

Trade Cooperation Indicators: Development of BRIC Bilateral Trade Flows**

Tereza De Castro*

It has been nearly ten years since Goldman Sachs introduced BRIC emerging markets as economies with great future potential. BRIC still remains a non-formal group but there are tendencies for further cooperation in various fields. This paper studies the evolution of trade intensity among BRICs during the period 1995-2009. Calculations are based on the trade intensity index as well as with a closer look at the trade complementarity index and RCA. An empirical analysis examines the intensity of bilateral trade flows not only between BRIC countries but also between BRIC and the EU since trade relations with the EU still play a substantial role for each of the BRIC countries. This paper reveals Sino-Brazilian and Sino-Indian trade as a trade with the highest intensity progression. Russia remains the most intensive trade partner for the EU.

Key words: BRIC, trade intensity, trade complementarity index, RCA, bilateral trade, EU

JEL Classification: F13, F14, F15, F47

1. Introduction

It has been nearly ten years since analysts of Goldman Sachs introduced the forecast for BRIC (Brazil, Russia, India, and China) emerging markets and pointed out their potential for future economic growth. It is obvious that BRIC countries have been increasing their economic as well as geopolitical power, especially after the world economic recession, since their economies recovered at a much faster rate than developed countries. Nevertheless, each of the countries aims to remain economic/political power, at least regionally, thus making it difficult to create close relations. BRIC still remains a non-formal group but there are arising tendencies for further cooperation in various fields already stimulated by three summits. BRICs' rapid economic growth is based on their specialization enhanced by a large endowment of factors of production with a comparative advantage which, combined could spur their mutual cooperation and development.

This paper assesses inter-BRIC merchandise trade intensity and its tendencies as one of the factors determining a deepening cooperation among countries. An empirical analysis examines the intensity of bilateral trade flows not only between BRIC countries but also between BRIC and the EU since trade relations with the EU still play a substantial role for each of the BRIC countries. The study applies three methodologies - trade intensity, trade complementarity, and revealed comparative advantage assessment. The aim of this paper is to test whether there have been some changes in BRIC to BRIC and BRIC to EU trade observing the pre-BRIC and

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post-BRIC period. The data period selected for the test took place between 1995 and 2009.

The chapters are divided as follows. The literature review is provided after the introduction, followed by an explanation of used methodologies and data collection. The following chapter describes BRIC/EU-partner trade dynamics. The main analysis of the examined indicators is included in The Findings (chapter five), followed by the conclusion.

2. Literature Review

Various indices were developed for analysis of the bilateral trade cooperation, the geographic trade distribution and to what extent countries trade with each other. The simplest formula for monitoring trade flows and patterns was defined as trade intensity (TI) by Brown in 1949 and Kojima in 1962. TI describes the bilateral trade between two countries in relation to the total value of world trade and its share to the world. Yamazawa (1971) applied the TI formula and further analyzed trade between country pairs. His work also assessed trade changes and factors affecting them. Trade intensity could be estimated, not only between countries but also, as intra or extra-trade intensity of some country groups/regions (lapadre 2004).

There are several ways to capture the degree of trade specialization. But the most common is Balassa's index. Balassa (1965) proposed the revealed comparative advantage (RCA) index which is calculated at a commodity level. A variation of his formula was further interpreted by Kunimoto (1977) and more critically reviewed by lapadre (2001).

To measure the compatibility of trade profiles the complementarity index (TCI) is proposed. The first TCI was proposed by Kojima and perfected by Drysdale in 1967. TCI shows whether or not one country exports products another country imports. This index matches only the demand of partners and does not include others parameters (e.g. distance of partners).

Each of the indices gives a different overview and therefore, for a better understanding of the problem, it is useful to combine them. Current papers using the combined approach were published e.g. by Chandran (2010) who discusses trade intensity as well as revealed comparative advantage on Indian-ASEAN trade relations. ASEAN regional trade intensity together with China, Japan and Korea was also studied by Kim (2002). Another complex analysis elaborating Indo-Chinese bilateral trade was conducted by Bhat, Guha & Paul (2006).

3. The Methodology and Data

This paper is based on three methodologies - trade intensity index (TII) which results are further tested by the regional trade introversion index (TIVI), trade complementarity index (TCI) and revealed comparative advantage (RCA). The measures of changing trend patterns within trade among BRIC countries and between BRIC and the EU are applied in this paper. Data series from 1995 to 2009 were selected for measurements in order to enable a time comparison between the pre-BRIC period and the current status.

