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# COMPARISON OF TURKISH CHEMICAL INDUSTRY WITH BRIC COUNTRIES ON THE BASIS OF REVEALED COMPARATIVE ADVANTAGES

**Elife AKİŞ*** **Murat ÇETİN****

**Abstract**

The chemical industry provides input for all of investments and industries of consumables within a wide spectrum from automotive to textile, communication technology to manufacture of machines, iron and steel to packing, and produces very important raw materials, intermediate products and consumables globally for both individual end-users and for other industries. Within this context, countries that seek to enhance their international competitiveness have to develop their chemical industries.

This study aims to calculate and analyse the Balassa's Revealed Comparative Advantages (RCA) by making use of figures concerning imports of chemicals and certain products under Section 5 consisting of 9 divisions in two digits on the basis of STIC (Standard International Trade Classification) Rev. 4 for the period of 2007-2014 for the comparison of the competitiveness of chemical industries of Turkey with the BRIC (Brazil, Russia, India and China) countries' in the world.

Based on findings, RCA index values of chemical industries of India, Russia and China and Turkey are higher than 1 where India's chemical industry is reviewed under three divisions; Russian and China, each, under two divisions, and Turkey under three divisions of the section 5; and RCA index value of the Chemical Industry of Brazil is calculated as less than 1 for all divisions.

***Keywords:*** *Competitiveness, Revealed Comparative Advantage Index, Turkish Chemical Industry, BRIC Countries Chemical Industry*

***Jel Classification:*** *E00, F10*

* Asst. Prof. , Istanbul University, Faculty of Economics, Istanbul, elifakis@istanbul.edu.tr

** Asst. Prof. , Istanbul University, Faculty of Economics, Istanbul, mcetin@istanbul.edu.tr

## 1.INTRODUCTION

The secret of companies, industries and countries to be able to sustain their existence and achieve success in the new economy policy lies on the competitiveness under today's conditions where globalization cuts across all boundaries. The competitiveness of a country across an international arena depends on the competitiveness of a company in micro terms, and of an industry and country in macro terms.

Chemicals seen as vital components of the modern life thanks to its contribution to life standards have a crucial role throughout all items ranging from food to fresh water supply, clothing to protection, health to transportation, and semi-conductor devices to technologies. The more a country is industrialized, the more it needs chemicals. Thus, the chemical industry helps other industries develop new products and new industries thanks to research-development activities across business lines directly involving chemicals to which products it supplies are directed towards. Speaking briefly, it is not possible for countries with less developed chemical industries to develop in other business lines (İSO, 2004: xxiii).

The demand for chemical agents and products is expected to be significantly in an increasing trend until 2020. The increase in demand among developed countries such as AB, NAPTA (North America Free Trading Area) and Japan will be relatively less. Among reasons thereof are the slowdown in private consumption expenses, restrictions imposed upon the industry for sustainable growth, shifting of industrial production facilities using the chemical industry's input towards developing countries and the increased production facilities and demands for materials that will substitute chemical agents (Ulengin, 2012: 15).

Based on such information, this study highlights the chemical industry as the leading sector thanks to products that currently contribute some great added value to business lines such as energy, agriculture, health, transportation, food, construction, electronics, textile and environmental protection in many countries and also thanks to technological advances introduced to such industries.

The most rapid growth of the market in sales of chemical products will be globally recorded among the markets of China, Far Eastern and South America in the chemical industry during the forthcoming period. (İSO, 2015: 37). Thus, chemical industries of BRIC

Countries and Turkey have been selected. The competitiveness of chemical industries of BRIC countries and Turkey in the world's entire chemical market is calculated according to the RCA index of Balassa on the basis of reviewed actual exports.

## 2. DEFINITION AND CLASSIFICATION OF THE CHEMICAL INDUSTRY

Chemical industry is complex of processes, operations and organizations engaged in the manufacture of chemicals and their derivatives (Britannica, 2016). In general, chemical industry can be defined as the industry employing the science of chemistry for the manufacture of chemical products. The sector processes various raw materials such as oil, gas and metal, and manufactures more than 70,000 products (Duru, 2014: 5).

30% of products manufactured by the chemical industry (ranging from plastics to cosmetics, and medication to paint) directly reach consumers, and 70% of such products are used as intermediate products or raw materials for other industries (such as textile, electrical appliances, metal, metallic products, construction, automotive, paper and service industries). Owing to this, the chemical industry is a crucial branch of industry for our lives as well as for other industries. The chemical industry has a very wide range of products. The sector manufactures consumables such as cleansing products, paints, cosmetic products, drugs in addition to fertilizers and pesticides for the agricultural industry, organic and inorganic chemicals, dyeing agents, laboratory chemicals, thermoplastics and similar products required by the manufacturing industry including the chemical industry (T. C. Bilim, Sanayi ve Teknoloji Bakanlığı, 2012: 5).

