

# Export Competitiveness of Tech products: A comparative Analysis of BRICS Countries

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## Abstract:

As a critical factor to speed up the economic growth, value-added technology product are the adequate commodity variant in BRICS's export basket-like, Highly sophisticated defence equipment in Russia, pharmaceutical and software in India, GM crops, chemical, electronic, and electrical in Brazil, China, and South Africa. Looking at the main issues in technological collaboration between BRICS countries, this paper analyses the export competitiveness of Tech products of BRICS nations based on the SITC REV.3 UNCTAD product classification from 2000 to 2014. Revealed Comparative Advantage Index (RCA) is used to measure the comparative advantage in the trade of High-tech products between average world level and from one country to another and Trade Intensity Index (TII) to evaluate the Trade potentiality among BRICS countries for Tech products. The technologically oriented trade is being promoted mainly by China compared to other members, and the Chinese presence is overpowering the block. Hence, this is not sustainable in the long run. The possibility of Inter-government technological cooperation can avoid the situations of countries competing for similar Tech products in the same market with an absence of mutual collaboration.

*Keywords* — BRICS, Technology products, comparative advantage, and export competitiveness

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## I. INTRODUCTION

With South Africa's inclusion in 2010, the former BRIC alliance became BRICS, another step in creating a new platform for “Common Big Fives” to emerge as global economic leaders. Due to the massive advancement in the technological progress of the present century, Technological products’ trade has become a crucially significant symbol of a nation’s growth indicator.

This paper aims at evaluating the trade in tech-products among the BRICS. The origin of BRICS is from an analytical memo of Gold man Sachs in 2003 in which they identified similarities in the economic growth of four Semi- developed countries Brazil, Russia, India, and China. The acronym BRIC is further broadened to BRICS with South Africa's accession during 2010 now, BRICS has

expanded into new horizons since they formed the New Development Bank (NDB) at the recently held Fortaleza summit, Brazil. Goldman Sachs came up with the projection that these countries would overtake the total output (PPP) of the current developed western countries by 2040. Their study reveals a comprehensive total outlook of the BRICS for the coming four decades, concluding that BRICS would be larger than G6 (US, UK, Japan, France, Italy, and Germany) within forty years in terms of economic size. China would overtake the US by 2039 in economic size in Dollar terms.

The main reason for BRICS growth mainly depends on the size of these countries' income and demographic features. Presently the Per-capita Income of BRICS countries is like that of the developed world. A similar decline in the working-age population across the entire BRICS would

significantly affect the working force's productivity and efficiency; hence, this active labour force also shifts the global demand pattern favourably towards BRICS domestic markets. The flow of FDI and Investments upon the high returns of domestic economies of BRICS would bring further stages of development in the region. Although the BRICS economies are not yet over passing the developed countries even after fifteen years of Goldman Sachs report, the Intra- trade flows and other Multi-Bilateral trade flows of BRICS play an essential role in world economic trade transactions, making an unavoidable power in taking world decisions.

Innovations and inventions are the backbones of any development process. The experienced growth in modern technological skills and entrepreneurship habits across the BRICS showcase another promising avenue for knowledge-seeking research. The potential for BRICS growing like global economic leaders of the future will only be possible with a substantial evaluation of technological advancement and other development attributes. In lieu of this, this paper investigates the export competitiveness of tech product's trade transactions of BRICS comprehensively. The technological content in product manufacturing and service sector transactions could perform as a valuable entity in the Balance sheet of any developing nation. The case of BRICS is also reflecting the same story. In a world, witnessing massive changes every day, technological spillovers are everywhere. The transformation in tech-spillovers may be possible through the trade in technology-intensive products or technology as a purchasing good itself is being addressed in the present paper. The primary objectives of this paper are the following:

- To Analyse the trade performance and trade intensity of technology products for each BRICS members.
- To examine the export competitiveness of Low Tech, Medium Tech and High-Tech products of BRICS.

