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BURSA INTERNATIONAL TRADE AND LOGISTICS SYMPOSIUM-II

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EDITOR
Prof. Dr. Orhan ÇAĞLAYAN



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INTERNATIONAL TRADE OF GREEN PRODUCTS: AN ANALYSIS OF TRANSPORTATION TECHNOLOGIES

YEŞİL ÜRÜNLERİN ULUSLARARASI TİCARETİ: ULAŞIM TEKNOLOJİLERİ ÜZERİNE BİR ANALİZ

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ABSTRACT

In order to minimize the extent of environmental problems, the production of green products, which are defined by their environmentally friendly properties, lower pollution levels and convertibility, has become increasingly important in recent years. Although green products are classified under many headings, transportation, which is the second largest source of carbon emissions after energy conversion, and transportation technology products of transportation come to the forefront in this classification. Transportation technology products encompass a multitude of items, including electric cars, electric motors, electric batteries, electric heating resistances, and electric motors. The production of these products can confer a competitive advantage upon countries and companies while simultaneously mitigating environmental issues. Consequently, the objective of this study is to analyze the international trade of green transportation technology products that can bestow a competitive advantage upon Türkiye. The selected Harmonized System (HS) coded product groups for transportation technologies, spanning the period from 2012 to 2022, were obtained from the Trade Map database. Consequently, the revealed comparative advantage (RCA) index was employed. The RCA index indicates that Türkiye has a comparative advantage in two of the selected transportation technology product groups: electric heating elements and parts and accessories for motor vehicles. Concurrently, Türkiye is a net exporter in one product group, namely parts and accessories for motor vehicles. Although Türkiye has a trade surplus in transportation technology product groups that are considered important for reducing carbon emissions in the period 2012-2022, it has a comparative advantage in a limited number of product groups. Moreover, Türkiye has the potential to gain a comparative advantage in lead-acid storage batteries.

Key Words: Green Product; Green Export; Comparative Advantages; Competitive Advantage; International Trade

ÖZET

Çevresel sorunların boyutunu en aza indirebilmek amacı ile çevre dostu özellikleri, daha düşük kirlilik düzeyleri ve dönüştürülebilirlikleri ile tanımlanan yeşil ürünlerin üretimi son yıllarda gittikçe önem kazanmıştır. Yeşil ürünler birçok başlık altında sınıflandırılmakla birlikte enerji dönüşümünden sonra en büyük ikinci karbon emisyon kaynağı olan taşımacılık ve taşımacılığa ait ulaşım teknolojileri ürünleri bu sınıflandırmada ön plana çıkmaktadır. Ulaşım teknolojileri ürünleri içinde başta elektrikli otomobiller olmak üzere elektrik motorları, elektrik pilleri, elektrik bataryaları, elektrikli ısıtıcı rezistanslar gibi birçok kalem yer almaktadır. Bu ürünlerin üretimi ülkelere ve firmalara rekabet üstünlüğü sağlayabileceği gibi aynı zamanda çevresel sorunları da en aza indirecektir. Bu doğrultuda çalışmanın amacı, Türkiye'ye rekabet üstünlüğü kazandırabilecek yeşil ulaşım teknoloji ürünlerinin

uluslararası ticaretini analiz etmektir. 2012-2022 dönemini kapsayan ulaşım teknolojileri için seçilmiş Harmonize Sistem (HS) kodlu ürün grupları, Trade Map veritabanından elde edilmiştir. Bu doğrultuda, açıklanmış karşılaştırmalı üstünlükler (RCA) endeksi kullanılmıştır. RCA endeksine göre Türkiye'nin seçilmiş ulaşım teknolojileri ürün gruplarından ikisinde (elektrikli ısıtıcı rezistanslar ile motorlu taşıtlara yönelik parça ve aksesuarlar) karşılaştırmalı üstünlüğe sahip olduğu görülmüştür. Aynı zamanda bir ürün grubunda (motorlu taşıtlara yönelik parça ve aksesuarlar) ise Türkiye'nin net ihracatçı konumda sahip olduğu görülmüştür. Türkiye, 2012-2022 döneminde karbon emisyonunun azaltılmasında önemli görülen ulaşım teknolojileri ürün gruplarında dış ticaret fazlası verse de, az sayıda ürün grubunda karşılşatırmalı üstünlüğün olduğu tespit edilmiştir. Buna ek olarak, Türkiye'nin kurşun-asit depolama pillerinde ise ürün gruplarında ise karşılaştırmalı üstünlük potansiyeli olduğu bulgusuna ulaşılmıştır.

