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Similarity and income content at the international trade: The case of BRICS during the period 2000/09

Orlando Monteiro da Silva; Rafael Rodrigues Drumond; Fernanda Maria de Almeida[1]

Abstract

This study aimed to calculate the patterns of similarity and income content of Brazilian, Russian, Chinese and Indian exports by means of indexes, and compare those patterns with those of OECD countries, covering a period between 2000 and 2009. The results indicate that Brazilian, Russian, Chinese and Indian exports became more similar between 2000 and 2006, but that similarity has declined ever since. Exports from China and India, in turn, are increasingly similar to each other and less different from the exports of OECD countries. Export sophistication has increased over the years, with higher growth rates in China and India. India and Russia's sophistication indexes surpassed that of Brazil in 2007, which signal that those countries currently export products with higher content of income. The study also indicated that Brazil has been losing market share for China and India as an exporter of sophisticated products.

Keywords: Exports, Brazil, Russia, China, India, similarity, income content

JEL: F14

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1. Introduction

In 2001, an article by Jim O'Neill (2001), made for a report of an investment bank (Goldman Sachs), first introduced the term BRICs to represent a group of developing countries (Brazil, Russia, India and China) which received an estimate for sustained economic growth above the global average. The report predicted that, in coming decades, the growth generated by the BRIC economies would be much higher and exceed the sum of the most industrialized economies back then.

China's growth over the last two decades is well known and has confirmed those predictions. China's exports of manufactured products have quickly shifted traditional producers from the international market and contributed to the explosive growth rates of its industrial sector. According to Nonnemberg et al. (2008), some of the reasons for this result include industrial policy measures such as tax incentives granted to certain industries located in special economic zones, the fact that multinational companies are obliged to join domestic companies, and a devalued, fixed exchange rate.

India is a country whose growth was above 8% during several years over the last decade. However, it seems that India has been significantly affected by its high dependence on imported oil as well as the financial crisis of 2008, as it has a large share of services in its export basket. According to Barbosa and Sousa (2008), the significant economic growth seen in India has been accompanied by a rise in trade, with exports growing 14% a year in the 2000s, compared to 7.3% in the 1990s. In the same period, the growth rate of imports rose from 9.9% to 16.6% per year. Still, when compared to other Asian countries, India is not very open to foreign trade.

The growing share of Brazil in international trade in the 2000s is characterized by both expansion with a surplus in the sector of raw materials and consumer goods and expansion with trade deficit in the sectors of capital goods and fuels (Source: Brazilian newspaper O ESTADO DE SÃO PAULO, 2010). Brazil had the biggest growth among major economies in the exports of natural resources, advancing 23.7% per annum on average during this decade.

After facing severe economic problems in the 1990s, the Russian economy started growing again in the 2000s. Rising prices of natural gas and oil - Russia's major exports - boosted the country's trade balance, which started to have growing surpluses (BERTHONHA, 2007). Between 2000 and 2007, the Russian economy grew by 6% per year, leading to increases in investments and domestic consumption. Even so, Russia could

hardly be called an economic power, as it currently accounts for only 1% of the world's GDP and is the 16th largest economy in the world.

China, India, Russia and Brazil have several characteristics in common. They are countries with a large territory, a big population (mainly China and India), large asymmetry in the distribution of income, and low per capita incomes. Moreover, the causes for the rapid economic growth observed recently are common to them all. They received a large inflow of foreign direct investment, mostly export-oriented, because of their low labor costs.

According to international trade theory, the set of products exported by a country should reflect their factor endowments and technological capability. Hence, countries with more capital and superior technology are expected to produce and export capital-intensive products with more sophisticated technology, while least developed countries with less capital are expected to produce and export less sophisticated products.

It is believed that the export of capital-intensive products with sophisticated technology result in greater benefits in terms of development, since the products exported reflect greater specialization of labor and appropriation of technology. The current globalization process has fostered the interest in analyzing the technological structure of exports by different countries so that one can better understand its structure and the implications for growth and development. It is known that if a country's trade structure is very similar to another country, then these two economies are more of competitors to each other. However, if they have very different trade structures, they are then seen more as complements to each other. Based on that, the purpose of this paper is to analyze the export structure from China, India, Russia and Brazil in the last decade, from the viewpoint of similarity and income content.

Section 2 of this paper describes the methodological procedures used to calculate the indexes of similarity and income content of exports. The results are presented and discussed in section 3, while section 4 presents the main findings.

2. Method

Two export sophistication indicators were used to compare the exports of Brazil, Russia, China and India with those of OECD countries. The first one is the Export Similarity Index (ESI), which measures the sophistication of a country's exports as they

overlap with those of another country or a group of more developed countries. The development of ESI is credited to Krenin and Finger (1979) and can be expressed as:

$$ESI_{AB} = \sum_i \min(S_{iA}, S_{iB}) \quad (1)$$

where ESI is the Export Similarity Index between countries A and B, and S_{iA} and S_{iB} are the shares of product i in all the exports of countries A and B, respectively. If countries A and B export the same products, ESI will be equal to one, but if totally different products are exported, ESI will be zero.

While ESI can indicate that a country "catches up" with others, it does not show that this country's exports surpass those of others. By means of a time series analysis of ESI, one can observe the increase in the ESI value of a given country in comparison to other countries. However, it does not show that the exports of that particular country surpass those of its trading partner because it is the minimum value that will prevail in the calculation of the index.