The technological features can be identified as follows: Low Tech products- traditional and low mechanical techniques used to produce less

capitalised production form. Medium Technology products- can be classified as using mechanical kind of technology of semi-complex products other than complex electrical data processing and electronic forms. High Tech products include products with a high intensity of Research & Development and a new and high complex form.

## II. LITERATURE REVIEW

The connection between technological content and BRICS performance can trace back to the standard features of BRICS nations. The cheap availability of human capital and traditional viable technologies used in village- small scale level is the striking factor behind this boom. Moreover, empirically BRICS shows some peculiarities in its technology trade pattern. Presently, Brazil in the agricultural sector uses Genetically Modified (GM) seeds for efficient production and its transactions to other countries, Russia in steel, Mineral extraction and High-end defence equipment, India in Software and pharmaceutical, China in Manufacturing of Hardware and South Africa in inventions in Nanotechnology.

The existing studies mainly revolve around the theoretical framework to define technological contents in trade transactions. Michel Porter et al., (1980) <sup>[11]</sup> raises a crucial question about the technology content, that the possibility of technological inputs can be equated with the wage market or at the knowledge production level. The answer to this question lies in the intensity of R&D activities. And its conversion to a feasible solution to the existing problems. This can be better revealed with an excellent example of the aviation industry, a High-tech industry, unlike other Medium tech industries. Its level of R&D investment is higher than other automobile industries; hence, it is both knowledge producible and highly paid job in the market.

Ying et al., (2014) <sup>[16]</sup> analyses the comparative advantage in the export of High-tech products'

export competitiveness of BRIC in the US market. Mathematical modelling and methodological tools are used here, along with Export Specialisation Index (ESI) and RCA Index with a Varying Coefficient Model. The study reveals that technological diffusion in trade is mainly based on R&D and Patent rights. He finds that high tech trade is positively related to technical qualities in R&D activities. Raghuramapatruni (2015),<sup>[12]</sup> examines the intensity of BRICS trade and its commodity trade in fourteen selected products. He finds that there exist complementarities rather than competition among BRICS. Pant (2011),<sup>[10]</sup> reveals the sustainability of Intra- BRICS trade and its technological issues. The RCA analysis is used in the study in measuring trade competitiveness. Mukhopadhyaya (2012),<sup>[8]</sup> finds that high tech products and international competitiveness are related because export competitiveness reflects a country's international competitiveness in commodity trade.

The competitiveness measurement has attracted many glimpses in economic literature after the famous Diamond model coined by the US man Micheal Porter et al.,<sup>[11]</sup>. He depicted in his study that in a collusive cluster model, any individual unit's competitiveness is closely related to its colleagues' reactions regardless of global or regional context. Porter's work gained much attention, and later many of the competitive measurement indexes originated based on the diamond model concept. Armington (1969)<sup>[14]</sup> presented an in-depth Interlink Model for a standard general analytical framework to ease calculating competitiveness complexities. The OECD branded this holistic approach by introducing the influence of price competitions on Imports and exports, revealing the inter-linkages between them. The central feature of this typical analytical framework was the global consistency of its all-competitive measurement tools. Coviello et al., (1997)<sup>[17]</sup>, in this study, explains the international competitiveness based on the theoretical framework of performance potentiality of the participating firms in international transactions.

### III. METHODOLOGY

This paper calculates the export competitiveness of technologically oriented products by measuring the RCA index. However, to measure the trade intensity between the two countries, we adopt Trade Intensity Index for the entire Tech products. It includes all the Low tech, Medium tech, and High-tech products in a combined form of Total tech products, and the study revolves over the fifteen years from 2000 to 2014. The data used in the analytical part is from several secondary sources of COMTRADE, Trade Indicator, UNCTAD and World Bank. Many of the Journals, Research articles are also referred to gather relevant information. The Lall classification of SITC.3 technology products was first given by UNCTAD to categorise the products based on their technological content. According to UNCTAD, Low technology manufactures include: Textile, garments, footwear, and other related fabrics; Medium tech include: Mechanical parts of automotive, Industrial equipment use for processing and other manufacturing engineering products; High tech products include: Electronic and Electrical products and other pharmaceutical spacecraft products. The technological strata of BRICS handled tradable materials are the same across the group. The analytical part is done with the help of two Indexes. Bela Balassa of Hungary provided the RCA Index or Balassa Index. This is used to calculate the international export competitiveness of trade transactions of different countries. This approach is based on the Ricardian concept of Comparative advantage in international trade transactions. Symbolically,