Activities of the chemical industry are reviewed under eight divisions of the Chapter 20 "D- Manufacturing" as per classification of activities under ISIC (International Standard Industrial Classification of All Economic Activities) (Rev.4) prepared by the United Nations. The sector is also reviewed under 15 divisions of the Chapter 20 "C – Manufacturing" as per classification of activities under of NACE (Statistical Classification of Economic Activities in The European Community) (Rev 2) prepared by the European Union.

Chemical industry products are reviewed under 9 divisions in 5 digits under the Chapter 5 throughout the system of SITC (Standard International Trade Classification) prepared by the United Stations and also used by the World Trade Organization.

Chemical industry products and plastic products are examined under 13 divisions in two chapters as per CTSP (Customs Tariff Statistical Position, a national foreign trade classification, used in our country and developed on the basis of a classification system to compare foreign trade data of EU countries.

We can consolidate and divide diversified products into three categories, i.e. basic industrial chemicals, specific and speciality chemicals and consumer chemicals, depending on their intended use, and commercial and technological features (T.C. Kalkınma Bakanlığı, 2015: 7-8).

***Basic Industrial Chemicals:*** They cover petrochemicals and artificial fertilizers manufactured on a colossal scale as organic and inorganic chemicals. Such chemicals are used mostly for manufacturing other chemicals.

***Specific and Specialty Chemicals:*** They are, in general, moderate and high-value-added chemicals manufactured on a relatively less scale compared to basic industrial chemicals. Such products derived mostly from basic industrial chemicals by means of added processes can be manufactured by a limited number of manufacturers due to rights protected under patents. Paints, pigments, industrial gases, glues, and catalysts take place in this group where some organic chemicals and plastics are assessed under this group as well.

***Consumer Chemicals:*** Chemicals categorized under this group are products directly offered to consumers. Chemicals classified under previous groups are, in general, used as raw materials for other industries or for the chemical industry, but chemicals under this group are offered to consumers directly. Cleansing materials, soap, detergent and cosmetic products are part of this group. In some sources, medical products under this group are used as “life science products”, and cosmetic products are reviewed under “consumer care products”.

## 3. TURKISH CHEMICAL INDUSTRY

Production facilities assessed as part of the chemical industry in our country had just been launched at the time of the Republic Period. Soap, rose oil and gun powder was manufactured at the time prior to the Republic Period, but was not to a great extent to be involved in an industrial scale. (DPT, 2001: 3).

The historical development of the sector in our country can be addressed in line with economic policies under three periods, i.e., first period until the beginning of the planned development process following the Industry Plan (1934-1962); second period from the beginning of the Planned Development Process until the liberalization of economy (1963-1979) and third period when a free market economy was adopted for targeting an outward-oriented and export-led growth (1980 and subsequent years).

It had been impossible for the private sector to be able to make investments in the chemical industry due to the inadequate accumulation of capital in the first years of the Republic Period. Thus, first industrial investments throughout the industry were carried out so as to manufacture intermediate products. For this purpose, some important chemicals were launched within the framework of the First Industry Plan implemented during the period of 1934-1938. Works for the oil refining that had started developing in the World during the said period were launched at this time. The objective of state investments of the chemical industry was to establish a pure chemical industry and manufacture raw materials needed for other industries. Private sector investments were oriented towards, in particular, consumer chemicals which could not be relatively large-scale products (T.C. Kalkınma Bakanlığı, 2015:2-3).

State investments for the chemical industry were increased during the Planned Development process where an import-substitution industrialization approach was adopted during 1963-1979. The sector of rubber and plastic products that employed its input largely from the chemical industry was restructured, and petrochemical investments made for the purpose of meeting needs of raw materials of the sector remained incapable against the growth of the sector. As a result, imports of raw materials for rubber and plastic industries continued its growth. In addition to refining investments that provided a great deal of input for

the chemical industry, other investments such as Petlas that used products of the sector were implemented. Moreover, the refinery integration of Petkim, which is currently the only integrated petrochemical plant of the country, took place during this period. It was, however, impossible to construct organic and inorganic chemical complexes planned to be built during this period in spite of all of these investments (DPT, 1979: 533-534).

