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Measuring Competitiveness in Chinese Electrical Machinery and Equipment Industry

Murat Emikönel

Kocaeli University, Faculty of Economic and Administrative Science, Economics Department, E-mail: murat.emikonel@kocaeli.edu.tr

Abstract

Today, China is the fastest growing and most exporting country in the world. The electrical machinery and equipment industry ranks first in China's trade volume. Therefore, The study aims to determine the comparative advantage and competitiveness of China's electrical machinery and equipment industry over the years. For this purpose, Balassa's Revealed Comparative Advantages Index (RCA), Relative Export Advantage Index (RXA), Relative Import Advantage Index (RMA), Relative Trade Advantage Index (RTA), Relative Competitive Advantage Index (RC) was used. According to the results of the analysis, the competitive advantage of China in the world market is high in this sector.

Keywords

Revealed comparative advantages, competitiveness, electrical machinery and equipment industry, China

JEL Codes: E10, F14, F40

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1. Introduction

Countries compete fiercely with each other to have a voice in international markets and reach high growth targets. Creating added value rather than selling products is more important to gain the upper hand in this competition. As conceptually competitiveness is the ability of a country to offer products and services that meet local and international quality standards, and to provide adequate returns from local and international markets (Etuk and Ohen, 2017). Emphasizing the importance of the country factor, Porter had said that local factors come to the fore in terms of creating and sustaining competitive advantages, contrary to the opinion that the country factor has become insignificant in the globalizing world. He tried to demonstrate the impact of these local elements with the model he called "Diamond Model." These factors are Factor Conditions, Demand Conditions, Related and Supporting Industries, and Firm Strategy and Rivalry (Porter, 1998). In this context, he conducted a four-year study with ten countries and emphasized that local features come to the fore in terms of creating and sustaining competitive advantages. Looking at the history of comparative advantage in international trade, the concept was first built on the principle of absolute superiority by Adam Smith (1776) and later developed by classical economist David Ricardo (1817). According to this theory, if a country has comparative advantage in the production of a good over another country it means that its opportunity costs of production are relatively lower than in the other country. Neoclassical economists Eli Heckscher (1919) and Bertil Ohlin (1933) developed the idea of comparative advantages in a model based on differences in resource donations. However, there are some difficulties in measuring the comparative advantage and testing the Hecksher-Ohlin theory. Because relative prices under autarky are not observable. Balassa (1965) says that comparative superiority "emerged" with observed patterns of trade, without including all factors that affect the country's comparative advantage. Comparative advantage from observed data is named “revealed” comparative advantage (RCA) (Ishchukova and Smutka, 2013).

2. China's commercial history

Looking at China's trade history, before 1978, China was a centrally planned economy with a limited trade relationship with the rest of the world. With the adopted protectionist and import substitution policies, it aimed to improve the export structure of China and to support the economic growth of the domestic industry as a whole. Due to the lack of competition, China has benefited limitedly from both the static and dynamic gains of free trade. Since 1978, China made important changes in its economic structure and gradually liberated its trade to create a socialist market economy. As a result of the new economic growth policy, there was a sharp increase in imports with an increase in average income. For this reason, in the early 1980s, customs tariffs were applied to stop the entry of many foreign products into the Chinese market. However, to promote the market mechanism and more efficient resource allocation, the Chinese government later canceled its import substitution policy and gradually reduced customs duties and non-tariff barriers (Caporale & Sova, 2015). Today, China is

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the fastest growing and most exporting country in the world. Among the sectors that stand out in the imports of China in 2019; electrical machinery and equipment, crude oil and petroleum oils, iron ores and concentrates and roasted iron pyrites, automobile and telephone/audio/video devices. Likewise, in 2019 exports, electrical machinery and devices rank first as in imports. The sector is of great importance for the Chinese economy as it is the first in both exports and imports. Considering this situation, the electrical machinery and equipment sector was examined in this study (https://www.trademap.org/, 2020). China's export-oriented development strategy can change the shape of the comparative advantage for labor-intensive manufacturers in the world market. There is also an ongoing debate in emerging countries about the rise of China and the threat and opportunity these poses (Batra and Khan, 2005). China, on the other hand, can support export growth by increasing the production of products with comparative advantage (Yue & Hua 2002).