$$RCA_{ij} = (EX_{ij}/EX_{it})/(EX_{wj}/EX_{wt})$$

where  $EX_{ij}$  = Exports of  $i^{th}$  country in  $j^{th}$  product,  $EX_{it}$  = Total Exports value of the  $i^{th}$  country,  $EX_{wj}$  = Total World Exports of  $j^{th}$  product, and  $EX_{wt}$  = Total World Exports.

RCA shows the comparative advantage of a particular product for a nation. The value will be of

any real number. If the  $RCA = 0$ , indicating competitive disadvantage and the value = 1, illustrate a comparative advantage in the export of an item.

The TII Index is used to measure the intensity of trade between the two nations. This method is widely used to exhibit the total trade performance of a country. Theoretically, this explains that one country's export share goes to the partner country divided by the world share of export goes to that partner nation. Symbolically,

$$TII = (EX_{ij}/EX_{it})/(EX_{wj}/EX_{wt})$$

Where  $EX_{ij} = i^{th}$  country's total exports to  $j^{th}$  country,  $EX_{it} = i^{th}$  country's total value of exports,  $EX_{wj} =$  world's total value of exports to  $j^{th}$  partner and  $EX_{wt} =$  total world exports

The TII value can be interpreted the same as RCA if  $TII = 1$ ; this shows an intense trade relation between two nations. Here, we use TII to find the trade potentiality of tech products only.

#### IV. TRADE PERFORMANCE AND INTENSITY OF TECH PRODUCTS AMONG BRICS

The major connector of trade and technology are the transactions of technology-based products across the world. The product's complex nature brings enough contradiction in defining technological alliance's cunningness in a good or service. Many of the scholars tried to extract the different variants of technology from end-use products or semi-products.

While defining technological content in trade transactions, many diversified clarifications [16] are available in the literature. The European economist Joseph R.A observed and examined a definition for high technological content in product explain, based on the usage pattern. He identified a set of variables closely connected with the industry and the intensity of innovation and R&D activities inside the industry to objectify the nature of

technical cooperation in product manufacturing. He called it an "Industry-based" technology definition. Bullock made another distinction of "Firm based", the complacent technology arises from firms' action rather than industrial influence. Another prevalent clarification in technological issues was coined by Serin and Hansen, assessing those product variations of technology is due to the R&D intensity of the product he called as product-based. Lastly, G Balcon provides another version of technology content in trade transactions: Life cycle-based. He argued that the trending fashion and quick adaptations of short-term technological spillovers by reputable firms are behind technology's diversified nature in products.

The South African data has been examined before its accession into the group to evaluate the influence of a new member's addition into the block. The statistics show that BRICS' share in the total world export of Tech products was 7.26% in 2000 and rose to 28.77% in 2014. This analysis substantiates the fact of improvisation in the export of tech products among BRICS. This is more evident if we examine the share percentage of tech products immediately after South Africa's accession into the system. After SA joined in 2010 in the system with technological cooperation in trade transactions, its total export share rose to 24.5% during 2011.

**TABLE 1**  
**THE COMBINED PERFORMANCE OF TECH PRODUCTS AMONG BRICS (IN % TO TOTAL EXPORT)**

Type of Tech	Year	Brazil	Russia	India	China	SA
Low Tech	2000	0.14	0.09	0.40	0.42	0.15
Low Tech	2014	0.08	0.05	0.25	0.34	0.10
Med Tech	2000	0.25	0.11	0.10	0.19	0.28
Med Tech	2014	0.22	0.08	0.16	0.21	0.31
High Tech	2000	0.14	0.03	0.03	0.24	0.05
High Tech	2014	0.05	0.03	0.06	0.34	0.05