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The analysis of the international trade intensity flow in this paper stems from the basic trade share formula (S) which tells us the relative importance of a trade partner.

$$S_{ij} = \frac{T_{ij}}{T_{iw}} = \frac{\sum_k x_{ij} + \sum_k m_{ji}}{\sum_k x_{iw} + \sum_k m_{wi}}$$

Where: T – trade; x – export; m – import; k – set of industries; i – source country; j – partner country.

For a comparison of trade shares from different countries it is more suitable to use the intensity index instead of trade shares (S), which at least partly reflects the size of the market. The trade (intra-trade) intensity index (I ; hereof TII), is defined as a ratio of trade shares of the partner, trade between country i and j to the total trade of country i as a numerator to the trade shares of the total trade of partner country j to a whole world trade as denominator.

$$I_{ij} = \frac{\frac{T_{ij}}{T_{iw}}}{\frac{T_{jw}}{T_w}}$$

Where: $T_{ij(w)}$ – trade between country i, j or world; T_w – total world trade.

The trade intensity index holds a value of 0 (no bilateral trade) to infinity. One indicates that partners are trading without geographic bias. The value below (above) indicates that trade is less (more) intensive than expected.

For a better comparison the intensity I is normalized to the symmetric form (SI_{ij}).

$$SI_{ij} = \frac{I_{ij} - 1}{I_{ij} + 1}$$

Where 0 means geographic neutrality, -1 no bilateral trade, and the values between 0 and 1 indicate greater importance of the partner.

The formula (SE_{ij}) for extra-trade which indicates intensity trade between source country i and all others countries excluding the destination country j can be defined in a similar way. In this case:

$$E_{ij} = \frac{1 - \frac{T_{ij}}{T_{iw}}}{1 - \frac{T_{jw}}{T_w}}$$

and

$$SE_{ij} = \frac{E_{ij} - 1}{E_{ij} + 1}$$

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Unfortunately, the formulas of I_{ij} and E_{ij} (SI_{ij} and SE_{ij} respectively) above have some limitations. The values of indices are the function of a region's total trade, so it is difficult to compare countries with different values. The next problem stems from the evolution of I_{ij} and E_{ij} which may not be perfectly complementary – it means, that both indices show the same trend at the same time (increase or decrease). Therefore, the interpretations might be misleading. The limitations hereof were solved by Lapadra (2004) who suggested the “trade introversion index” (TIVI) defined as:

$$TIVI_{ij} = \frac{[HI_{ij} - HE_{ij}]}{[HI_{ij} + HE_{ij}]} \quad \text{where} \quad HI_{ij} = \frac{\frac{T_{ij}}{T_{iw}}}{\frac{T_{oj}}{T_{ow}}} \quad \text{and} \quad HE_{ij} = \frac{\frac{[1 - \frac{T_{ij}}{T_{iw}}] T_{ow}}{T_{oj}}}{[1 - \frac{T_{oj}}{T_{ow}}]}$$

Where: T_{oj} – trade between the rest of the world (excluding country i) and country j ; T_{ow} – total trade of the rest of the world.

Again, if the index equals 0 countries are geographically neutral, if it is above 0 the intra trade is dominant. On the contrary, if the value is negative then the extra trade is dominant. An increase of the index means that the intra trade grows faster than extra trade. The opposite occurs when the index falls (the extra trade grows faster than intra trade).

The data sources used for the trade intensity index and trade introversion index calculations were derived from the official UNCTAD online database. The problem of discrepancy between export prices listed in FOB and import prices based on CIF was excluded by the average mean between FOB and CIF prices. Possible arising inconsistency in trade reports caused by the accounting of exports and imports assigned to different months and the divergent beginning period of the fiscal year in India are both nearly eliminated due to a long life cycle. Hong Kong and Macau SARs have been excluded from all data in this paper regarding China.

The trade complementarity index (TCI) is the second indicator used in this paper. It is one of the overlapping indices that enables a comparison of export and import profiles between two countries i.e., how the export set of industries from the source country matches with the import set of industries from a destination country.

$$TCI = \left(1 - \sum_i \left[\left| \frac{\sum_w m_{iwd}}{\sum_w M_{wd}} - \frac{\sum_w x_{isw}}{\sum_{jr} X_{sw}} \right| \div 2 \right] \right) \times 100$$

Where: d - importing country of interest; s - exporting country of interest; w - set of all countries in the world; i - set of industries; x - commodity export flow; X - total export flow; m - commodity import flow; M - the total import flow.

The degree of TCI ranges between 0 and 100 percent. Higher complementarity value indicates a better export/import match, while 0 value indicates no complementarity at all.