After outward-oriented economy policies were implemented in 1980, customs tariff rates of chemical products were decreased immediately after the enactment of the Customs Law in 1984. Production quantities and capacities of the Turkish chemical industry were increased after decisions taken and policies pursued accordingly, thus facilitating exports to grow rapidly (T.C. Kalkınma Bakanlığı, 2015: 3). The role of the private sector in the industrialization had been highlighted in the development plans drawn up since 1980 and a focus was made to increase the share of private sector investments among all of manufacturing industry investments (DPT 1989:3); support the technology transfer and development so as to increase competitiveness and take precautions needed to lower input costs (DPT, 1995:65) and increase R&D investments throughout information-intensive sectors (DPT, 2000:221).

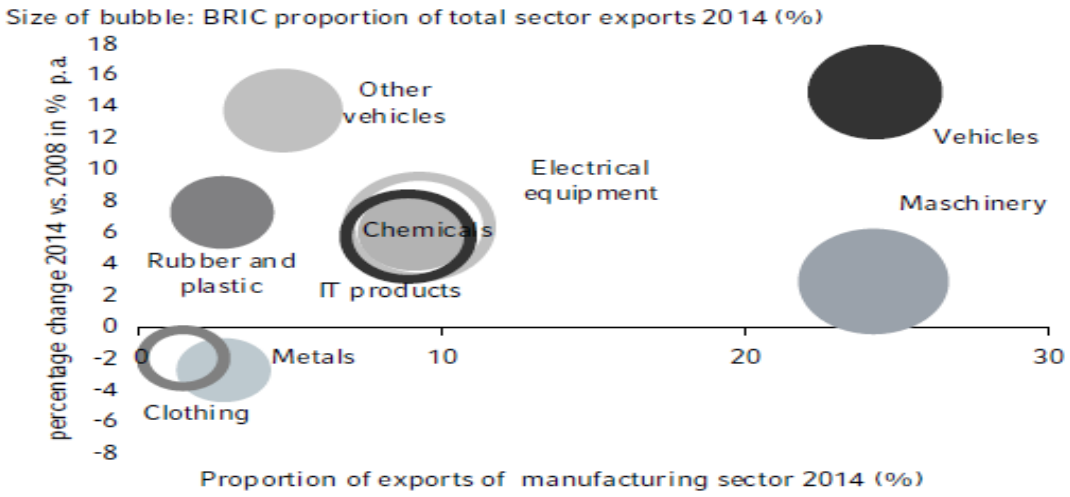
UN's Commodity Trade Statistics Database STIC Rev. 4 suggested that the amount of Turkey's total exports of chemicals and related products was USD 9,176,878,450 in 2014 and total exports were realized at USD 157,714,945,962. In other words, Turkey's total exports of chemicals and related products make up 5.82% of the total exports.

The Turkish chemical industry consists of facilities manufacturing various chemical raw materials and consumables mainly such as petrochemicals, soap, detergent, fertilizers, medical drugs, paint-varnish, synthetic fibre, soda etc. Companies running facilities in the sector differ in terms of scale and capital resources. The majority of companies engaged in the sector are small and medium-scale enterprises; in addition, large-scale companies and multinational enterprises actively carry on business activities. The chemical industry is an import-dependent sector. 70% of used raw materials are imported; and 30% of such materials are met by domestic manufacturing facilities. 90% of the main input of plastic manufacturing facilities is provided via the industry of petrochemicals. And the industry of petrochemicals is a large-scale investment and technology-intensive sector. The rubber and plastic sector is an import-dependent sector, representing a rate of over 90% (T.C. Ekonomi Bakanlığı, 2015: 4).

The three basic domains required to be focused in the chemical industry are identified as country positioning, technological advance and infrastructure and statutory regulations so that Turkish chemical substances and products can achieve at a level of 0.79% in exports stipulated for 2023. Within this context, the emphasis is to use the enhanced image of Turkey as leverage, draw the foreign capital to the country, increase R&D infrastructural investments for a technological transformation and to provide support with diversified financial models after improving bureaucratic procedures, incentive mechanisms and commercial agreements (Ulengin, 2012: 46).

## 4. CHEMICAL INDUSTRIES IN THE BRIC COUNTRIES

BRIC Countries known as emerging economies take place near the top in the world for many industries and also for the chemical industry when it comes to the rapid growth, direct drawal of foreign investments and export potentials. You can see here below exports of sub-sectors of the manufacturing industry on the chart of 2014.




*Size of bubble : BRIC proportion of total sector exports 2014 (%)
**Source:** (Commerzbank, 2015: 5)

**Figure 1: BRIC Exports (2014)**

The size of bubbles on Figure 1 represents the share of each sub-sector among BRIC countries in exports of 2014. Based on the Figure 1, we can say that export potentials of BRIC countries in the chemical industry, the subject matter of this study, in addition to sub-sectors of other manufacturing industries, are pretty high. It would be beneficial to scrutinize everything to see potentials of countries within the scope of the chemical industry.