The second index was developed by Michaely (1986), who named it "export income content". Lall et. al. (2006) later adapted it and called it "export sophistication level". This index has been widely used in the recent literature (HAUSMAN; HWANG and RODRIK, 2007; SCHOTT, 2006 and 2008) and seeks to capture the productivity level associated with the exports of product i by country j by first calculating the following ratio:

$$PRODY_i = \sum_j [(x_{ijt} / X_j) / \sum_i (x_{ijt} / X_j)] * Y_j \quad (2)$$

where $PRODY_j$ is the productivity level associated with product i; x_{ijt} are exports of product i by country j in year t. X_j is the total exports by country j and Y_j is the per capita GDP of country j. Therefore, x_{ji}/X_j is the share of exports of product i in value terms, as a total of exports of country j $\left(X_j = \sum_i x_{ji} \right)$; $\sum_j \left(x_{ji} / X_j \right)$ is the sum of the shares of exports of product i from all the countries that export it, and Y_j is the per capita GDP of country j. This expression hence represents a weighted average of the per capita income, with the weights corresponding to the revealed comparative advantages for each country that exports product i. Thus, at this stage, the exported products may be ordered according to their income content. For example, a single product exported by a country whose per capita income is $10,000 would have a income content of $10,000. If the same product were exported by more than one country, its income content would be obtained by the weighted

average of the incomes of each exporting country, because of the importance of that product in the total trade among countries.

At a second stage, the productivity level associated with the total exports of a country is defined as:

$$EXPY_j = \sum_i (x_{ji} / X_j) * PRODY_i \quad (3)$$

Equation (3) indicates the total export sophistication level of country j, calculated by an average of the individual productivity of each product exported, weighted by the shares of each product in the total exports of that country. Here, the shares of each product in the total exports of a country are used as weight to aggregate income content of all the products exported by the country. Therefore, an increase in the exports of a product with a high (low) PRODY would yield a significant increase (decrease) in the EXPY index of the country which exports that particular product.

According to Xú (2007), in addition to indicating a country's "catching up" with others, the EXPY index also indicates when that country surpasses another in terms of export sophistication by directly responding to changes in the composition of the basket of products it exports.

Data

The data used in this study were obtained from two sources: the United Nations Commodity Trade Statistics (COMTRADE) and the World Bank (World Development Indicators). Information on exports of all products of 172 different countries between 2000 and 2009 were collected from the COMTRADE. These countries were selected because of the availability of data on their per capita GDP in the World Bank database throughout the period of analysis. The exports cover more than 5,000 different products and correspond to the 6-digit level of the Harmonized System of classification of goods (SH6).

3. Results

Before the values found for the indexes of similarity and income content are presented and discussed, a performance analysis is made of the total exports of Brazil, China and India to the OECD countries, between 2000 and 2009.

3.1. Overview of exports

Figure 1 shows the evolution of exports from Brazil, Russia, India and China to the countries of the Organisation for Economic Cooperation and Development (OECD)2 between 2000 and 2009.Together, the 30 OECD countries imported 58%, 66%, 67% and 54% of the total exports of those three countries and accurately represent the evolution of foreign trade in that period. The values of exports from Brazil, Russia and India are on the left axis of Figure 1 and those for China are on the right axis. An illustration of the difference in exports of the three countries in 2008 is as follows: the value of China's exports to the OECD was $ 1,084 billion, while the values of Brazil, Russia and India were $ 110, $ 290 and $ 95 billion, respectively. In terms of total imports by OECD countries, imports of goods from China more than doubled over the period, reaching 10.62% in 2008. The share of imports from Brazil accounted for 1.07%, from Russia, 2.95%, and from India, 0.90%. Exports in the three countries grew continuously until 2008, but had a higher rate of growth since 2002 onwards. In 2009, there was a general fall in the world's exports, due to the financial crisis which started in the United States but spread quickly and reached the world's largest economies.

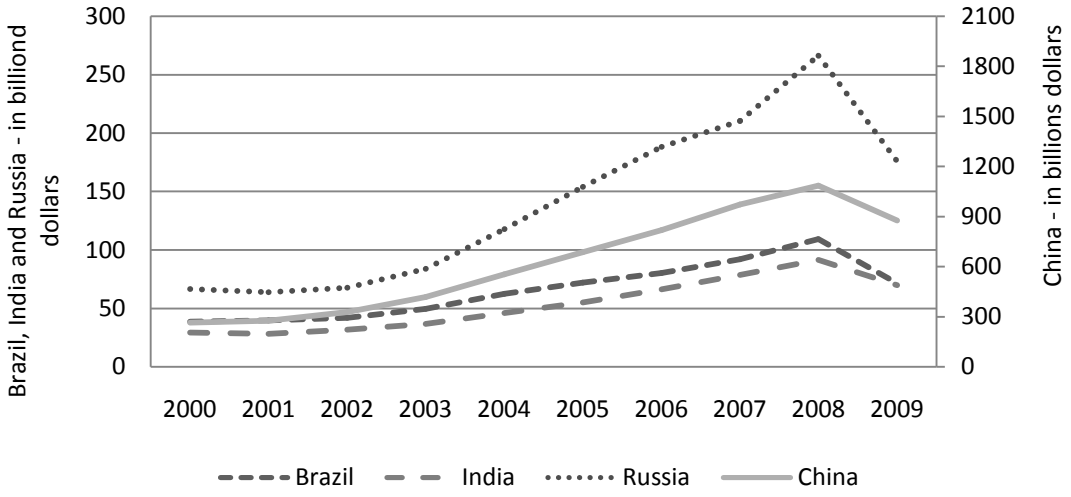

Figure 1: Value of total exports from BRICS to OECD (2000-2009).
Source: Comtrade (2010).