The last index used in this paper for identification of the comparative advantage of a particular country is the basic Ballasa's revealed comparative advantage index (RCA). It is defined as the share of one commodity of a total country's exports to the share of the same commodity exported by the world to the total world's export.

$$RCA = \frac{\frac{x_{ij}}{x_i}}{\frac{x_{wj}}{x_w}}$$

Where: x_{ij} – export of commodity j by country i ; x_i – total export of country i ; x_{wj} – export of commodity j by the world; x_w – total export of the world.

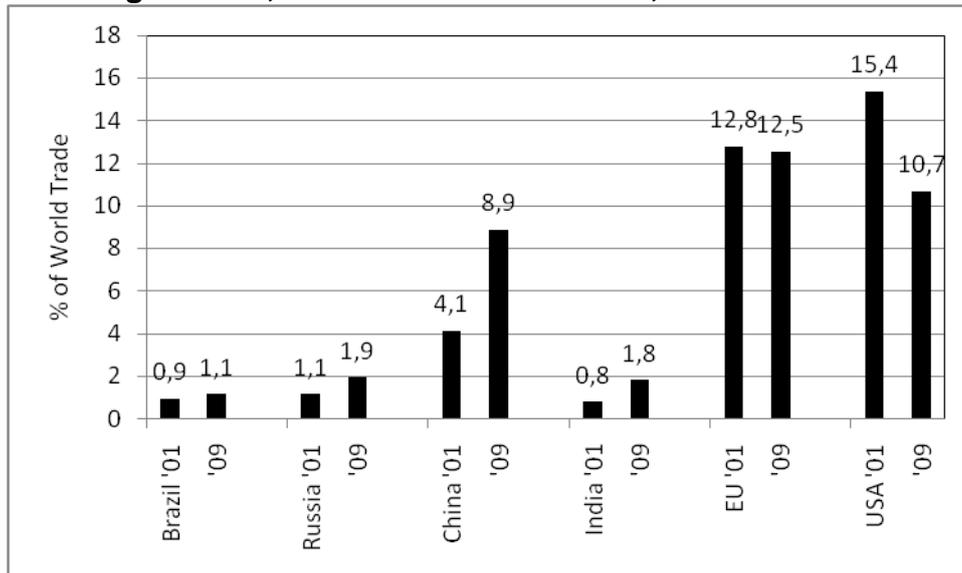
The RCA index reaches values from 0 to infinity. When RCA results are between 0 and 1 it indicates a comparative disadvantage, values above 1 mean comparative advantage for a particular country in a particular commodity, and 1 stands for neutrality.

TCI and RCA data calculations were collected and accessed from the International Trade Centre online database. A cross-pair comparison between all BRIC members and the EU was conducted for two years. 2001 and 2009 were particular years examined enabling a comparison of the complementarily degree since the new-coined BRIC group was brought in. The trade data for TCI and RCA calculations was computed from a 2-digit HS level of exports and imports.

4. BRIC/EU Trade Overview

BRIC economies are considered highly integrated in global trade. Their trade with the world has increased more than five times since 1999 and their share of world trade in the past decade has nearly doubled (Freemantle & Stevens 2010), currently being around 14% (Figure 1).

Fig. 1 BRIC, EU World’s Trade Share, 2001 and 2009



Source: International Trade Centre database

Moreover, BRIC to BRIC annual growth rate of trade is about 32%. Brazil’s trade is the most geographically spread across all continents out of all the BRIC countries. It has also remained the most closed economy of the group with very little trade liberalization since large tariff reductions at the turnover of the 1980s and 1990s

(Freemantle & Stevens 2010). The EU, USA and China are among its major trade partners (EC 2010a). Most Brazilian exports consist of metals, fuels and agricultural products, thus it has closer trade relations with China and India rather than with Russia. Russian trade is characterized as the least diversified out of BRIC with a strong orientation to the EU market. Over 45% of its trade is conducted with the EU and shares tend to increase over the years. Their economic relations are guided by the Partnership and Co-operation agreement which allows Russia the implementation of flexible unilateral tariff measures (EC 2010e). Other trade partners are China (nearly 9%) and Ukraine (over 4%) (EC 2010b). Russia is also the only BRIC country that is not a member of the World Trade Organization (WTO). Its accession in the future could advance Russian trade liberalization but only at a small extent due to its exports of products (natural resources) which already face little trade barriers from importing countries (Sally 2009). The most important trade partner for India is the EU, followed by China (EC 2010c). India has rapidly reduced its average tariffs from above 80% in the early 1990s to below 15% recently (OECD 2009). And the in regards to China, the most important trade partner is once again the EU, followed by the USA (EC 2010d). Large tariff cuts were also implemented by China prior to accession to the WTO and also after (OECD 2009). Mutual trade between India and China has been further intensified by China's accession to the Asia-Pacific Trade Agreement in 2001. China persists to be the largest 'single' country exporter in the world however; it is strongly reliable in imports from other countries such as BRIC. Recent trends in trade thus reveal tendencies towards south-south free trade co-operation between Brazil-South Africa-India.