Brazil is currently one of the leading countries for the chemical sector. When looking over the development of the chemical industry in the country, we can see that the state followed import-substitution policies until 1990s. The development of the chemical industry can be defined under three phases during 1950-1990. Accordingly, the rapid expansion of the Brazilian economy after the Second World War created a large demand for finished products such as detergents, solvents, paints, etc. with several newly built plants by international corporations. While a few domestic firms invested in the intermediate and finished products sectors, most had modest market presence and technological development (Pinto, 2011: 57).

It was seen that the petrochemical sector had come to the forefront during the second phase defined as the period covering 1968-1975. The state established a company in this business line at the end of 1960s and the expansion of petrochemical sector in the private sector remained limited. We can then see that, in addition to the said public corporation, there were some state incentives and interventions because credit subsidies and tariff rates imposed on imports of chemical goods were indications to it. This phase also corresponds to the period when Brazil attained its highest rate of growth. We can see that new plants were established in the field of petrochemicals during the third phase from 1976 to 1990. Within this context, the first and second-generation petrochemical sectors were integrated into the third-generation sector, and on the other hand, new policies were introduced for the purpose of paving the way for the transfer of private capitals and technologies. It was seen in the midst of 1980s that advancements were recorded in the first and third-generation sectors, but the second-generation sector was still contestable. Thereupon, the government imposed applications such as customs tariffs on intermediate products. After 1990, the chemical industry of Brazil became less state-controlled and driven by privatizations (Pinto, 2011: 58).

The chemical industry of Brazil ranked fourth at a share of 9.67% of the Gross Domestic Product after processed food-beverages, petrochemicals and automotive industries in the industrial size ranking in 2014. It represents 3% of the GDP of the country. The chemical industry of Brazil ranks sixth in terms of net sales in the world's ranking (www.export.gov.brazil)

When overviewing the development of the chemical industry in Russia, origins of the sectors dated back to 17$^{th}$ and 18$^{th}$ centuries. However, we will deal with the most recent period. 20. The Russian chemical industry contained a total number of 349 public and private

enterprises that provided employment for 43,000 employees. The sector was then facing some infrastructural deficiencies even though it ranked eighth in the world's ranking of chemical production facilities. The government gave precedence to the development of the chemical industry after the Russian Revolution in 1917 where the target was to increase the production facilities of the sector by 250% in line with the Soviet Plan. The sector recorded some bright growth from the Russian Revolution and the Second World War. We can see that large factories were established during this period. The production facilities of chemical and petrochemical industries of the Soviet Union had ranked 5$^{th}$ in the world's ranking in 1940. However, factories demolished during the war led to the decreased production across the chemical industry (Dyakonov et. al., 2014: 45-46).

A sizeable amount of funds were allocated for the development of the chemical industry by virtue of the resolution taken by the Communist Party's Central Committee Plan of the Soviet Union in 1958. The sector demonstrated some strong growth after 1960. Witnessing the significant infrastructural works, the period of 1960-1980 was called as the shining era. The Russian chemical industry showed some decrease in its production facilities and fell down to 1% of the world's production and ranked 20$^{th}$ of the world's ranking in the manufacture of chemicals. The sector was affected heavily by the crisis in 2008, but it got back to the level prior to the crisis during the term of 2010-2012 once again. (Dyakonov et. al., 2014: 46-47).

The crucial importance that the chemical industry bears for the future of the economy has recently encouraged Russia to develop strategies in line with its targets for 2030. Within this framework, fundamental problems of the industry are first emphasized. These are, in summary, excessive prices, lack of sufficient raw materials; production facilities failing to be in good working order; inadequate human resources and technologic and scientific potentials; excessive electricity and freight fees; under-development of quality control systems of chemical products; lack of capacities of the domestic market; and dependence of strategic sectors on imports of raw materials (Batkhin, 2014: 9). Within this context, it was stated that it was necessary to improve the national safety and increase the competitiveness of the chemical industry as a priority according to the plan to be implemented at three stages, i.e. from 2014 to 2016, 2017 to 2020 and 2021 to 2030. Secondary targets were defined as the

enhanced importance of use of chemicals in economy, creation of qualified employment, substitution of imports in the consumption of chemicals by domestic production facilities, accommodation of innovative potentials, and procurement of domestic chemicals to sectors of strategic importance (Batkhin, 2014: 15, 21).