To China or another country to compete in the international arena, it must have international competitiveness. For this reason, over the years, international competitiveness has become a target in economies' struggle to achieve high levels of performance. Since the macroeconomic environment and stability play an important role at the national level, the international competitiveness of a country is also directly related to the international competitiveness of the companies (Herciu, 2013). The electrical machinery and equipment industry ranks first in China's trade volume. Therefore, the study aims to determine the comparative advantage and competitiveness of China's electrical machinery and equipment industry over the years. Both academic and government economists use the RCA index in various studies on commercial policy and structural adjustment issues. For this purpose, primarily the RCA index was used. The advantage of the approach is that it can be easily measured in the form of an index used in cross-country and cross-industry comparisons of various types (Yeats, 1985). In addition to this index, RXA, RMA, RTA, and RC indices were calculated.

3. Lierature review

Some countries see the concept of competitiveness as a macroeconomic phenomenon such as interest rates and exchange rates, while others see abundant natural resources, cheap and abundant labor (Porter, 1990). Competitiveness is important in terms of performance in the tradable sector (Durand *et al*., 1992). In the past, many authors analyzed the country's competitiveness in different sectors, using the revealed comparative advantage index (RCA). Looking at the previous studies (Balassa, 1979; Prasad, 1997; Leu, 1998; Das, 1998; Batra & Khan, 2005; Balasubramanyam & Wei, 2005; Kilduff & Chi, 2007; Gao, 2007; Widodo, 2008), the researchers used the revealed comparative advantage index to study the competitiveness and trade structure of different economies and sectors (Islam, 2001; Ahmed, 2009). The RCA index was used by Seyoum (2007) for analyzing the services sector in developing countries; Vaidya & Bennett (2007), for evaluating the degree of change of China's comparative advantage; Ferto & Hubbard (2003), to analyze the competitiveness of Hungary's agri-food products compared to the EU; Jayawickrama & Thangavelu (2010), for analyzing trade links in industrial products and the degree of export competitiveness; Batra & Khan (2005), for analyzing the comparative advantage of China and India according to factor density; Mykhnenko (2005), for analyzing the competitiveness of Poland and Ukraine in technology products; Hossain (2006), to identify the strengths and weaknesses of Bangladesh's fisheries exports. More recently, He & Lin (2016), Balogh & Jambor (2017), Fojtíková (2017), Szczepaniak (2018) have worked to analyze industry-specific and country-specific competitiveness using the RCA approach.

There are many studies to measure China's competitiveness. For example, Adams *et al.* (2006) analyzed China's competitiveness in the world economy and reached the conclusion that China is successful in catching the world export markets. Vaidya & Bennett (2007) examined China's comparative advantage in manufacturing between 1987 and 2005 and concluded that China remained competitive in low-tech labor-intensive products. Wei and Chunming (2012) conducted a detailed analysis of the comparative advantage of Chinese manufacturers in the world and US markets between 2002 and 2009 and emphasized that most of the comparative advantage products have comparative advantage in low-tech products. Nath et al. (2015) analyzed the patterns and determinants of comparative advantage in China and India and US service trade between 1992-2010 using comparative advantage criteria. Yu & Qi (2015) examined the competitiveness and complementarity of Chinese and 5 Central and Eastern European countries in agricultural products using the RCA, TCI, and GL indices. Fojtíková (2017) analyzed the competitiveness of the Chinese iron and steel industry in the 2001-2016 period using the announced comparative advantage index. According to the analysis result, it was concluded that China had a comparative advantage only in 2007, 2008, 2014, 2015, and 2016.

In this study, primarily the RCA index was used. Both academic and government economists use the RCA index in various studies on commercial policy and structural adjustment issues. The feature that distinguishes the study from other studies is that China examines the electrical machinery and equipment industry in terms of the revealed comparative advantages. In other studies, different sectors were analyzed or two countries were compared for China. This study will help determine whether China has comparative advantages in the electrical machinery and equipment industry.

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4. Methodology of research

In the study, the international competitiveness of China's electrical machinery and equipment sector between 2001-2018 was measured and analyzed with the RCA index, RXA index, RMA index, RTA index, RC index. The data used to calculate the indices in the study were taken from the International Trade Center in US dollars. (Code: 85).[1]

4.1. The revealed comparative advantage index (RCA)

The revealed comparative advantage ındex, first introduced by Liesner (1958), was developed by Balassa in 1965. RCA index, which can also be expressed as Balassa Index; compares the country's domestic specialization in one sector with that of the world or other country (Bojnec, 2001). It is calculated as follows:

$$RCA = (x_{ij}/x_j)/(x_{iw}/x_w) \quad (1)$$

x_{ij}: country *j* export of product i; x_j: country *j* total export; x_{iw}: world export of product i; and x_w: total export of the world.