5. The Findings

In order to provide a complex overview, all presented figures highlight intra-trade intensity as well as extra-trade intensity indices from 1995 to 2009. The paper confirms that behavior of the intra-trade intensity and extra-trade intensity indices are, according to assumption, complementary. In terms of growth it means that one index is increasing while the complementary is declining and vice versa. According to definition the extra-trade intensity index measures trade intensity between country i and all other countries except country j . Due to the size of total trade, it is clear that the complementary extra-trade intensity index is affected much less than the intra-trade intensity index. The left axis of the following figures contains a scale of figures from the intra-trade intensity index, and the right axis contains the extra-trade intensity index.

Figure 2 illustrates the trade intensity indices between Brazil and Russia. It is evident that TII trends were overall increasing until 1999 followed by a down swing in 2000 in which the cause can be a result of the economic crisis in both countries right before the new millennium. As the BRIC group was introduced in 2001, TII reached neutrality at the same time and succeeded with short-term index growth, reaching neutrality again at the turn of 2003 to 2004. Since then TII had registered a general downward trend and remained bellow neutrality, which means an under-representation of mutual trade intensity between Brazil and Russia. This could be a consequence of the export similarity structure of both partners.

TII between Brazil and India is represented in Figure 3. Variations of TII value have changed from the lowest level of -0.4 in 1998 to the highest level 0.1 in 2002 with further fluctuations bellow and above the neutrality threshold. From 2007 to 2008 the

TII trend had shown a growing propensity and in 2009 it exceeded zero value towards over-representation.

Figure 4 portrays the Sino-Brazilian TII development. In comparison to the aforementioned trade relations the TII trend between 1999 and 2009 practically remained at an increasing manner. And in 2006 it raised above the neutrality level. Out of all of the studied BRIC bilateral relations it recorded the biggest change not only in value but also towards over-representation. The discovery of new natural resources in Brazil, mainly of crude oil, and its imports to China and the exports of products from China to Brazil, might have strongly contributed to the recent TII development.

Both TII's between Russia and India (Figure 5) and Russia and China (Figure 6) indicate some similarities. Observations reveal a long-term decreasing trade intensity. By 2004 the TII trend was characterized by upward and downward movements but only above the neutrality threshold. The Russian crisis of 1998 negatively influenced the development of trade intensity between Russia and the EU thus relative trade intensity of Sino-Russian trade relations increased. The year 2004 was a turning point in both bilateral trade linkages, and as latter years followed, TII was decreasing. Even though Sino-Russian TII registered one upswing in 2007, later tendencies were of declining character. On the contrary, in 2008 Russia-India TII indicated an increasing nature. However, in 2009 it still remained below the Sino-Russian TII level. One of the factors causing the decline of mutual intra-trade for both pairs could be a rising orientation of Russia towards the European market rather than to its Asian partners.

The early Sino-Indian bilateral trade relations (Figure 7) show nearly identical development as in the Sino-Brazilian case (Figure 4). However, their TII had already reached zero value in the turn of 2003 to 2004. TII had maintained its value between neutrality and 0.08. In contrast to Sino-Brazilian TII, the index between India and China had slightly decreased as of 2008 and was once again reaching neutrality. The improving intra-trade between China and India might have resulted for several reasons. Firstly, since the reforms in India in the early 1990s India has been opening up to the world. Secondly, in 2001 China entered the World Trade Organization and that same year China joined the Asia-Pacific Trade Agreement. And last but not least, the latest decline could have been impacted by the world recession.

