369605 (0.612620)	0.115595 (0.153808)	OPEN SA
-0.147894 (-1.128317)	----------	-0.017996 (-0.123429)	LANG
0.191088 (-1.254515)	---------	6.028158 (6.080845)	DISTANCE
0.890028	0.965261	0.941036	R-squared
0.867469	0.954646	0.927071	Adjusted R-squared
39.45437	90.93587	67.38441	F-statistic test

- **The T-statistics are in parentheses.**
- **Source:** Author's calculation from Eviews 8.

5-2 Diagnostic Tests

Before selecting the most efficient method and examining the estimated results of the panel regression in accordance with the best appraisement technique in this study, there are some diagnostic tests are required. Adhering to this requirement ensures that the estimated

regressions portraying bilateral trade flows between South Africa and other BRICS countries will no longer be biased and their coefficient estimators accurately elucidated.

5-2-1 Hausman specification test:

To select the most appropriate model, The hausman test was applied to check whether the fixed effects model was more efficient than the random effects model. This would be true if the null hypothesis of no correlation between the individual effects and the regressors was rejected. In addition, it is imperative to compare the test statistics calculated against the chi-square critical value. Table 3 shows the results of this test. The results of the Hausman specification test carried out in Table 3 demonstrates that the test statistics are lower than the critical values at the significant level 5%, suggesting exogeneity of the BRICS regressors. The null hypothesis thus could not be rejected. In other words, there is no correlation between individual effects and any regressors in the gravity equation analyzing BRICS flows of trade. In addition, when the null hypothesis is not rejected, it is important to note that the random

Effects model is favored over the fixed effects model. However, in this study the random effects are absent in the gravity equation analyzing the BRICS' export flows. Therefore, the fixed effects model is preferred over the random effects model, because of the heterogeneity across BRICS cross-sections acknowledged by this model when estimating these countries' specific effects. For that reason, in this case study, the fixed effects model appears to be relevant for BRICS analysis in view of consistent parameter regressions' estimation.

Table 3: Hausman test results

Prob.	Chi-Sq. d.f.	Chi-Sq.Statistic	Test Summary
1.0000	8	0.325224	**Cross-section random**

Source: Author's own calculations from Eviews 8

5-2-2 Panel Unit root test.

To investigate the stationary of panel data in each BRICS cross-section, the unit root test are performed, following the procedure described by Baltagi (2008). In addition, this test is required to investigate whether or not there is a feasibly cointegrated relationship between variables. Moreover, the panel unit root test

could not check the stationarity of distance and common language referring to dummy variables, as they are fixed and time unresponsive. It follows that both tests are compared with the critical values.

We have taken the natural log of all variables in order to avoid the possibility of biased results emanating from a likely existence of unit roots in the variables under study, so the south Africa exports , GDP, population ,and exchange rate become stationary. Then we have taken the first difference for BRIC GDP, population, South Africa openness, and BRIC openness. All the variables became stationary.

Table 4: Panel unit root test

PP-Fisher	ADF – Fisher	Prob.	LLC	Series
-	-	0.0445	-1.70121	**Exports**
3.90662	5.20080	0.0016	-2.94409	**GDPSA**
21.1613	14.6024	0.0067	-2.47055	**GDPBRIC**
58.9127	21.7994	0.0001	-3.75367	**POP BRICS**
93.1185	67.2474	0.0000	-15.6615	**POP-SA**
62.4525	22.0814	0.0000	-5.00010	**OPENSA**
4.97650	27.1206	0.0000	-5.25983	**OPENBRICS**
0.44461	0.69648	0.9863	2.20605	**REALEXCHANGE**

Source: Author's own calculations from Eviews 8

5-3 Discussing the Fixed Effects Estimation Results:

After performing the diagnostic tests presented above, a panel of trade analysis with a fixed effects model for BRICS countries is conducted. This is because of the fact that the random effects model did not acknowledge heterogeneity in the BRICS cross-sections.

Table 2 indicates that all coefficients are statistically significant, aside from South Africa's GDP, South Africa openness, and the population of the BRIC countries. This means that they have an impact on the flows of trade between South Africa and the BRIC nations. In addition, as reported by the regression results, all coefficients appear to have the expected signs, which do not contradict with the theory of the gravity model, except for the real exchange rate. A 1% growth in the BRIC's GDP increases exports flows from South Africa to the BRIC nations by 0 .124%. South African GDP has a positive coefficient on the export flows between the country and the BRIC economies. This is in agreement with the theoretical expectations.

With regards to the population variable, the coefficient in South Africa exhibits a positive and significant sign on trade flows displaying that the country expands its exports when its population rises by reason of economies of scale. For instance, South Africa's bilateral exports with the BRIC countries increase by approximately 21% as South Africa's population grows by 1%. This result is coherent with the gravity model assumption that states that volumes of trade rise together with an increase in market size. In addition, bigger markets tend to produce more goods and services for exports, which, in turn, lead to the increase of demand for importing goods.