If the RCA index is equal to 1 as a result of the analysis, the export share of the sector under consideration is the same as the world average. If the RCA index value is over 1, the country is said to have a relative advantage in this sector. The country is said to have a relative weakness in this sector when RCA is below 1 (Laursen, 1998).

Vollrath, criticizing the index developed by Balassa, said that the revealed comparative advantages index only considers exports, whereas the net export effect should be taken into account along with exports and imports when calculating the index. Thus, he made three different definitions for the revealed comparative advantages index. These are the relative export advantage index, relative import advantage index and relative trade advantage index (Vollrath, 1991).

4.2. The relative export advantage index (RXA)

The difference of this index from the revealed comparative advantage is the subtraction of the numerator in the denominator section. Thus, it is prevented that the goods or sector in question are added to the calculation twice.

$$RXA = (x_{ij}/x_{kj})/(x_{iw}/x_{kw}) \quad (2)$$

x_{ij}: country *j* export of product i; x_{kj}: country *j* export rest of the commodities; x_{iw}: export of product i; and x_{kw} world export of the rest of the commodities.

As a result of the analysis, if the index value is greater than 1, it means that the country has a competitive advantage in the product, and if it is less than 1, the country is disadvantageous.

4.3. The relative ımport advantage index (RMA)

The difference of this index from the relative export advantage index is that it uses import data instead of export data in the equation and is interpreted as the opposite of the relative export advantage index.

$$RMA = (M_{ij}/M_{kj})/(M_{iw}/M_{kw}) \quad (3)$$

M_{ij}: country *j* import of product i; M_{kj}: country *j* import rest of the commodities; M_{iw}: world import of product i; and M_{kw}: world import of the rest of the commodities.

As a result of the analysis, if the index value is greater than 1, it means that the country has a disadvantage in the product, and if it is less than 1, the country is in an advantageous state.

4.4. The relative trade advantage index (RTA**)**

The Relative Trade Advantage Index is an index that considers imports as well as exports. The index is equal to the difference between the Relative Export Advantage Index and the Relative Import Advantage Index.

$$RTA = RXA - RMA \quad (4)$$

As a result of the analysis, if the index value is positive, it means that the country has a competitive advantage in the product, and if it is a negative value, the country is disadvantageous.

[1] Code 85 refers to electrical machinery and equipment and parts thereof. Moreover, code 85available at website

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4.5. The relative competitive advantage index (RC)

RC is the difference between the logarithm of the Relative Export Advantage Index and the logarithm of the Relative Import Advantage Index.

Formulated of Relative Competitive Advantage Index (RC);

RC = Ln (RXA) -Ln (RMA) (5)

According to Vollrath, the RC index is more likely to be preferred because it contains the supply and demand balance. He explains the reason for this as a better reflection of the comparative advantage of a country or a good (Vollrath, 1991). However, in cases where there is no bilateral trade (no import or export), it will not be possible.

Vollrath said that the RTA, RXA, and RC indices show the competitive advantage of the positive values, and the negative values indicate the competitive disadvantage. The most important feature of these three indices is that the product in the equation is distinguished from the other products. Vollrath's indices take into account all traded products and all countries and examine the global trade intensity. It covers both relative supply and relative demand dimensions, as it uses export and import data. Thus, double counting is not done in the index calculation. Also, Vollrath states that the RXA index is used more widely in practice (Vollrath, 1991).

5. Results

In this part of the study, first of all, the export and import shares of the electrical machinery and equipment sector are evaluated. Later, China's export and import shares in this sector were revealed.

Table 1. Worldwide export and import shares of the electrical machinery and equipment industry, 2001-2018

Code: 85	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Share of exports	0.059	0.073	0.087	0.103	0.123	0.139	0.166	0.178	0.187	0.198	0.209	0.225	0.243	0.241	0.258	0.242	0.237	0.242
Share of imports	0.062	0.079	0.098	0.108	0.119	0.128	0.134	0.130	0.141	0.147	0.150	0.162	0.176	0.166	0.173	0.167	0.167	0.175

Note: Code 85 refers to electrical machinery and equipment and parts thereof.

When Table 1 is analyzed, the share of electrical machinery and devices increased both in exports and imports from 2001 to 2018 worldwide. The export rate, which was 0.59% in 2001, increased to 24.2% in 2018. The import rate, which was 6.2% in 2001, increased to 17.5% in 2018. The rate of increase in exports is higher than that of imports. These increases in rates show how intensive trade is in the sector. Particularly, the fact that China ranks first in the exports and imports of the sector and the developments in technology have increased the world demand and domestic demand for the sector, and the trade volume in the sector has improved.