The bilateral EU-BRIC intra/extra-trade intensity indices are represented in Figures 8 through 11. The figures illustrate that all bilateral TIIs range above the zero threshold. A closer look at EU-BRIC relations reveals that while the intensity of intra-trade between EU-Brazil and EU-India is falling (as a result of trade diversion to other partners especially towards China), the intra-trade intensity with China and Russia shows a rising pattern. In particular, the relationship between EU and Russia corresponds to a higher than standard behavior. EU-Russia TII reached its peak at the level of 0.62 in 2006, and then it slightly declined to 0.6. This could be explained by the European demand for Russian natural resources and the increasing Russian demand for European goods. In general, EU-China intra-trade intensity had continued growing with periodic ups and downs (2002 and 2005) but without any significant declines. This confirms the increasing role of China in European trade and vice versa. On the contrary, EU-India trade relations reveal the most dramatic decline

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in intra-trade intensity from 0.32 to 0.15. Interestingly, even after the striking drop, TII ended in 2009 at about the same value as TII between EU and China.

Moreover, from the information above it is evident that due to the extent of China's market its extra trade is less dependent on changes in bilateral intra-trade as it is illustrated in Figures 4, 6 and 7. The EU market records similar effects. There are hardly any changes in extra-trade for EU-Brazil and EU-India trade partners. However, the significance of China's market for EU trade relations can be well observed in the Figure 11.

Fig.2 Brazil-Russia Trade Intensity Index

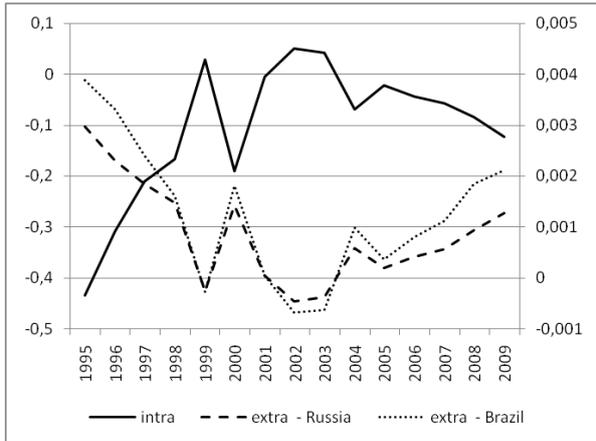


Fig.3 Brazil-India Trade Intensity Index

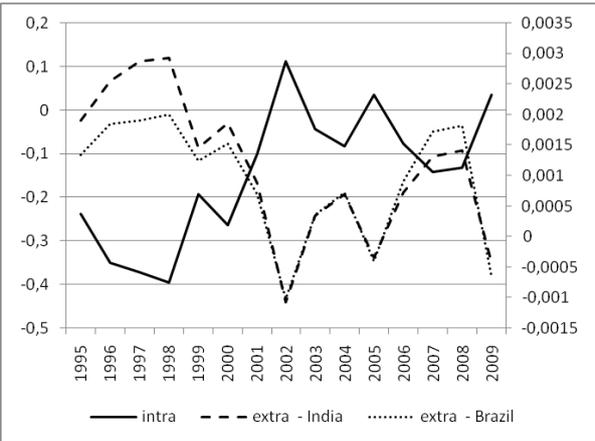


Fig.4 Brazil-China Trade Intensity Index

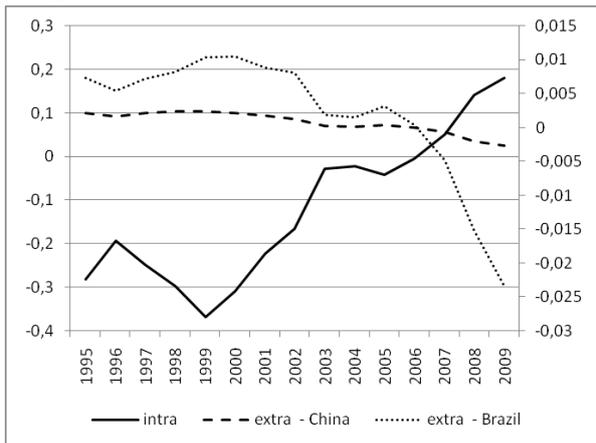
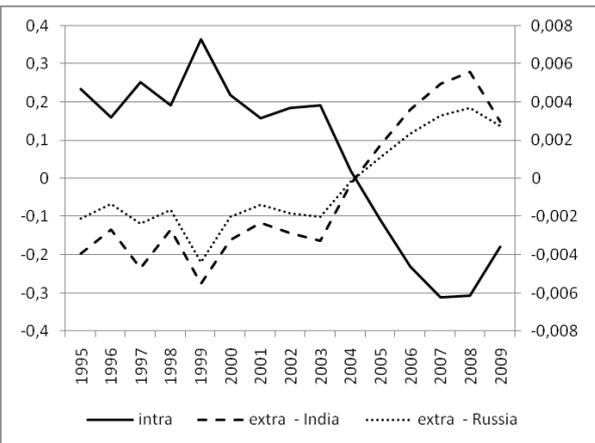