When reviewing the development process of the Indian chemical industry, we can see that some phases have taken place since 1950 (KPMG, 2010: 22). It can be seen that chemical products have contributed to the economic growth for the purpose of preserving agricultural products and developing the health sector during 1950 – 1952 called as the phase of basic necessities. The period of 1972-1980 was named as the phase of establishment. Public enterprises were then set up for the purpose of developing the petrochemical industry. The period of 1980-1992 was defined as the phase of reinforcement. This phase is dominated by a pattern of many small-scale companies running at a low capacity and high costs. These companies were protected against international competition with tariff and non-tariff obstacles where such protection allowed companies to increase their profit margins. Investment plans involving multinational companies were implemented during the phase of liberalization covering the period of 1992-1995. Tariffs were lowered and the domestic industry was exposed to international competition conditions. The role of public organizations was narrowed during this period.


**Source:** (CEFIC, 2016:.4)

**Figure 2: World Chemicals Sales (2014)**

The period followed by 1999 is known as the phase of expansion. During this phase, investments made in the petrochemical sector demonstrated some significant growth and

attempts were made to protect the market's share in spite of competition and decreased prices of countries that carried out manufacturing facilities on low costs. Branding was adopted by way of diversified products. New plant and equipment investments were made in order to take advantage of scale economies. With its added value, the Indian chemical sector ranks 5th in the world's ranking and 2nd after China in Asia (with its fixed prices of 2000) in 2010. The sector is very important for the economy of India because it makes up 10% of the country's manufacturing industry, and 13% of exports (Exim Bank of India, 2012: 13). The report drawn up in March 2015 by India Brand Equity Foundation states that, in terms of production volume, the Indian chemical industry ranks 3rd in Asia, and 12th in the world. The same report states that, in terms of its added value, it ranks 6th in the world, and 3rd in Asia (IBEF, 2015: 3). There is some descent in the ranking when compared to that of 2012; however, it remains at a considerable level in terms of the worldwide economy of the sector.

When we review China, we can see that China is actually the country that dominates the international chemical industry. On the Figure 2, you can see the geographical breakdown of worldwide sales of chemical products in 2014 (in billion Euros). As it can be seen on the figure, China alone has more sales than those of economic unions such as EU, NAFTA etc. In this sense, we can easily say that China really dominates the chemical industry all around the world as it does throughout all other industries.

Four of seven emerging sectors set out in the 12th Five-Year Plan covering the period of 2011-2015 are affiliated with the chemical industry where such five-year plans are of great importance for governments and also for industries. (KPMG, 2013: 14). This can be considered as a preliminary indication of steps to be taken by the country to increase its efficiency in the upcoming period.

## 5.INDEX OF REVEALED COMPARATIVE ADVANTAGES AND APPLICATION THEREOF ACROSS CHEMICAL INDUSTRIES OF TURKEY - BRIC COUNTRIES

One of the most significant factors that affect competitiveness of a country is foreign trade indicators. Countries do foreign trade by relying on their comparative advantages.

Changes experienced through such comparative advantages over time can be clarified by data derived from foreign data. It may be hard to measure comparative advantages that determine competitive capacities of countries on an international arena as pre-trade relative costs are unknown. Thus, an RCA (Revealed Comparative Advantage) based on actual foreign trade data is employed to identify revealed comparative advantages (Yalçınkaya, 2014: 49).

RCA index is an approach that is most commonly used among those adopted for gauging the competitive power where it dominates this area. Attempts are made to identify relative export performances for certain products of countries within the scope of this approach. Liesner first utilized an RCA index in 1958, but Balassa refined and popularized its use. An RCA approach assumes that the true form of a comparative advantage will be derived from post-trade data. The purpose here is to determine whether a country has comparative advantages rather than to address underlying resources of such comparative advantages (Baltacı et al., 2012: 8).

The RCA index developed by Balassa (1965) can be expressed as follows:

$$RCA = (Xij / Xit) / (Xnj / Xnt) = (Xij / Xnj ) / (Xit / Xnt)$$

Here X represents exports; i, one country; j, one commodity (or sector); t, one group of commodities (or sectors) or n, one group of countries (or world countries). Based on these variables, RCA is measured as a certain country's share in exports of certain products of industries compared with shares of a country group of the same product or industry or with its share in total worldwide trades combined. If the calculated index value is higher than 1 (RCA>1), then the country is said to have a comparative advantage in the addressed field. If the calculated index value is lower than 1 (RCA<1), then the corresponding country is believed to have competitiveness in the production of commodities (Fertö and Hubbard, 2002: 5; Yue and Ping, 2002: 278; Utkulu and Seymen, 2004: 8-9).