Tables 1 and 2 shows the share of imports originated in Brazil, China, Russia and India in the total imports by OECD in the 2000/2002 and 2007/2009 trienniums, and the

[2] Member countries: Germany, Australia, Austria, Belgium, Canada, Chile, South Korea, Denmark, Slovakia, States, Slovenia, Spain, United Finland, France, Greece, Hungary, Ireland, Iceland, Israel, Italy, Japan, Luxembourg, Norway, New Zealand, Mexico, the Netherlands, Poland, Portugal, United Kingdom, Czech Republic, Sweden, Switzerland, Turkey.

absolute variation among them, according to the 21 sectors of the Harmonized System (HS2).

It can be observed that the absolute variation of Brazil's total exports to OECD countries was 0.16%, while that of China was 4.81% (Table 1). The absolute variation of imports from Russia 1.03% and that of India was 0.26% (Table 2). The Brazilian share was reduced in seven of the 21 sectors (five sectors are related to manufacturing and two sectors, to mining). The biggest declines occurred in the sectors of footwear (-1.30%), metals (-0.17%) and transport equipment (-0.12%). The largest increases occurred in the sectors of vegetable products (1.11%), oils and fats (1.09%) and arms and ammunition (0.83%).

The share of exports from China rose in almost all sectors except vegetable products (-0.52%) and mineral products (-0.46%). Increases occurred in the following sectors: textiles and clothing (15%), machinery and equipment (12.69%), hides, skins and leather (12.03%) and miscellaneous (14.18%). In China, exports in sectors which are intensive in natural resources had a small growth or a reduction, while capital-intensive sectors had a significant growth.

In the Russian case, exports from the mineral products (including oil) increased by 3.14%, followed by exports of oils and fats (0.98%) and arms and ammunitions (0.69%). Six other sectors presented a reduction on exports during that period, the largest being that on pearls and precious metals (3.58%).

Exports from India were reduced in only four sectors, three of them in agriculture: animal products (-0.36%), vegetable products (-0.11%) and oils and fats (-0.53%). The largest increases in India occurred in the textile and clothing industries (1.16%) and footwear (0.76%).

Table 1 - Share of imports from Brazil and China in total imports by OECD, by sector, between 2000-2002 and 2007-2009.

Sector	Description	Brazil's share			Chinas's share		
		2000 2002	2007 2009	Abs. Var.	2000 2002	2007 2009	Abs. Var.
1	Animal products	1.38	1.86	0.48	4.01	4.18	0.17
2	Vegetal products	4.22	5.33	1.11	3.90	3.38	-0.52
3	Fats and oils	0.64	1.73	1.09	0.37	0.59	0.22
4	Food, bever. and tobacco	3.74	4.03	0.29	3.19	3.72	0.53
5	Mineral products	0.92	1.35	0.43	1.21	0.75	-0.46
6	Chemical products	0.38	0.56	0.18	2.13	3.82	1.69
7	Plastics and rubbers	0.36	0.52	0.15	5.13	8.56	3.43
8	Hides, skins and leather	1.82	1.85	0.03	29.76	41.80	12.03
9	Wood and furniture	2.66	2.86	0.20	5.98	11.48	5.50
10	Cellulose and paper	1.53	2.30	0.77	2.08	5.73	3.66
11	Textiles and clothing	0.24	0.23	-0.02	15.91	30.91	15.00
12	Footwear	3.13	1.83	-1.30	39.60	47.33	7.73
13	Ceramics and glass	0.99	1.40	0.41	10.10	17.77	7.66
14	Pearls and precious metals	0.62	0.33	-0.29	2.47	4.35	1.87
15	Metals	1.45	1.35	-0.10	5.08	10.80	5.72
16	Machinery and equipment	0.37	0.37	0.00	7.30	19.99	12.69
17	Transportation material	0.83	0.72	-0.12	0.79	2.38	1.59
18	Opt. Prec. Instrum.	0.15	0.13	-0.02	6.89	9.14	2.25
19	Arms and ammunition	1.75	2.57	0.83	1.20	3.13	1.93
20	Miscellaneous	0.40	0.31	-0.09	31.42	45.60	14.18
21	Works of art	0.07	0.18	0.11	2.41	3.06	0.66
	Total	0.87	1.03	0.16	6.27	11.08	4.81

Source: Comtrade (2010).

Table 2 - Share of imports from Russia and India in total imports by OECD, by sector, between 2000-2002 and 2007-2009.