Source: COMTRADE

The percentage share of different category tech products in the total export value shows a consistent performance throughout the period, and it has been depicted in Table 1. The Low-tech products stand as the more disenchantment for the study period among BRICS. Each member lost

control over this variable. Brazil, Russia, and India have shown an almost 50% dip. For Medium tech products, every member country exhibits comparative gain over the export items except Russia, which has lowered the export contribution to 0.8% from 0.11% at a span of fifteen years. In the case of High-tech products, only India and China illustrate advancement during the study period. Both hikes up their shares by 50% and 40% respectively as the share to total export. SA and Russia display a steady and consistent performance while Brazil decreases 60% for High-tech products. The total volume of the trade value of BRICS for High tech items during 2000 was 67269.04, going up to 785984.5 million US \$ in 2014. Medium tech product also exhibits tremendous progress in its export from 73786.18 608252.9 million US \$ in 2014. Low tech goods have shown a massive hike in export from 128820.2 to 862169.3 Million US \$ in 2014. From 2000 to 2014, the total BRICS export of technologically adapted products exposes a 7.36% growth rate of a previously achieved 269875.5 to 2256407 million US \$ (UN COMTRADE).

Trade intensity refers to the total value of trade transactions between two countries that would be smaller or greater than the trade of the world average. In this section, the study has analysed the trade intensity of tech products among each BRICS member and BRICS as a whole block. The categorised analysis of each tech classification does not show here because it partially matters while considering the trade intensity. Trade intensity index commonly used between two countries for the total product. Here we have chosen only tech products for analytical purposes. Earlier literature works have already evaluated total trade intensity among BRICS. Hence it is also excluded from our analysis part. Usually, the developed countries enjoy most of the transactions in technologically packed international trade, the economies like Japan, US, Germany are the most intense trade partners in technologically driven product's trade. The Semi developed groups of BRICS have some exclusive technological product's business transactions like Russia in high-end military defence equipment,

India in Software and pharmaceutical exports and China in Medium tech export in the manufacturing sector. The total trade volume of the entire BRICS in tech product trade is 2198.90066 billion US Dollar during 2014. China was the most contributing nation with 1963.197 billion US Dollar. The leading destination for Chinese export of tech products is the USA, followed by other developed nations. The tech export shows a steady-state growth pattern except for the financial crisis years of 2009 to 2011. The central analysis of this study includes trade intensity for separate BRICS members.

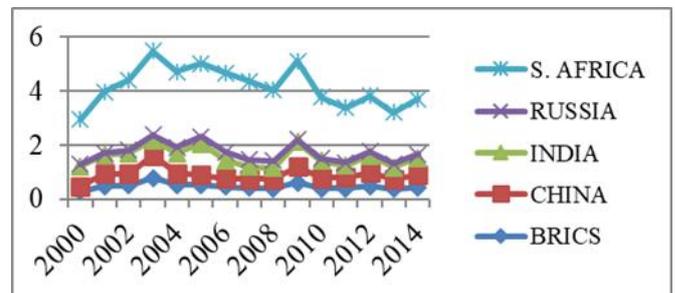


Fig. 1 Brazil: Trade intensity in Tech products between Brazil and BRICS

Brazil has gradually grown up as a giant trading partner with other BRICS members, and its domestic economy achieved self-sufficiency through the experiments with Genetically Modified Crops cultivation. However, those regional experiments went in vain in the international market due to the worldwide agitation against artificiality grown-up Genetic varieties. Fig 1 indicates Brazil's intensity in tech products with other BRICS members. Brazil's tech product intensity with the other BRICS members as an entire block depicts no significant trade transactions. Instead, it explains a decreasing trend from 2000 to 2014. India also experiences the same tragedy with Brazilian trade in tech products except for a single year (during 2005 as 1.15) TII remains untouched 1. China also has a very constant trading partnership with Brazil for tech products. None of the values touched more than unity. From the year 2000 onwards, Russia shows an intense trading relation with Brazil till 2014. However, the country SA displays impressive TII values, with Brazil crossing up to 2 in TII Index.