Foreign trade indicators are one of the most significant factors of the competitive power of a country. This study, therefore, aims to determine whether chemical industries of Turkey and BRIC Countries have competitiveness by using the chemical industry's real foreign trade data of the period of 2007-2014 and calculating their RAC indices.

**Table 1: Chemical Industry Commodities according to SITC Rev. 4 Classification**

| SITC Rev.4 | Commodities |
|---|---|
| 5 | Chemicals and related products, n.e.s. |
| 51 | Organic chemicals |
| 52 | Inorganic chemicals |
| 53 | Dyeing, tanning and colouring materials |
| 54 | Medicinal and pharmaceutical products |
| 55 | Essential oils and resinoids and perfume materials, toilet, polishing and cleansing preparations |
| 56 | Fertilizers (other than those of group 272) |
| 57 | Plastics in primary forms |
| 58 | Plastics in non-primary forms |
| 59 | Chemical materials and products, n.e.s. |

**Source:** UN Comtrade Database, 2015.

The study involves data of chemical industries of Turkey and BRIC Countries compiled from UN COMTRADE Database within the scope of SITC (Standard International Trade Classification) Rev. 4 prepared by the United Nations. The Table 1 demonstrates classifications of commodities of the chemical industry.

**Table 2: RCA Index for The Brazilian Chemical Industry (2008-2014)**

| SITC Rev.4 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| **5** | - | 0.67 | 0.62 | 0.58 | 0.56 | 0.61 | 0.57 | 0.57 |
| **51** | - | 1.38 | 1.14 | 0.97 | 0.90 | 1.05 | 1.00 | 0.93 |
| **52** | - | 0.94 | 0.94 | 0.90 | 0.90 | 0.94 | 0.79 | 0.91 |
| **53** | - | 0.56 | 0.49 | 0.49 | 0.45 | 0.49 | 0.45 | 0.45 |
| **54** | - | 0.21 | 0.22 | 0.23 | 0.23 | 0.25 | 0.24 | 0.26 |
| **55** | - | 0.62 | 0.60 | 0.63 | 0.58 | 0.59 | 0.51 | 0.55 |
| **56** | - | 0.57 | 0.55 | 0.50 | 0.41 | 0.38 | 0.54 | 0.55 |
| **57** | - | 0.64 | 0.84 | 0.69 | 0.69 | 0.70 | 0.62 | 0.73 |
| **58** | - | 0.51 | 0.50 | 0.46 | 0.46 | 0.41 | 0.43 | 0.48 |
| **59** | - | 0.55 | 0.55 | 0.52 | 0.48 | 0.54 | 0.52 | 0.53 |

**Source:** The data in the table was calculated based on UN, Commodity Trade Statistics Database (COMTRADE).

As you can see from Table 2, this index value of this year could not be calculated as the Brazilian chemical industry's data of 2007 had not been compiled. A descent is observed in indices of all chemicals and related products after 2008 affected by the impact of the global crisis. Organic chemicals – only the division where the index value of the Brazilian chemical

industry was RCA > 1 during the period of 2008-2014 - did not survive any continuity (Under Code 51).

**Table 3: RCA Index for The Russian Federation Chemical Industry (2007-2014)**

| SITC Rev.4 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| **5** | 0.46 | 0.50 | 0.38 | 0.38 | 0.40 | 0.46 | 0.43 | 0.46 |
| **51** | 0.54 | 0.44 | 0.34 | 0.37 | 0.38 | 0.40 | 0.41 | 0.46 |
| **52** | 1.50 | 1.33 | 1.36 | 1.37 | 1.43 | 1.65 | 1.85 | 2.09 |
| **53** | 0.13 | 0.10 | 0.11 | 0.09 | 0.08 | 0.12 | 0.12 | 0.13 |
| **54** | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.05 | 0.05 | 0.05 |
| **55** | 0.28 | 0.25 | 0.26 | 0.17 | 0.15 | 1.33 | 0.24 | 0.23 |
| **56** | 8.03 | 6.21 | 6.22 | 5.85 | 5.22 | 6.05 | 5.61 | 6.22 |
| **57** | 0.16 | 0.13 | 0.19 | 0.16 | 0.15 | 0.16 | 0.19 | 0.22 |
| **58** | 0.13 | 0.11 | 0.11 | 0.06 | 0.06 | 0.13 | 0.15 | 0.17 |
| **59** | 0.16 | 0.11 | 0.11 | 0.08 | 0.07 | 0.12 | 0.13 | 0.15 |

**Source:** The data in the table was calculated based on UN, Commodity Trade Statistics Database (COMTRADE).

Table 3 includes RCA index values calculated for the Russian chemical industry. It covers two divisions under (52) Inorganic chemicals and (56) Fertilizers (other than those of group 272) where it has competitive power during and after the global crisis. It is observed that it has high competitiveness when compared to that of other countries reviewed in particular under the division of (56) Fertilizers.