Sector	Description	Russia's share			India's share		
		2000 2002	2007 2009	Abs. Var.	2000 2002	2007 2009	Abs. Var.
1	Animal products	2.21	1.45	-0.76	1.13	0.77	-0.36
2	Vegetal products	0.33	0.42	0.09	1.61	1.50	-0.11
3	Fats and oils	0.06	1.04	0.98	1.56	1.04	-0.53
4	Food, bever. and tobacco	0.14	0.20	0.06	0.37	0.56	0.19
5	Mineral products	7.24	10.38	3.14	0.29	0.56	0.27
6	Chemical products	0.97	1.08	0.11	0.62	1.08	0.47
7	Plastics and rubbers	0.17	0.32	0.15	0.28	0.50	0.22
8	Hides, skins and leather	0.55	0.40	-0.15	3.69	3.94	0.24
9	Wood and furniture	3.47	3.84	0.37	0.15	0.19	0.05
10	Cellulose and paper	0.70	0.59	-0.11	0.08	0.16	0.09
11	Textiles and clothing	0.28	0.04	-0.24	3.29	4.45	1.16
12	Footwear	0.03	0.01	-0.01	1.48	2.24	0.76
13	Ceramics and glass	0.09	0.16	0.07	0.83	1.34	0.50
14	Pearls and precious metals	6.76	3.18	-3.58	6.03	5.97	-0.06
15	Metals	3.76	3.92	0.16	0.64	1.08	0.45
16	Machinery and equipment	0.05	0.06	0.01	0.14	0.40	0.26
17	Transportation material	0.05	0.07	0.02	0.08	0.33	0.25
18	Opt. Prec. Instrum.	0.05	0.08	0.03	0.15	0.26	0.10
19	Arms and ammunition	1.10	1.79	0.69	0.13	0.22	0.09
20	Miscellaneous	0.07	0.09	0.02	0.45	0.53	0.08
21	Works of art	1.06	1.58	0.52	0.31	0.65	0.34
	Total	1.43	2.47	1.03	6.27	0.64	0.91

Source: Comtrade (2010).

3.2. Similarity index

Table 3 and Figures 2 and 3 show the evolution of the similarity indexes of Brazilian, Chinese, Russian and Indian exports to OECD countries between 2000 and 2009. In the Appendix, Table A1 shows the number of different products (at the 6-digit level) exported by each of those countries and compares them.

In 2007, Russia had the lowest number of products exported (3,503), followed by Brazil (4,091), followed by India (4,364) and China (4,805).They all showed a drop in the number of products exported from 2008 onwards as a result of the financial crisis, but it was in Brazil where the fall was greater, with the number of products falling to 3,792 in 2009.

Table 3 - Export Similarity Index

Year	To OECD					
	Brazil vs. China	**Brazil vs. India**	**Brazil vs. Russia**	**China vs. Russia**	**China vs. India**	**Russia vs. India**
2000	0.155	0.184	0.139	0.066	0.261	0.075
2001	0.161	0.189	0.133	0.065	0.277	0.075
2002	0.170	0.189	0.135	0.061	0.270	0.076
2003	0.173	0.203	0.157	0.060	0.272	0.076
2004	0.166	0.210	0.163	0.057	0.271	0.081
2005	0.174	0.213	0.166	0.052	0.284	0.107
2006	0.173	0.215	0.189	0.052	0.290	0.124
2007	0.162	0.212	0.181	0.052	0.290	0.131
2008	0.141	0.196	0.202	0.054	0.300	0.144
2009	0.127	0.191	0.191	0.037	0.292	0.127
	To the rest of the world					
		India vs. OECD	**Brazil vs. OECD**	**China vs. OECD**	**Russia vs. OECD**	
2000		0.254	0.344	0.342	0.203	
2001		0.283	0.355	0.348	0.215	
2002		0.285	0.351	0.356	0.210	
2003		0.290	0.359	0.361	0.212	
2004		0.300	0.372	0.370	0.213	
2005		0.311	0.387	0.385	0.211	
2006		0.326	0.385	0.396	0.217	
2007		0.337	0.361	0.404	0.220	
2008		0.352	0.339	0.403	0.232	
2009		0.351	0.343	0.393	0.209	

Source: Author’s calculations.

The degree of similarity between Brazil's and China's total exports increased from 0.155 to 0.174 between 2000 and 2006 but fell thereafter reaching a value of 0.127 in 2009. The same pattern was observed between Brazil's and India's exports. The export similarity index rose until 2006, which it reached a value of 0.215, and fell thereafter. For Russia, the export similarity index with Brazil increased until 2008. Furthermore, the ESI for China's, Russia's and India's exports grew throughout the whole period, indicating that those countries are becoming more competitive in their exports to the OECD.

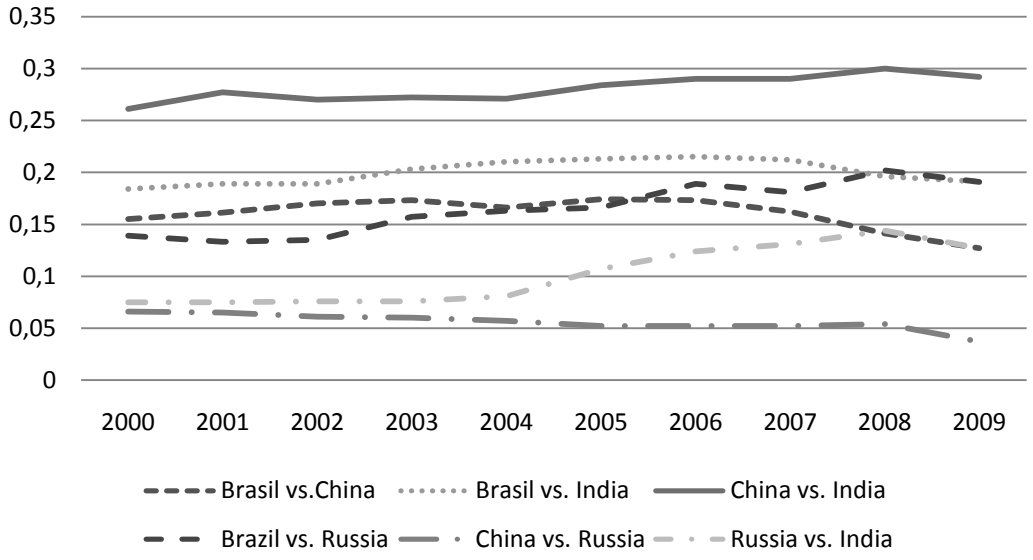

Figure 2 - Evolution of the Export Similarity Index to OECD countries (2000-2009).
Source: Designed by the authors.