So here, Brazil exhibits an intense trading strategy with only two nations - SA and Russia.

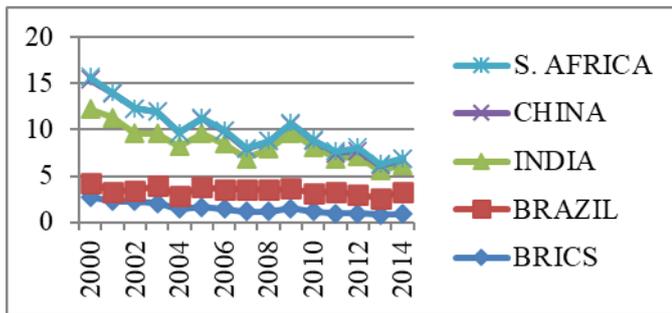


Fig. 2 Russia: Trade intensity in Tech products between Russia and BRICS

Fig 2 indicates Russia's intensity in tech products with other BRICS members. Geographically, Russia is the biggest country on the planet, making it an enormous mineral and gas deposit reservoir. The former Soviet Union has lost its past glimpse after the dismantling of the USSR. Even though today, Russia is considered as one of the centres of the world's Geo-politics. We could identify this Russian dominance on their TII Index analysis with the rest of the BRICS. Previously, Russia enjoyed unquestioned relation with the BRICS as an entire block, now it has lost the grip and started fading out its glory to a below one mark from 2.74 in 2000. Comparing Russia with a single member still enjoys an effective trading movement in tech products' transactions. In Brazil's case, it successfully maintains TII above two points till 2014 and illustrates a constant relation with SA, concluding no intense trade transaction. The Chinese story is also the same as Russia. Initial 3.16 dipped to 0.61 in the later period of 2014. The tremendous loss of Russia is visible when compared with India's TII values. Former Soviet friends had a relation of 8 points in the TII index declined to 2.90 in 2014. Thus, Russia's whole story tells that it has an intense trade transaction in tech products with only two BRICS members- India and Brazil.

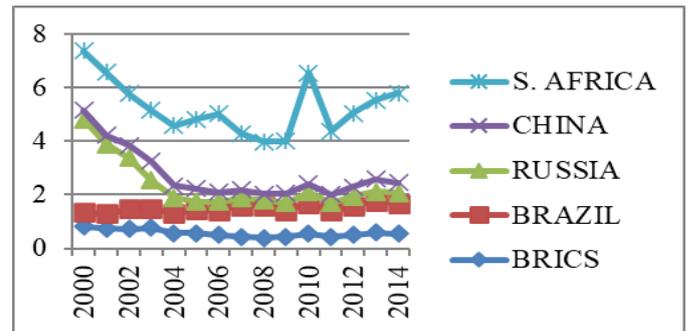


Fig. 3 India: Trade intensity in Tech products between India and BRICS

Fig 3 indicates India's intensity in tech products with other BRICS members. India is a legal trading entity with its precious wealth since time immemorial. This trading legacy was there with the nation while the BRICS established. India's total tech products trade with the entire BRICS block remains firm with the additional incubating technologically driven trade transactions. Brazil, India's traditional trading partner, shows an upward rising TII curve of tech products, crossing the one-point thresholds. The Indo- Chinese trade in tech products also has not flourished yet. The case of Russia is again another tragic event conceding below one in TII during 2014 from 3.48 in 2000. Only S.A performs an intense trading relation with India crossing, 3point in TII index.