Fig.5 Russia-India Trade Intensity Index



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Fig.6 Russia-China Trade Intensity Index

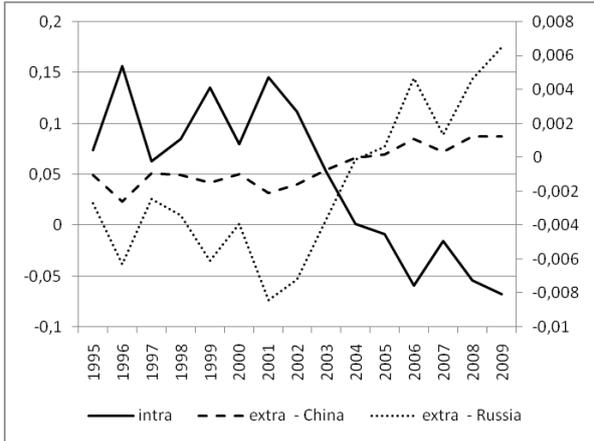


Fig.7 India-China Trade Intensity Index

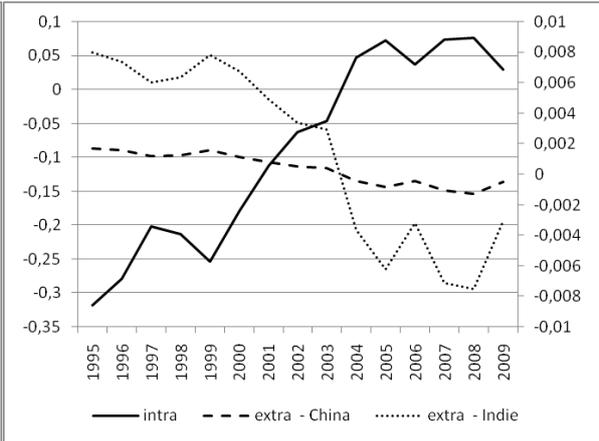


Fig.8 Brazil-EU Trade Intensity Index

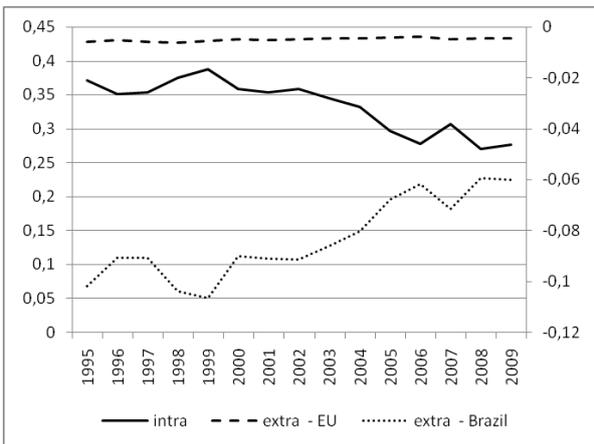


Fig.9 Russia-EU Trade Intensity Index

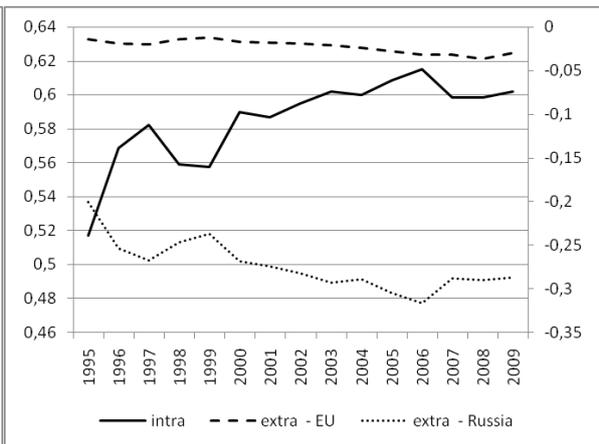


Fig.10 India-EU Trade Intensity Index

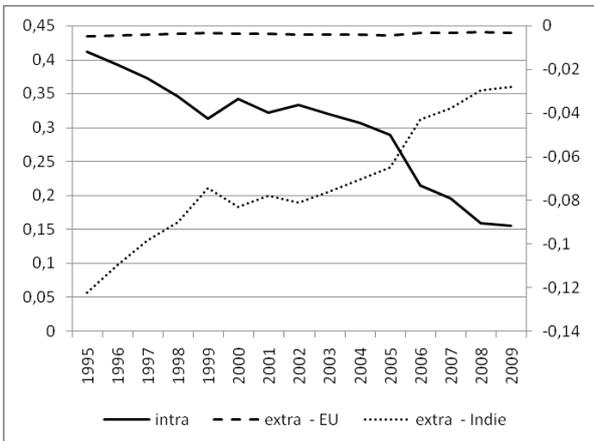
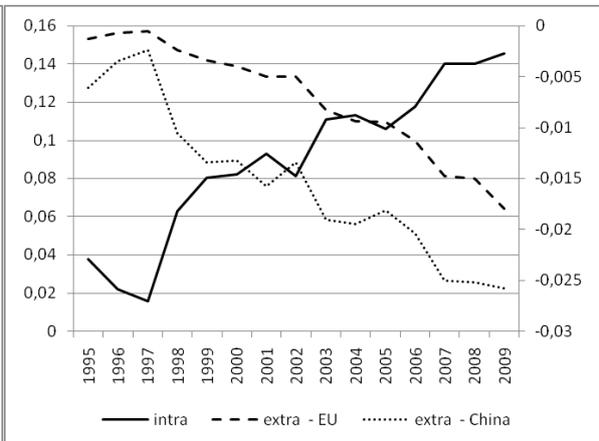


Fig.11 China-EU Trade Intensity Index



Source: Calculated by author based on data from the UNCTAD database

Due to limiting factors of the trade intensity index results were also tested on the trade introversion index. The results in Figures 12 and 13 correspond to the trends of the trade intensity findings. BRIC countries had proven to be the most balanced in terms of trade intensity for the period 2003 to 2005.