A comparison between the export similarity indexes from the four countries and those of OECD would allow some inferences about the evolution of the degree of export sophistication, which is shown in the last three columns of Table 2 and Figure 3. In this case, the exports of different products from those countries to the rest of the world were considered. It can be seen that the sophistication of China's and India's exports has grown steadily in relation to that of OECD, except for 2009, again as a result of the international financial crisis, while the sophistication of the products exported by Brazil grew until 2005 but has been falling thereafter. As a result, such behavior allows the assumption that exports from China and India have become relatively more competitive and displaced part of Brazilian exports from international markets. This fact had already been detected by Jorge and Kume (2009), which showed that Chinese exports shifted part of Brazilian

exports away from the U.S. market. The Russian index was the lowest one and kept constant for most of that time, presenting a small increase from 2006-2008.

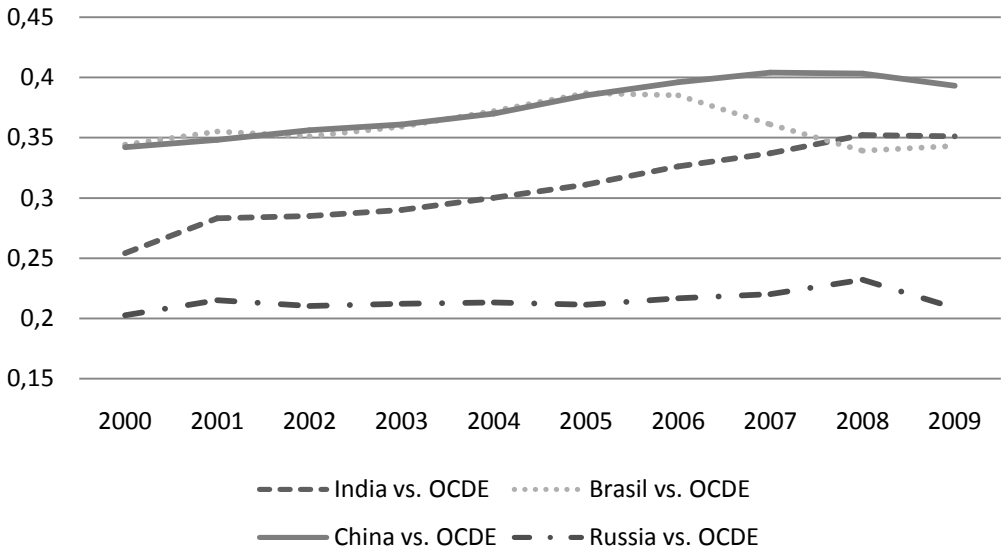

Figure 3 - Evolution of the similarity index of total exports (2000-2009).
Source: Designed by the authors.

3.3. Income content index

Table 3 shows the five products from Brazil, China, Russia and India with the highest and lowest PRODY, respectively, for the years 2000/2001 and 2008/2009. As expected, the items with the lowest PRODY values are commodities, while those with the highest PRODY values are capital-intensive products. Interestingly, there is little variation among products with higher values PRODY over the period analyzed. Because they are industrial products with smaller price fluctuations, they tend to remain on top of the list. The product with code 730110 (a special type of steel sheet), which had the highest content of income in 2000 and 2001, maintained the second largest income in 2008 and 2009.

As for products with lower PRODY values, the opposite is true. Because they are mostly agricultural products, which are subject to big price fluctuations, there is a greater change in the ratio of these products over time.

Table 3[3] - Products with the highest and the lowest content of income in 2000, 2001 and 2008, 2009. (SH6-digit level)

The 5 products with the highest *PRODY*							
2000		**2001**		**2008**		**2009**	
Product	***Prody***	**Product**	***Prody***	**Product**	***Prody***	**Product**	***Prody***
730110	42458.92	730110	41519.10	590290	88198.5	590290	78029.61
721633	38788.10	721069	38735.95	730110	86872.51	730110	75498.29
741011	37856.17	721633	38025.28	721633	68808.33	721633	65787.59
721061	37668.49	560312	36205.78	722530	68424.68	590210	58547.64
560312	37107.79	721061	36110.15	481121	64364.59	721069	57204.21
The 5 products with the lowest *PRODY*							
2000		**2001**		**2008**		**2009**	
Product	***Prody***	**Product**	***Prody***	**Product**	***Prody***	**Product**	***Prody***
80131	369.65	410612	314.9931	531010	450.98	261590	452.97
90700	350.18	120792	271.1114	71390	426.28	530490	391.15
120792	327.61	71390	251.4651	410619	411.97	410611	387.67
261590	317.04	261590	246.6487	140390	376.79	71390	360.41
130120	234.82	130120	240.0609	410612	323.34	901041	333.39

Source: Author's calculations.