**Table 4: RCA Index for The Indian Chemical Industry (2007-2014)**

| SITC Rev.4 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| **5** | - | - | 0.95 | 1.00 | 0.99 | 1.16 | 1.13 | 1.14 |
| **51** | - | - | 1.61 | 1.62 | 1.52 | 1.82 | 1.66 | 1.73 |
| **52** | - | - | 0.69 | 0.77 | 0.61 | 0.89 | 0.58 | 0.58 |
| **53** | - | - | 1.52 | 1.68 | 1.48 | 1.68 | 1.92 | 2.24 |
| **54** | - | - | 0.97 | 1.08 | 1.17 | 1.39 | 1.42 | 1.43 |
| **55** | - | - | 0.68 | 0.66 | 0.69 | 0.93 | 0.76 | 0.73 |
| **56** | - | - | 0.27 | 0.06 | 0.07 | 0.09 | 0.07 | 0.08 |
| **57** | - | - | 0.40 | 0.54 | 0.62 | 0.55 | 0.64 | 0.59 |
| **58** | - | - | 0.52 | 0.59 | 0.68 | 0.63 | 0.57 | 0.57 |
| **59** | - | - | 0.86 | 0.85 | 0.74 | 0.88 | 0.92 | 0.90 |

**Source:** The data in the table was calculated based on UN, Commodity Trade Statistics Database (COMTRADE).

As you can see from Table 4, index values of 2007 and 2008 could not be calculated as data of the Indian chemical industry were not compiled for the relevant years. It can be

seen that, when RCA index values calculated for the Indian chemical industry are compared to RCA index values of chemical industries of other countries so reviewed, India is the only country that has the competitive power under the division of (5) Chemicals and related products, n.e.s. At the same time, it has competitiveness as seen under divisions (51) Organic chemicals (53) Dyeing, tanning and colouring materials and (54) Medicinal and pharmaceutical products. With its RCA index value of 2.24 in 2014, we can also see under the division of (53) Dyeing, tanning and colouring that it has the highest competitiveness.

India has the competitiveness in the chemical industry under the division of (51) Organic chemicals as basic industrial chemicals; (53) Dyeing, tanning and colouring materials and (54) Medicinal and pharmaceutical products classified under medium and high-value-added specific and specialty chemicals derived through additional processes of basic industrial chemicals.

Table 5 shows that the China's chemical industry has 34.4% of worldwide chemical sales owing to its performance of 1.111 billion Euros in 2014 (CEFIC, 2016: 4) and has the competitive power under divisions of (52) Inorganic chemicals and (56) Fertilizers (other than those of group 272) according to its RCA index similarly as in the Russian chemical industry.

**Table 5: RCA Index for The China's Chemical Industry (2007-2014)**

| SITC Rev.4 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| **5** | 0.55 | 0.58 | 0.47 | 0.52 | 0.58 | 0.54 | 0.52 | 0.56 |
| **51** | 0.71 | 0.89 | 0.74 | 0.74 | 0.78 | 0.77 | 0.75 | 0.83 |
| **52** | 1.60 | 1.59 | 1.20 | 1.30 | 1.50 | 1.25 | 1.19 | 1.29 |
| **53** | 0.74 | 0.67 | 0.58 | 0.63 | 0.67 | 0.63 | 0.64 | 0.70 |
| **54** | 0.21 | 0.23 | 0.21 | 0.23 | 0.23 | 0.22 | 0.21 | 0.20 |
| **55** | 0.29 | 0.28 | 0.28 | 0.31 | 0.33 | 0.34 | 0.34 | 0.35 |
| **56** | 1.51 | 0.75 | 0.73 | 1.08 | 1.11 | 1.00 | 0.92 | 1.31 |
| **57** | 0.36 | 0.35 | 0.28 | 0.31 | 0.36 | 0.36 | 0.36 | 0.41 |
| **58** | 0.58 | 0.58 | 0.52 | 0.59 | 0.68 | 0.73 | 0.73 | 0.77 |
| **59** | 0.67 | 0.72 | 0.61 | 0.66 | 0.68 | 0.62 | 0.61 | 0.64 |

**Source:** The data in the table was calculated based on UN, Commodity Trade Statistics Database (COMTRADE).

However, we can see that comparative advantages referred to under those two divisions remain at a relatively low level when compared to that of the Russian chemical

industry. In other words, China follows Russia under divisions of (52) Inorganic chemicals and (56) Fertilizers (other than those of group 272). All in all, we can see that the China's chemical industry has also been affected by the global economic crisis in 2008.