Fig.12 BRIC-BRIC Trade Introv. Index

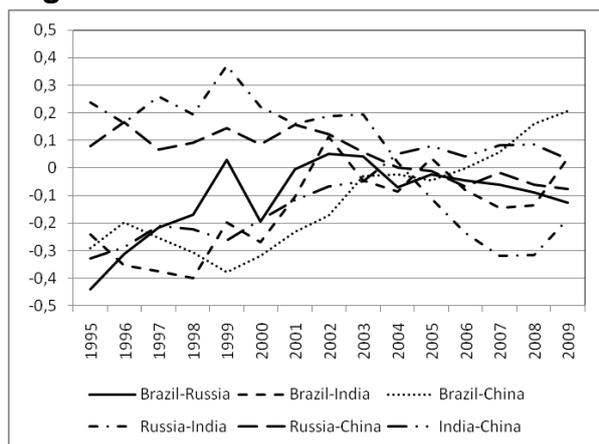
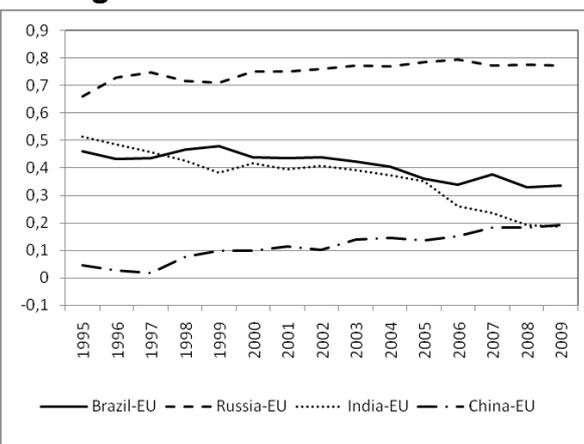


Fig.13 EU-BRIC Trade Introv. Index



Source: Calculated by author based on data from the UNCTAD database

The second part of the analysis focuses on the trade complementarity index and the revealed comparative advantage examination. Cross-pair calculations of TCI and RCA for 2001 and 2009 are inserted in Table 1 and Table 2 respectively.

Table 1 Trade Complementarity Indices for BRIC, EU Cross-Pairs, 2001 - 2009

Exporting \ Importing	Brazil 01 - 09	Russia 01 - 09	India 01 - 09	China 01 - 09	EU 01 - 09
Brazil	-	36 - 34	41 - 55	58 - 57	71 - 75
Russia	59 - 45	-	45 - 47	53 - 59	72 - 80
India	40 - 44	54 - 52	-	40 - 40	45 - 52
China	50 - 53	34 - 31	42 - 50	-	66 - 60
EU	57 - 56	34 - 34	51 - 61	62 - 57	-

Source: Calculated by author based on data from the International Trade Centre database