Table 2. RCA, RXA, RMA, RTA, RC Index, 2001-2018

Code: 85	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
RCA	1.36	1.68	2.01	2.38	2.84	3.21	3.83	4.09	4.31	4.56	4.81	5.19	5.61	5.54	5.95	5.58	5.46	5.57
RXA	1.44	1.55	1.61	1.75	1.87	1.94	2.17	2.29	2.23	2.19	2.30	2.34	2.45	2.24	2.17	2.13	2.14	2.19
RMA	1.77	2.02	2.10	2.07	2.23	2.37	2.34	2.15	2.01	1.79	1.73	1.82	1.91	1.77	1.95	1.93	1.81	1.81
RTA	-0.32	-0.47	-0.48	-0.32	-0.36	-0.43	-0.16	0.14	0.22	0.40	0.57	0.52	0.54	0.47	0.22	0.20	0.33	0.37
RC	-0.20	-0.27	-0.26	-0.17	-0.18	-0.20	-0.07	0.06	0.11	0.20	0.29	0.25	0.25	0.24	0.11	0.10	0.17	0.19

Note: Code 85 refers to electrical machinery and equipment and parts thereof.

Table 2 shows the RCA, RXA, RMA, RTA, and RC index values for China between 2001-2018. The fact that the RCA index value is greater than 1 indicates that China has a comparative advantage in the electrical machinery and equipment sectors. Moreover, the higher the RCA index value, the greater the competitive advantage of the country. The index value has increased continuously from 2001 to 2013. There is a decrease in the rate of 2014, 2016, and 2017, but the superiority continues. In 2018, the rate increased again. These results show that China has very high competitive power in the sector. Looking at the RXA index values, China has a competitive advantage in exports in the electrical machinery and equipment sectors. There is an increasing competitive advantage between 2001-2008. Although it maintained its competitive advantage in 2009-2010, there was a decrease in the rate. Later, the rates recovered and increased for the years 2011-2013. Although it maintained its competitive advantage for the years 2014-2016, small decreases were observed in the rates and it increased again after 2017. While the RMA Index value greater than 1 indicates the disadvantage in the competition, less than 1 indicates the advantage in the competition. It is disadvantageous in imports in Chinese electrical machinery and equipment sectors for 2001-2018. The disadvantaged situation for 2004, 2007-2011, 2014, 2017-2018 has improved slightly compared to previous years. However, in general, China is at a disadvantage in the sector.

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A positive value of the RTA Index shows an advantage in competition, while a negative value shows a disadvantage in competition. In this case, China is at a disadvantage in the sector between 2001-2007. Between 2008 and 2018, China became advantageous in the sector. Although the advantageous situation continued in 2012 and 2014-2016, there were small decreases compared to previous years, but the most severe decline occurred in 2015.

A positive value of the RC Index shows an advantage in competition, and a negative value indicates a disadvantage in competition. As such, China is at a disadvantage in the industry between 2001-2007. Since 2008, China has become advantageous with its competitiveness. Looking at the results over the years, results similar to the RTA index are also seen in the RC index. Although the advantageous situation continued in 2012, and 2014-2016, there were small decreases compared to previous years, but the most severe decline occurred in 2015.

Considering the results, the most striking indices are RTA and RC indices. RTA and RC indices changed from negative to positive since 2008. There are several reasons for this situation. First, after the crisis, China's exports increased more than imports in this sector. In addition to this, China's export growth in this sector has been higher than the world's export growth in this sector. This means that the numerator portion increases more than the denominator portion. As a result, it means an increase in the index value. Another factor that affects the index positively is that both the sectoral increase in world exports and the increase in exports in the whole goods group lag behind China's export increases. In this case, according to the index calculation, the RMA index has decreased because the denominator portion will increase compared to the numerator portion. Although there are increases in the RMA index over the years, the fact that the RXA index has increased more than the RMA index has provided the RTA and RC indices to maintain a positive situation. When the post-crisis period is summarized, it is seen that the increase in exports in China's electrical machinery and equipment sector and all sectors are higher than the increase in imports. Also, China's export growth was higher than the world export increase in both the electrical machinery and equipment industry and all commodity groups. The fact that China's share of the electrical machinery and equipment sector in the world increased from 17.7 percent in 2008 to 24.2 percent in 2018 supports this. As a result, both the increase in the share of China's electrical machinery and equipment sector in the world and the increase in index results show that China has a great dominance in this sector.