(52) Inorganic chemicals and (56) Fertilizers (other than those of group 272) are under basic industrial chemicals where Russian and Chinese chemical industries have the competitive capacity. Such chemicals are used mostly for manufacturing other chemicals.

**Table 6: RCA Index for The Turkey's Chemical Industry (2007-2014)**

| SITC Rev.4 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| **5** | 0.45 | 0.45 | 0.43 | 0.50 | 0.50 | 0.51 | 0.54 | 0.57 |
| **51** | 0.17 | 0.19 | 0.15 | 0.21 | 0.18 | 0.19 | 0.17 | 0.17 |
| **52** | 0.34 | 0.30 | 0.30 | 0.37 | 0.35 | 0.43 | 0.40 | 0.51 |
| **53** | 0.87 | 0.91 | 0.98 | 1.10 | 1.08 | 1.13 | 1.28 | 1.23 |
| **54** | 0.16 | 0.14 | 0.14 | 0.18 | 0.17 | 0.18 | 0.20 | 0.19 |
| **55** | 1.13 | 1.13 | 1.17 | 1.25 | 1.25 | 1.23 | 1.29 | 1.35 |
| **56** | 0.39 | 0.41 | 0.28 | 0.57 | 0.40 | 0.28 | 0.21 | 0.33 |
| **57** | 0.32 | 0.33 | 0.35 | 0.39 | 0.42 | 0.42 | 0.43 | 0.48 |
| **58** | 2.04 | 2.11 | 2.03 | 2.14 | 2.30 | 2.31 | 2.52 | 2.56 |
| **59** | 0.33 | 0.29 | 0.30 | 0.35 | 0.34 | 0.37 | 0.41 | 0.39 |

**Source:** The data in the table was calculated based on UN, Commodity Trade Statistics Database (COMTRADE).

Table 6 shows RCA indices of the Turkish chemical industry during the period of 2008-2014. The Turkish chemical industry has considerable competitiveness advantages under divisions of (53) Dyeing, tanning and colouring materials, (55) Essential oils and resinoids and perfume materials, toilet, polishing and cleansing preparations and (58) Plastics in non-primary forms. In particular, it may be a significant advantage when BRIC countries make their presence felt under divisions of (55) Essential oils and resinoids and perfume materials, toilet, polishing and cleansing preparations and (58) Plastics in non-primary forms where their chemical industries gain comparative advantages. The Turkish chemical industry has a competitive capacity under divisions of (53) Dyeing, tanning and colouring materials and (58) Plastics in non-primary forms as part of special and specialty products, and (55) Essential oils and resinoids and perfume materials, toilet, polishing and cleansing preparations as part of consumer chemicals.

## 6. CONCLUSION

The chemical industry has a crucial role in production and also in foreign trade as a business line that procures intermediate goods and raw materials for many industries. There are very few products manufactured by use of raw materials in the chemical industry. Within this context, it procures end and intermediate products for many industries ranging from pesticides, synthetic fertilizers, veterinary drugs, synthetic fibres, soap, detergent, cleansing materials, plastic raw materials, medicines for human use, cosmetics, paint, auxiliary materials, leather, textile, construction (pipe, sheet, door, window etc.), glues, joints (seams), filling materials, insulation materials, photograph materials, gun powder and explosives.

When considering the extent of the chemical industry as well as its global positioning, its close relationship with any industrial production facilities as well as its increasing trade volume make this industrial area open to developments and readily available for investments. The growth of developing countries in this sector is one of the most significant indicators for it.

Comparative advantages of chemical industries and competitive capacities of BRIC countries in addition to that of Turkey are reviewed on the basis of Balassa's Revealed Comparative Advantage index, and we can see according to findings derived from this study that the economic crisis sustained in 2008 had an impact on the chemical industry as it did on other areas. It is observed that effects of the crisis have been diminishing since 2010.

Russian and Chinese chemical industries are seen to have competition capacities under basic chemicals used for manufacturing other chemicals; and the Indian chemical industry, under medium and high-value-added specific and specialty chemicals derived through additional processes of basic industrial chemicals, and the Turkish chemical industry, under specialty groups and also consumer chemicals.

If Turkey and BRIC countries like to make their chemical industries competitive, then they have to set up and develop their own technologies in the manufacture of high- value-added and environmental friendly products. They therefore need to develop their R&D culture in the sector by developing their R&D policies.

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