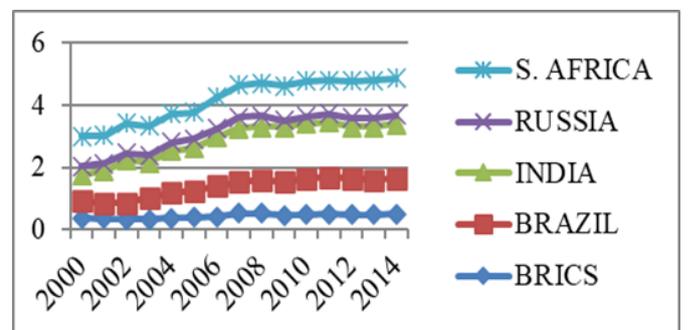


Fig. 4 China: Trade intensity in Tech products between China and BRICS

Fig 4 indicates China's intensity in tech products with other BRICS members. China enjoys the status of the biggest economy among BRICS and stands at the top in tech products' trade transactions. BRICS, as an entire block, shows nominal values in the TII index crossing below 00.05. Russia also exhibits the same level of

dissatisfied trade transactions for the tech products up to 0.027 at the end of 2014. The Brazilian economy has a robust and intense relation with Chinese tech export crossing 1.15 in 2014. India and SA also depict almost the same level of significant positive values above one. Only, the Chinese economy shows significant export intensity with the other three members of BRICS.

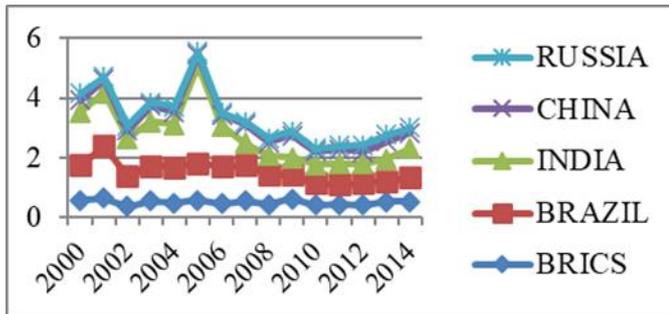


Fig. 5 S.Africa: Trade intensity, Tech products between S.Africa and BRICS

Fig 5 indicates South Africa's intensity in tech products with other BRICS members. South African economy is the smallest among BRICS and exposes significant trading partnership with all other BRICS in the export intensity measurement of each member. South African significant export intensity values are that it is the smallest economy; hence, it depends upon other's exports. This shortcoming has shrunk the South African economy from establishing vigorous export intensity with other group members. It has an in-significant TII value with the other four partners crossing below one point in the Index. India and Brazil illustrate comparatively closer values to one, showing .96 and .80, respectively. Thus, the South African economy exhibits the weakest intensity among all BRICS.

## V. RCA ANALYSIS

The source of any comparative advantage in trade is the state or individuals' different level initiatives to promote trade transactions. These differences arise from the variations in the source of technological input of a system. The Georgia High-Tech indicators <sup>[18]</sup> suggest that the total technological output can be equated with the use of

total technological inputs prevailing in society; they further describe the total inputs identified as the mix of socio-economic infrastructure, national orientation, technological infrastructure, and product capacity level available to that nation. R&D investment is a crucial factor in determining the technological level of a country. It expresses a direct relationship between the growth rate of both technologies aligned products and the nation's total growth rate. Suppose higher the R&D higher will be the growth rate and vice versa. The productive capacity is directly attributed to the trends and pattern of a nation's science and technological innovations. Intellectual property and patent rights have always supplied the availability of technological skills and knowledge to society. Hence the productive capacity illustrates a direct link with patents achieved in that country.

The BRICS formed as a union to help each other in achieving a better financial world without shortcomings. The concept of technical cooperation with other members in the block will become more crucial in technological advancement and tech products trade. More autonomous investment-related technological cooperation can be a proxy to survive the interest of each member among BRICS. All the BRICS partners observe comparative advantage in the High-tech product's export of Computer, office machinery, Pharmacy, and aerospace. The difficulty in defining the exact technological contents in the wide variety of tech products limiting us to take the broad disaggregated level products instead of Low tech, Medium tech, and High-tech products.