The EXPY index values for Brazil, China, India, Russia and OECD countries are shown in Table 4 and Figure 4. An EXPY index considering only agricultural exports to the same countries is shown in Figure 1A and Table A2 in the Appendix. The purpose of calculating the EXPY index for agricultural products was to relate the growth of exports in this sector, which is particularly important for Brazil, to the evolution of the sophistication of the total exports of other countries.

[3] **Highest PRODY:** 481121 - Paper, self-adhesive, unlabeled; 560312 - Nonwovens; 590210 - Tire Cord Fabric of High Tenacity Yarn of Polyamides; 590290 - Tire Cord Fabric of High Tenacity Yarn of Viscose Rayon; 721061 – Flat-rolled aluminum-zinc alloys; 721069 – Other flat-rolled aluminum-zinc alloys; 721633 – Iron, extruded; 722530 - Alloy steel, hot-rolled, in coils; 722592 – Sheet piling of zinc; 730110 - Sheet piling of iron or steel; 741011 – Foil of refined copper;
Lowest PRODY: 71331 – dried seeds of specific grass (Urd,mung,Black); 71390 – leguminous vegetables, dried and shelled; 80131 – Dried, unprocessed cashew nuts; 90700 - clove; 120792 – Shea nut (karite nut); 130120 – Gum arabic; 130214 - Pyrethrum, roots containing rotenone and extracts; 140390 - vegetal material used in brooms or brushes; 261590 - Niobium, tantalum and vanadium ores and their concentrates; 410310 – Raw Hides and Skins of Goats or Kids; 410611 – Goat or Kid Skin Leather (Without Hair On; Vegetable Pre-tanned); 410612 – Goat or Kid Skin Leather (Without Hair On; Otherwise Pre-tanned); 410619 – Goat skin leather (Without hair on); 530490 – Sisal or agave; 531010 – Woven fabrics of jute; 560710 – Twine, Cordage, Rope and Cables of Jute; 901041 – Apparatus & equipment for photographic laboratories.

Table 4 – Income content indexes for exports between 2000/2009

	Brazil	China	India	Russia	OCDE
2000	7419.21	8382.84	6687.39	7144.17	12502.38
2001	7096.95	7988.06	6760.21	6628.94	11790.21
2002	7301.03	8697.35	7010.51	6779.55	12479.89
2003	8554.86	10197.52	8230.26	7818.70	14177.09
2004	9360.03	12016.99	9078.62	8596.73	15756.24
2005	9962.01	12654.62	9555.92	9574.77	15832.72
2006	10586.14	13282.82	10178.86	10704.74	16165.76
2007	11639.71	14997.87	11843.78	12391.48	18145.91
2008	12123.06	16058.29	12611.05	13217.61	18801.62
2009	10607.85	14409.48	11925.85	11433.57	17020.29

Source: Author's calculations.

The values calculated for the EXPY index showed continued growth throughout the period, except in 2009. The higher values refer to OECD exports and the lower ones to Indian exports (until 2006) and Brazilian (after 2006), indicating significantly greater export sophistication from OECD countries. However, the growth of the index of export sophistication of OECD countries between 2000 and 2008 was 50%, while the growth rate of Brazil was 63%. In India, China and Russia, EXPY index values increased 89%, 92% and 85%, respectively, during the same period. The gap with OECD countries has been decreasing; this difference in the countries' indexes is shown in Figure 4.

It is important to note that Indian and Russian exports had a lower index of sophistication than the Brazilian index at the beginning of the series, but it became larger in 2007 and remained so until 2009. Also, one can notice that the largest proportional fall in the EXPY index, due to the international financial crisis, was that of Brazil. An analysis of Table A2 and Figure A1 in Appendix clarifies the reason for that. Among the other countries, Brazil is the largest exporter of agricultural products. The share of agricultural products in Brazilian exports, which had been decreasing since 2002, increased again in 2008 and accounted for 32.5% of total exports in 2009.