The BRIC's population has a negative and significant coefficient, displaying that they are negatively related to the bilateral flows of exports between South Africa and the remaining BRICS countries. This implies that the growth in the BRIC's population will lead to the expansion of their local markets, thus creating a greater magnitude of self-sustenance and, as a consequence, there will be no exigency to trade between them. These results are in conformity with the expected theories.

As can be seen from the estimated results in Table 2, the coefficient value of real exchange rate is found to be statistically significant and carries a negative sign (not the expected sign). The negative coefficient of exchange rate might be attributed to the fact that South Africa's bilateral flows of exports with other BRICS nations rely upon its currency appreciation, which is described by an increase in its real exchange rate. This implies that the appreciation of the South African Rand against the BRIC's currencies discourages bilateral exports from South Africa to the BRIC countries and worsens their trade relations to a maximum level. From this estimated regression's outcome, it is clear that 1% currency appreciation leads to (while holding other explanatory variables constant) a 1.1% decline in South African exports to the BRIC countries.

As shown in Table 2, the South African openness variable has the expected positive sign, but is found to be statistically insignificant. This means that this variable seems not to have an effect on the flows of trade between South Africa and the BRIC countries. The coefficient of the openness variable for the BRIC countries has the expected positive sign. This implies that South Africa trade with all other BRICS nations is presumably going to considerably improve, together with trade barriers' liberalisation in the BRIC countries.Furthermore, the overall performance of the model, for instance the goodness of these models' fit, appear to be

extremely positive, with an R-squared of 0.95. This means that the gravity equation used in this study are proficient in explaining more than 90% of the variances in bilateral exports between South Africa and the rest of the BRICS nations (the dependent variable).

Moreover, it is evident that the fixed effects model does not seem to be able to administrate time-invariant variables such as distance and the dummy variables (language) by reason of perfect multicollinearity and lack of variations inside of these variables. This is owing to time insensitivity. Because of this, a separate regression, with individual fixed effects as the dependent variable and distance and dummy variable (language) as the explanatory variables, needs to be conducted, so that these variables may be estimated in the second step (Zarzoso and Lehmann, 2003). The results of the second-stage estimation are presented in Table 5 below.

Table 5: Second stage results: fixed effects regressed on dummies

Coefficients	Variables
-307.979 (-24.36)	**Constant**
34.792 (24.65)	**Distance**
18.391 (23.92)	**Language Dummy**

- The T-statistics are in parentheses
- **Source**: Author's calculation from Eviews 8.

From the estimated results of Table 5, the variable distance has a significant and positive effect on South African trade flows with the BRIC countries. This is not in line with the theory of the gravity model, because the long geographical distance between South Africa and the BRICs should raise transportation costs and therefore affect flows of trade negatively. This positive coefficient can be attributed to the fact technological innovation and progress has been promoted in South Africa, making the geographical distance less important. For instance, the development of information and communication technology as well as the use of internet amplifies the flows of exports among BRICS economies, since they diminish all transaction and transportation costs involved by South African trade with the BRIC nations. The language dummy variable displays the expected positive sign and is found to be significant. This implies that the BRIC nations, where English is the official language, is influential in increasing South African flows of exports to the rest of the BRICS group.

6- Conclusions and Policy Recommendations:

6-1 conclusions

This study examines the magnitude of trade flows between South Africa and the BRIC countries. A comparative analysis is conducted in Section Two in terms of these countries' performance in economic growth, and trade flows, in order to observe changes they have created in the global economy and how they have contributed in the main sectors of their economies. Among BRICS countries, China is found to be the most prominent in this group in terms of economic growth and trade flows. In addition, China represents an emerging economic market with a high rate of economic growth and a great prospective for imports and exports. South African economic performance is lower than that of other BRICS countries. South Africa imports more from than exports to the BRIC countries.

Section 3 of the study represents a theoretical analysis of the gravity model which reveals its capacity to explore the magnitude of trade flows between two or more countries, regardless of its unsatisfactory theoretical foundation. Empirically, most studies have used the gravity model to determine factors and potential of trade (exports) flows. However, few studies have examined the patterns and magnitude of trade flows between South Africa and the BRIC economies. This study thus addressed this deficit in the existing literature by applying the gravity model for BRICS.

Furthermore, the study uses panel data econometrics technique, in preference to cross-section data technique, due to biased results and lack of heterogeneity's control that the latter may produce in the context of the gravity model. Data used in this study is as follows: annual export flows, real GDPs, populations, real exchange rate, distance, language, and openness to trade. These variables are chosen to specify how bilateral trade flows are determined between South Africa and other BRICS countries in view of the South African economic integration into the BRICs. Based on data availability, this analysis covers a sample period of time 2000-2013.