The RCA Index here used to measure the trade potentiality between two countries at a higher disaggregated level. RCA analysis aims to evaluate the performance of the trade potential of tech products' three-tier classifications provided in the paper. The total tech product categorised into low tech, medium-tech, and high tech to explain disaggregate level trade potentiality among BRICS. General product's comparative advantage has been deeply examined by many researchers of earlier literature. They found that major BRICS countries

have massive trade potentialities in primary and related products, especially in Minerals and Mining. The study conducted by Raghuramapatruni R reveals that Brazil has a comparative advantage in food, fuels, mining, and steel with others. India can gain potential trade in food, fuels, steel, and pharmaceutical products. The Russian case is slightly different; it has good command over fuels, mining, iron, steel, and automotive transport machinery. China enjoys a comparative advantage in iron, steel, telecommunication, machinery, and transportation. South Africa can show trade potentiality in Agricultural products, pharmaceutical, mining, and telecommunication with other BRICS members.

**TABLE 2**  
**COMPARATIVE ADVANTAGE TECHNOLOGY PRODUCTS**  
**AMONG BRICS**

Year	India	China		S. Africa
	Low tech	High tech	Low tech	Medium tech
2000	2.4065	1.01946	2.56067	0.849841
2002	2.14936	1.33785	2.33594	1.06783
2004	2.2124	1.68688	2.08829	1.0298
2006	1.98312	1.78884	2.14448	1.03781
2008	1.62493	1.98798	2.19192	1.21737
2010	1.60316	1.97623	2.13061	1.11243
2012	1.75926	1.98365	2.29128	1.01192
2014	1.56819	1.82158	2.20858	1.08372

The RCA values observed for BRICS countries shows that the comparative advantage in the export of different category tech products' is the same for Brazil and Russia; both nations did not enjoy comparative advantage either in Low tech, Medium tech, or High-tech goods transactions. The RCA values are below one here. The significantly fewer RCA values for Russia and Brazil indicated an indecent comparative advantage in tech products' trade. This is because both are much advanced in primary economic activities, especially in minerals, fuels, and mining. Wherever they show their strength in world markets, they face higher competition from other developed nations. Brazil has excellent control over the aerospace industry

among BRICS, but its competition is lacking behind the USA or France on a global platform. Hence for these two BRICS members, the trades in tech products need more attention from the policymakers.

India and China are the biggest nations among BRICS in terms of population and size of the economy. Hence these two illustrate comparatively better performance compared to other members. China is the only country that could successfully achieve trade potentiality for two groups (Low tech and High tech) among BRICS. China exhibits trade potentiality in electronic data processing, office machinery and telecommunication and transport equipment in High tech products and other machinery for the iron and steel industry in Low tech products. China displays a consistent performance in both the tech categories throughout the study period. Another important nation among BRICS, India, exhibits comparative advantage in High-tech products and not in other tech categories. Indian High tech Export is exposing significant RCA values from 2000 to 2014 only. The major products of Indian comparative advantage are the telecommunication and computer processing tools. South Africa is another nation in BRICS that shows comparative export advantage in Medium tech products only. The RCA value of more than 1 in Medium tech exhibits South Africa's strong position in automotive products.

## VI. CONCLUSION

Globalisation stands at the centre of spreading technological spillovers across the world, but the distribution of technological richness mismatches with the allocation of the low-cost labour force. These differences in technological products' manufacturing pave the stones for International trade transactions. World witnesses an abundant presence of technological products in the baskets of Developed countries. On the other hand, the manufactures of tech products look at the emerging markets in search of low-cost production techniques. BRICS countries are in the middle of these two

classifications. Simultaneously it operates as a technologically prosperous nation with quick adaption from the western world and its supply of adequate human capital at a meagre cost. Hence it is difficult to assess which BRICS comes under which category? This paper brings an answer to this question. The RCA analysis and Trade Intensity analysis of BRICS tech products suggests that BRICS stands unique among technologically rich nations and emerging markets. China and India have a comparative advantage in top technological classifications. China has an advantage in both High tech and Low tech, India has the upper hand in Low-tech transactions, and South Africa has in Medium tech products. Brazil and Russia have no comparative advantage in the tech trade, but it exhibits an intense trade potentiality with others in tech trade transactions. These value-added trade transactions among BRICS can be concluded as an engine of future growth. The one useful method for every member state's technological benefit is to go for the industrial specialisation where partnership advantage is equally high to each member.

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