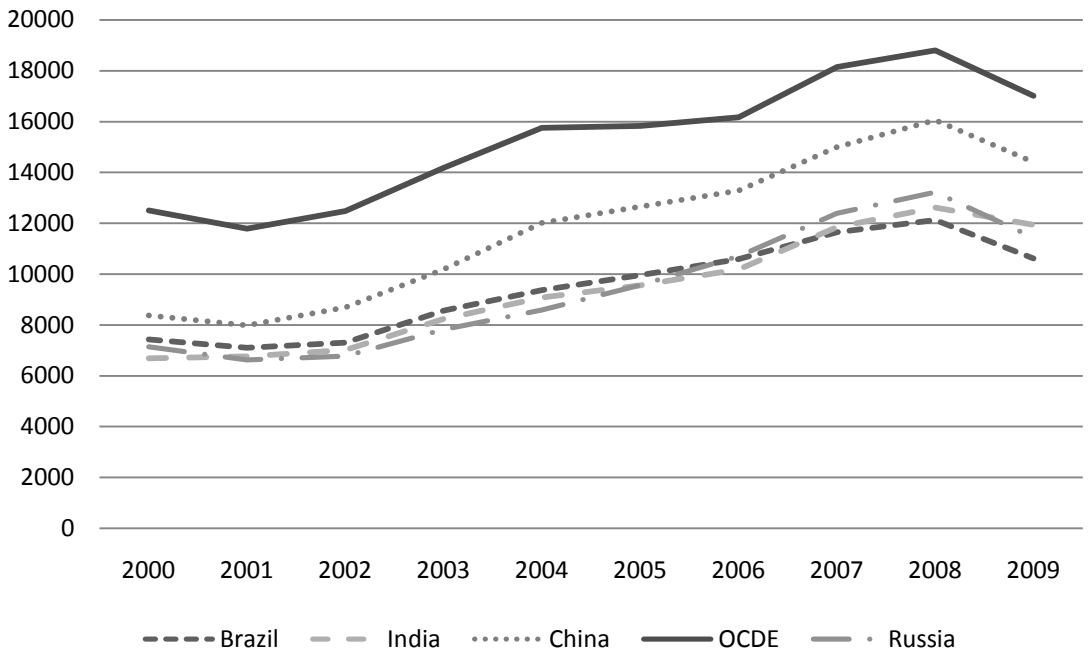

Figure 4 - Evolution of Content of Income (EXPY) of total exports (2000 – 2009).
Source: Designed by the authors.

Finally, it is worth mentioning that, unlike Brazil, the share of agricultural products in China's total exports has declined, while shares in exports from India and OECD countries have remained constant. Exports of agricultural products from Russia also showed a small increase starting from a very incipient basis. Exports of commodities tend to have a low value for the EXPY index, even though the per capita GDP in Brazil in 2009 ($ 6,598.14) was less than half that of Russia ($ 15,300)., and more than twice as much that of China ($ 2,952.06) and eight times higher than India's ($ 827.37).

4. Conclusions

This study estimated similarity and income content indexes of exports from Brazil, China, Russia and India to the OECD market between 2000 and 2009. It was observed that similarity between exports from Brazil, China and India increased until 2005. After that year, the similarity ended due to the increase in Brazil's exports of agricultural products. On the other hand, the similarity of exports from India and China has increased continuously, suggesting greater competition among them for exports to OECD countries. The opposite was observed with the similarity between exports from China and Russia which declined continuously. During the period of analysis, Chinas' exports showed

highest and an increased similarity with those from OECD countries, while Russia's exports showed a lowr similarity.

Regarding the income content index, the results showed that the export sophistication has increased over the years with higher growth rates in China and India, making their sophistication even more similar to the export sophistication of OECD countries. This behavior is consistent with the argument that exports from richer countries do not grow as rapidly as those of poorly countries. The increase in China's content of income index is worth of notice despite the existing asymmetries in the country. As for Russia and India, the sophistication index exceeded Brazil's in 2006, showing either a countries current export of products with higher income content or that Brazil has not been able to shift its specialization pattern toward products of higher productivity content.

It should also be noted that only commodity exports were considered when the indexes were calculated, whereas in the case of India, the export of services plays a significant role.

Finally, the analysis of this study shows that Brazil has lost market share to the other three countries in the export of more sophisticated products, as evidenced not only by the decrease in the number of exported products but also by the increased share of agricultural products in the total exports.

5. References

BARBOSA, M. J.; SOUZA, N. J. (2008). Padrões do crescimento econômico da Índia: estrangulamento e perspectivas. <http://online.unisc.br/seer/índex. php/cepe/article/view/739/769>. (in Portuguese). Access 25/11/2010.

BERTONHA, J. F. (2007) Modelos para o Brasil: Rússia? Revista Espaço Acadêmico. 76(9), 1-4. (in Portuguese)

BRAGANÇA, A. A.; LEMOS, M. B. (2009) **Estrutura Produtiva e Crescimento Econômico Regional.** ANPEC - XXXVII ENCONTRO NACIONAL DE ECONOMIA.

FINGER, J. M.; KREININ, M. E. (1979) A Measure of Export Similarity and Its Possible Uses, Economic Journal, 89 (December 1979), 905-912.

HAUSMANN, R.; HWANG, J.; RODRIK, D. (2007) "What You Export Matters," **Journal of Economic Growth**, 12(1), 1-25

JORGE, M. F.; KUME, H. (2009) A competitividade do Brasil e da China no mercado norte-americano no período 2000-2008. ANPEC.

LALL, S.; WEISS, J.; ZHANG, J. (2006) "The 'Sophistication' of Exports: a New Trade Measure," **World Development**, 34(2), 222-237.

MICHAELY, M. (1986) Trade, Income Levels and Dependence. **Journal of Development Economics,** 21(2), 383-386.

NONNEMBERG, M. B; LEVY, P. M.; DE NEGRI, F.; COSTA, K. P. (2008) **O Crescimento econômico e a competitividade chinesa**. IPEA. Texto para discussão n.1333. Rio de Janeiro.

O ESTADO DE SÃO PAULO. (2010) Brasil lidera crescimento de exportação de commodities. Caderno Economia e Negócios. 24/07/2010.

O'NEILL, J. **Building Better Global Economic BRICs**. (2001) GS Global Economics Website. Global Economics Paper n. 66. 16 p.

SCHOTT, P. K. (2006) The Relative Competitiveness of China's Exports to the United States vis a vis other Countries in Asia, the Caribbean, Latin American and the OECD. Occasional paper 39. Buenos Aires: IDB-INTAL.

SCHOTT, P. K. (2008) The Relative Sophistication of Chinese Exports. **Economic Policy**, vol.23, no 53.

XU, B. Measuring China's Export Sophistication. China Europe International Business School. 41p. October 2007.