6. Conclusions

With the innovations brought by globalization to the world, the world has become a global village where borders remain only on paper. With the removal of borders in this way, competition between countries gained speed and they entered the race to get more share of world income. In countries, they respond to these changes by directing their competitiveness to the areas they specialize in. Determining in which sector the countries are advantageous and concentrating in that sector increases the income of the countries as well as generating income for the whole world. The mutual removal of quotas after China's membership in the world trade organization has been an important factor affecting its trade. In addition to this, abundant and inexpensive labor force, steadily high growth figures and foreign direct investments have provided an advantage for China to gain a competitive edge. Therefore, the competitiveness of the electrical machinery and equipment sector, which ranks first in the Chinese trade, was investigated. Thus, the importance of the sector in the Chinese economy was emphasized. As a result of this study, which examines the comparative advantage and competitiveness of China's electrical machinery and equipment industry, it is seen that China's electrical machinery and equipment industry has comparative advantage and competitiveness in the world markets. According to the results of RCA, RXA, RTA RC index, China is advantageous in both competition and exports. However, according to the RMA index results, China is at a disadvantage in imports. The reason for this is that China imports more in this sector compared to other countries. As China uses this import to increase its exports and meet its domestic demand, it has become very advantageous in other indices, especially in the RCA and RXA indices, and has increased this advantage over the years. Also, China uses these imported products as intermediate goods. For this reason, this situation, which seems to be disadvantageous, provides an advantage as it has turned into value-added products in the following years. It may also increase the importance it attaches to technological development and investments in R&D to maintain and increase its competitiveness in the sector during and after this period.

In future studies, the competitiveness of different regions of China in the electrical machinery and equipment sector can be determined. Thus, government incentives for the electrical machinery and equipment sector can be provided to regions that benefit more from specialization. Different from this study 48 different subgroups in the sector can be analyzed. Thus, it can be determined which products have a comparative advantage and which ones should focus on their production.

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Appendix 1

Export figures for electrical machinery and equipment and parts thereof (US Dollar thousand)

Years	China's export of code 85	China's total export	World's export of code 85	World's total export
2001	51299483	266098209	869479244	6127467761
2002	65113879	325595970	893963844	6424391781
2003	88957089	438227767	1019985671	7486202969
2004	129652028	593325581	1252996271	9099996891
2005	172313776	761953410	1397732980	10340858415
2006	227476356	968935601	1633507475	11956256558
2007	300306615	1220059668	1806776468	13832342053
2008	342083349	1430693100	1925242897	15969594225
2009	301099032	1201646800	1607277124	12346656501
2010	388755010	1577763800	1962946621	15095502449
2011	445756705	1898388400	2132349898	18103987370
2012	487322454	2048782200	2164161287	18395803866
2013	561288340	2209007300	2305452245	18881587009
2014	570924486	2342292696	2373463168	18878970324
2015	594325411	2273468224	2299890370	16399773904
2016	553168922	2097637172	2283148482	15881855749
2017	598325186	2263370504	2525220604	17550866220
2018	664425033	2494230195	2744835074	19284580098

Note: Code 85 refers to electrical machinery and equipment and parts thereof.

Appendix 2

Import figures for electrical machinery and equipment and parts thereof (US Dollar thousand)

Years	China's import of code 85	China's total import	World's import of code 85	World's total import
2001	55881167	243552881	908351239	6296038499
2002	73244911	295170104	928310234	6600816800
2003	103918388	412759796	1064750408	7701147992
2004	142313337	561228748	1323201301	9392556197
2005	174835242	659952762	1473329930	10609058973
2006	218965743	791460868	1705984654	12260643416
2007	256822547	956115448	1914916654	14097073216
2008	266514884	1132562200	2045369258	16337564429
2009	243756119	1005555200	1731967442	12617842289
2010	314282498	1396001600	2143685648	15317452371
2011	350954252	1743394900	2334903856	18333200296
2012	381520999	1818199200	2360179749	18499034199
2013	439417537	1949992300	2494670588	18890303095
2014	424319488	1959234625	2553556781	18900140474
2015	428694319	1679564325	2471339434	16523532123
2016	412879365	1587920688	2471705185	16041432143
2017	457922456	1843792939	2749101312	17795040828
2018	521542155	2134987265	2972992558	19665278451

Note: Code 85 refers to electrical machinery and equipment and parts thereof.

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