The empirical part of this study is presented in section Five, which represents and analyses the main findings of the study. Moreover, the fixed effects model approach is employed as suggested by the results of the diagnostic tests, instead of the pooled method, as it prevents the omission of appropriate variables (for instance, the heterogeneity bias). It is also important to note that this estimation technique allows for the acknowledgement of BRICS countries' specific effects, controlling for

unobserved meaningful variables. The empirical findings were consistent with the previous expectations. The main determinants of trade flows between South Africa and the BRIC are GDP , population , openness, language and distance. In addition, the overall performance gravity equation is extremely good in describing on average 95 % of the variation in bilateral exports among BRICS emerging economies. It follows that the GDP of South Africa, the BRIC's GDP , the language dummy, the population of south Africa , the openness of south Africa and BRIC, and the distance are found to be positively related to bilateral exports from South Africa to the BRIC emerging economies. This implies that the rise in the above-mentioned factors is the reasons, which contribute to the increase in trade flows during the time period under study.

6-2 Policy Recommendations:

As a consequence, South Africa should promote policies that permit necessary and increased labour market flexibility as its population should be expected to increase. Policies that lead to the exceptional advancement of the domestic economy through trade liberalization are indispensable in each BRIC country. South Africa should improve policies that make distance less important in its trade flows with the BRIC countries by investing more on advanced and efficient communication devices as well as infrastructure in the country. South Africa should also encourage policies that facilitate the country to gain more access to international markets such as other the BRICS countries, in order to accelerate its economic development progress, regardless of the consumption market or market size's growth. In addition, market access for exports should be extended in South Africa so that its trade with the BRIC economies would be strengthen. South Africa should adopt further policies that liberalize trade by reducing many restrictions in the regulations related to trade, such the exchange control regulation. Policy makers in South Africa need to pay particular attention to the export-oriented trade system so that the country would tend to export more to than import from BRIC nations. In addition, policies that result in the depreciation of the Rand against the BRIC's currencies are required, in order to promote these countries' exports. However, this will be successful if the embedded structural constraints in the South African economy are eradicated.

It is also important to note that because of the BRIC countries' large populations policies that restrain population's growth should be

promoted in these countries, otherwise, if the populates grows, there would no need to trade between South Africa and the BRIC countries.

Moreover, these findings provide information that may be employed by BRICS policy makers to generate pragmatic trade policies for further economic growth and investment prospects. This might contribute to the analysis of how trade flows between South Africa and the BRIC countries have altered after the period of time used in this study and how this has affected primary sectors of their economies as well as the global economy. It would also be interesting to scrutinize how these bilateral trade flows have influenced trade relationships for different parts of their respective regions. The type of research could be of great interest for policy makers from the BRICS countries who may have the intention to expand rate of exports in the future.

References;

1- Adekunle, B. & Gitau, C. W. 2013. "Illusion or Reality: Understanding the Trade Flow between China and Sub-Saharan Africa", *Journal of African Business*, 14(2): 117-126

2- Arora, V. & Vamvakidis, A. 2005. "The Implications of South Africa Economic Growth for the Rest of Africa", *South African Journal of Economics*, 73(2): 229-242.

3-Aziz, N. 2008. "The Role of Exchange Rates in Trade Balance: Empirics from Bangladesh", University of Birmingham, United Kingdom.

4- Baumann, R. & Ceratti, R. 2012. "Trade among BRICS: Still a Bumping Road from a Brazilian Perspective", Instituto de Pesquisa Economica Applicada (IPEA), University of Brasilia.

5- Baltagi, B. H. 2008. *Econometric Analysis of Panel Data*. United Kingdom: John Wiley and Sons, Ltd.

6-BRICS. 2012. Accessed from http://www.bricsindia.in /index .html

7- Çakir, M. Y. & Kabundi, A. 2011. "Trade Shocks from BRIC to South Africa: A Global VAR Analysis", Working paper, 250, Department of Economics and Econometrics, University of Johannesburg.

8- Clarete, Edmonds & Wallack, 2002, Asian Regionalism and Its Effects on Trade in the 1980s and 1990s, Asian Development Bank, NOV.2002.

9- Duncan, F. 2013. "Next up: A Post-BRICS World. Looking for the Next Big Thing as BRICS Growth slows", The burning question, Money web. Available from http://www.moneyweb.co.za.

10-Eita, J. H. & Jordaan, A. C. 2011. "Identifying South Africa's Wood Exports Potential using a Gravity Model", *International Conference on E-business, Management and Economics,* 3: 159-164.