UNCTAD – United Nations Conference on Trade and Development. **COMTRADE**. <http://comtrade.un.org/db/?>. Access in 30/08/2010.

WORLD BANK. **Key Development Data & Statistics**, 2010. <http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS>. Access in 05/09/2010.

Appendix

Table A1 – Total number of products exported to OECD countries (2000-2009).

Number of products exported to OCDE										
Total exports										
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Brazil	3720	3807	3925	3947	4064	4110	4121	4091	3956	3792
China	4820	4841	4831	4844	4886	4913	4926	4805	4643	4652
India	4155	4212	4257	4303	4386	4435	4498	4364	4330	4264
Russia	3406	3416	3467	3517	3611	3645	3646	3503	3473	3407
In common with Brazil										
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
China	3612	3703	3849	3879	4000	4060	4076	4020	3915	3759
India	3263	3416	3559	3617	3736	3826	3877	3824	3755	3571
Russia	2786	2851	2980	3038	3162	3233	3250	3209	3145	2989
In common with China										
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
India	4082	4134	4204	4254	4355	4409	4473	4325	4305	4247
Russia	3303	3322	3406	3460	3572	3607	3618	3475	3443	3384
In common with India										
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Russia	2949	2996	3099	3161	3301	3347	3407	3285	3270	3192

Source: Comtrade, 2010.

Table A2 – Content of Income Index for Agricultural Exports (2000-2009).

	Agricultural Content of Income Index(*EXPY*) Agricultural exports/Total exports				
	Brazil	**China**	**India**	**Russia**	**OCDE**
2000	995.70 (25.01%)	205.39 (3.57%)	304.89 (11.18%)	128.84 (1.85%)	621.24 (6.97%)
2001	1126.94 (29.02%)	192.02 (3.31%)	324.41 (10.46%)	135.35 (1.83%)	630.55 (7.45%)
2002	1153.11 (30.44%)	179.99 (3.15%)	336.49 (10.60%)	166.61 (2.35%)	661.39 (7.63%)
2003	1368.54 (30.06%)	183.67 (2.90%)	351.97 (9.58%)	176.94 (2.25%)	775.74 (7.74%)
2004	1480.48 (28.5%)	173.17 (2.28%)	388.71 (9.57%)	145.87 (1.59%)	846.16 (7.43%)
2005	1428.04 (26.25%)	167.64 (2.15%)	336.94 (7.70%)	158.05 (1.62%)	839.87 (7.17%)
2006	1488.45 (25.19%)	164.03 (1.97%)	357.58 (8.89%)	171.55 (1.63%)	854.10 (6.99%)
2007	1920.56 (24.48%)	179.39 (1.98%)	428.82 (8.94%)	268.47 (2.22%)	989.81 (7.23%)
2008	2133.02 (28.56%)	182.25 (1.86%)	533.66 (10.46%)	242.54 (2.08%)	1092.36 (7.73%)
2009	2155.78 (32.47%)	185.28 (2.02%)	402.24 (8.45%)	284.97 (2.62%)	1112.93 (8.56%)

The numbers in parentheses show the share of agricultural products in the total exports of each country.

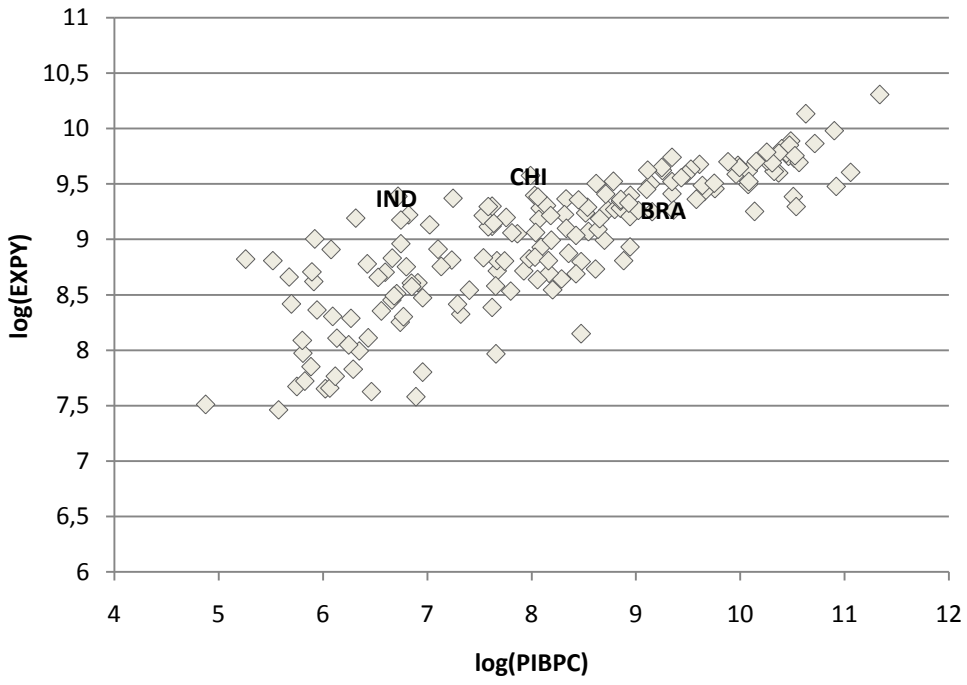

Figure A1 - Ratio between content of income index and GDP (2009).
Source: Author's calculations.