Table 2 Number of RCA Cross-Pairs, 2001 - 2009

Exporting \ Importing	Brazil 01 - 09	Russia 01 - 09	India 01 - 09	China 01 - 09	EU 01 - 09
Brazil	-	35 - 30	61 - 27	31 - 34	34 - 30
Russia	29 - 25	-	38 - 31	40 - 42	38 - 38
India	15 - 20	11 - 8	-	21 - 24	28 - 32
China	21 - 23	9 - 13	17 - 18	-	29 - 23
EU	27 - 20	10 - 10	27 - 27	32 - 24	-

Source: Calculated by author based on data from the International Trade Centre database

According to the trade theory mutual trade of two countries can expand when the trade complementarity is increasing. Moreover, a higher chance for trade in a particular commodity between two countries occurs when the exporting country's RCA index is above unity and the importing country below unity for this product. The numbers of commodities that confirm this condition are depicted in Table 2.

Although the TII between partners is influenced by many factors, some trends of TII are possibly put into context with TCI or RCA development. From the results of TII, TCI, RCA and the share of each country in world trade it can be assumed that there is more intensive trade together with a smaller number of commodities between China and the EU. Their trade is driven especially by China's exports to the EU. The growth of RCAs and the increase of TCI correspond to higher TII between China-India and China-Brazil. Even though the number of mutual RCAs and TCIs of China's exports to Russia is increasing, their TII is declining. Mutual trade between China and Russia may therefore be substituted by other trade partners. However, the growth of RCA and TCI can indicate potential for future trade, in particular for exports from China to Russia.

Trade between EU-Russia, from an export composition perspective, remains invariable. Reciprocal TII is standard at a high level with a moderate growing tendency which is in accordance with the growth of TCI exports from the EU to Russia. More intense trade between EU-China and EU-Russia and concurrently increased TII between China-India and China-Brazil may result to a decline in TII between the EU and India and EU and Brazil (in spite of a moderate increase of TCI exports from the EU to Brazil). This corresponds to a decrease in RCA numbers between the EU and Brazil and a decline of TCI exports from Brazil to the EU. That reveals that their reciprocal exports are losing position. Trade intensity between the EU and India fell, particularly Indian exports to the EU. Yet, an augmented number of RCAs and TCIs may create a condition for the development of future trade cooperations between the EU and India.

The relationship between Russia and India is characterized by a constant TCI level and substantial drop of RCA numbers. Lower RCA corresponds to lower competitiveness of their products in a mutual market. This leads to a decrease in TII which especially has an impact on the reduction of exports from India to Russia.

A slight TII increase between Brazil and India is the result of a particular growth of exports from Brazil to India. Significant TCI growth of India-Brazil gave a substantially great potential for future trade expansion.

6. Conclusion

This paper assessed statistical data of merchandise trade between BRIC countries and BRIC economies with the EU. The analysis of data was based on measures of TII, CTI and RCA. Results revealed that the TII, which describes the quality of intra-trade compared to other partners, has increased its values for the cross-pairs China-India and China-Brazil. As for Brazil-India the trend has constantly been around zero for the past ten years and is in accordance with trade development with all world partners. The TII between Russia and other BRIC partners implies decreasing trends since 2001 and the EU has become a more important partner for Russia with a very high TII score. The EU also maintains a persistent positive TII index with Brazil and India, but the trends are descending mainly due to their increasing mutual trade relations with China. This differs in comparison to EU-China, where TII is still lower than that of EU-Brazil or EU-India, but the average trend is progressive for all observed periods. The findings mentioned above were confirmed with trade introversion index calculations which eliminated the interpretation mistakes of TII.

Although the trade complementarity index does not reflect other determining factors such as distance, possibility of transport, trade barriers etc., the TII findings are consistent with the changes of CTI values in almost all cases. Nevertheless, both cross-pairs EU-India and EU-China face contradictory results. The higher TII of EU-China corresponds to higher trade intensity with less commodity groups. The RCA indicator has improved for all China-BRIC partners and EU-India and for EU-Russia it remained unchanged. However, it is necessary to note, that not only the number of RCA is important for trade potential but also the kinds of commodities for which RCA exist.

Overall, from the conducted analysis of TII, TCI and RCA we can expect trade potential between the EU and India and for China's exports to Russia. The data presented in the paper does not reveal any unequivocal dependency that would support the assumption that mutual trade between BRIC countries, in terms of merchandise trade, would concurrently be at a considerably higher level than with other countries. It is argued that even though BRIC is making an effort to make the best of their current situation their closer relationships with developed countries, such as the EU, and/or neighboring countries remain persistent.

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