11-Hummels, D. & Levinsohn, J. A. 1995. "Monopolistic Competition and International Trade: Reconsidering the Evidence", *Quarterly Journal of Economics,* 110: 799-836.

12- IMF. 2013. International Monetary Fund. *International financial Statistics*, June. Available from www.quantec.co.za or . http://www.imf.org

13-Keith,H (2003), Gravity for the Beginners ,university of British Columbia, Faculty of Commerce .

14- Moghadam, R. 2011. "New Growth Drivers for Low-Income Countries: The Role of BRICs", Department of Strategy, Policy and Review, International Monetary Fund.

15- OECD. 2013. Organization for Economic Co-operation and Development. *Economic Surveys*: *South Africa*. Available from http://www.oecd.org.

16- Onyekwena , Chukwuka et al. ,**South Africa in BRICS: A Bilateral trade analysis**, South Africa institute of international affairs, occasional paper NO.181,April 2014.

17 - Polodoo, V., Seetanah, B., Sannassee, R. V. & Padachi, K. 2012. "Trade and Economic Growth-A perspective from BRICS nations and Implications for Developing World". University of Mauritius.

18- Pöyhönen, P. 1963. "A tentative model for the Volume of Trade between Countries". *Weltwirtschaftliches Archive*, Band 90: 93-100.

19 -Pöyhönen, P. 1963. "Toward a General Theory of International Trade", *Economiska Samfundets Tidskrift,* 16: 69-77.

20-Republic of South Africa, "South Africa Position's in BRICS"**,** Quarterly Bulletin, January to March 2013.

21-Ricci, L. A. 2006. "South Africa's Real Exchange Rate Performance", International Monetary Fund (IMF) Paper.

22-Rosstat, Statistics of Russia, "BRICS Joint Statistical Publication 2015"

23- Sidiropoulos, E. 2011. "Perspectives from the BRICs: Lessons for South Africa", South African Institute of International Affairs Report.

24- Szirmai, A., Naude, W. and Haraguchi, N. 2012. "Structural Change, Poverty Reduction and Industrial Policy in the BRICS", Vienna: United Nations Industrial Development Organization.

25- Tinbergen, J. 1962 *Shaping the World Economy – Suggestions for an International Economic Policy.* New York: Twentieth Century Fund.

26- UNCTAD. 2013. United Nations Conference on Trade and Development. *Unctad Statistics*. Available from http//www.unctad.org.

27- UNCTAD. 2015. United Nations Conference on Trade and Development. *Unctad Statistics*. Available from http//www.unctad.org.

28 - Zannou, A. 2010. "Determinants of Intra-ECOWAS Trade Flows", *African Journal of Business Management*, 4(5): 678-686.

29- Zarzoso, I M. & Lehman, F. N. 2003. "Augmented Gravity Model: An Empirical Application to Mercosur-European Union Trade Flows", *Journal of Applied Economics*, 6(2): 291-3.

ملخص الدراسة:

تهدف هذه الدراسة الى التعرف على المحددات الأساسية لتدفقات التجارة الثنائية بين جنوب أفريقيا و دول تجمع البريكس ، وذلك من خلال استكشاف حجم الصادرات بين هذه الدول .ولقد تم استخدام نموذج الجاذبية وذلك باعتباره الإطار النظري المفضل في شرح و تقييم تدفقات التجارة الثنائية بين جنوب أفريقيا و دول تجمع البريكس . ولقد طبق الجزء العملي من هذه الدراسة أسلوب بيانات السلاسل الزمنية المقطعية فى الفترة الزمنية ٢٠٠٠-٢٠١٣ ، وتضمن التحليل دول تجمع البريكس الخمسة في العينة . وقد خضعت نتائج الانحدارات إلى مجموعة من الاختبارات للتأكد من مدى جودتها. ولقد توصلت الدراسة الى وجود علاقة موجبة ومعنوية بين تدفقات صادرات جنوب افريقيا من جهة ، والناتج المحلي الإجمالي لدول تجمع البريكس ، و الناتج المحلي الإجمالي لجنوب أفريقيا ، وعدد سكان جنوب أفريقيا ، ومتغير المسافة، و المتغير الصورى المتعلق باللغة ، ودرجة الانفتاح التجارى لكل من جنوب أفريقيا ، ودول التجمع . ومن ناحية أخرى ، فان المتغيرات المتعلقة بسكان دول البريكس ، و سعر الصرف الحقيقي ، وجد أنهما يؤثران سلبا على تدفقات صادرات جنوب افريقيا

الكلمات الدالة :

جنوب افريقيا ، تجمع البريكس ، الاداء الاقتصادى للتجمع ، التدفقات الثنائية للتجارة، نموذج الجاذبية ، بيانات السلاسل الزمنية المقطعية .