Anahtar Kelimeler: Yeşil Ürün; Yeşil İhracat; Karşılaştırmalı Üstünlükler; Rekabet Üstünlüğü; Uluslararası Ticaret

INTRODUCTION

International trade plays a pivotal role in fostering economic prosperity and ensuring that individuals have access to a diverse range of products. Nevertheless, the market's inability to achieve success and the subsequent deterioration of the environment are two additional negative consequences. The absence of a robust global environmental organization has the effect of impeding the monitoring of environmental pollution resulting from the production and consumption of goods and services. Nevertheless, international trade organizations are capable of exerting considerable influence over the production and consumption activities of individual countries through the imposition of trade restrictions. It is possible that the aforementioned restrictions may indirectly influence environmental pollution. In certain instances, countries are directly responsible for establishing environmental standards. This situation is not conducive to the desired outcome. In certain instances, the imposition of high standards by domestic firms may result in the relocation of production to countries with lower standards. However, in parallel with the growing environmental awareness of individuals and civil society organisations, both countries and firms are compelled to adapt their production processes to accommodate these new challenges. In addition, the products manufactured in accordance with green trade policies are undergoing a process of transformation into green products.

The term "green products" is used to describe products that have been designed with minimal impact on the environment. In comparison to traditional alternatives, the objective of green products is to reduce environmental pollution, energy consumption, and material utilization (Wang et al., 2021: 1). The aforementioned products encompass those manufactured from recycled materials, those designed for reuse or recycling, and those derived from renewable resources (Korucuk and Çetin, 2019: 252). Furthermore, green products may also be defined as those that have been certified as environmentally friendly by an independent third party. Moreover, green products encompass a diverse range of products, including energy-efficient devices, environmentally friendly construction materials, and many other items.

In the contemporary era, a subset of the more prevalent green product categories can be delineated as follows (Sdrolia and Zarotiadis, 2019: 153):

1. Energy-Efficient Appliances: These devices consume less energy than traditional models. The reduction in energy consumption has resulted in both a reduction in carbon footprint and a reduction in electricity bills.

2. Environmentally Friendly Construction Materials: These materials are produced from sustainable resources. In addition, these materials are designed to be environmentally friendly throughout their lifespan.

3. Recycled Products: The term "recycled products" is used to describe products that have been transformed from one form to another. The term "recycled products" refers to materials derived from waste, including at least some of the components of the original product. The use of recycled products can help to reduce the amount of waste sent to landfill and incineration facilities.

4. Compostable Products: Compostable products are composed of organic materials that can be safely composted. The use of compostable products can help to reduce the need for chemical fertilizers and pesticides, while also improving the quality of the soil over time.

Green products are typically composed of durable and recycled materials. Additionally, the use of minimal packaging and packaging materials is employed for green products. It is not feasible to encounter a completely green product. It is important to note that the production of these products continues to rely on a variety of energy sources and resources. The production, storage, transportation, and disposal of these products result in the generation of byproducts and emissions. In this context, the concept of "green" is still relatively new. These products are defined as those with a lesser environmental impact than their alternatives (Durif et al. 2010: 27).

The concerns about the impact of consumption habits on the environment have been on the rise alongside the growing interest in green products. In order to encourage sustainable economic and social growth, governments have focused their efforts on the development and promotion of green products (Yuan et al., 2021: 399). In comparison to traditional products, green products tend to be more expensive and command a higher price. Consequently, the acceptance of green products has been impeded (Yang et al., 2021: 61413). Conversely, governments have employed a range of regulatory instruments to encourage the production and consumption of these products. necessity for firms to engage in green production, acquisition of green materials, and implementation of green technologies has led to a rise in production costs, which in turn has prompted firms to reduce incentives for production.

Green products can be classified in a number of ways, including by the type of green infrastructure involved, such as green construction. Transportation technologies also constitute a significant subset of the products and services that are classified as "green." In the context of transportation technology, green transportation is defined as the elimination of environmental harm caused by the transportation sector through the replacement of fossil fuels with sustainable energy sources, the optimization of transportation networks, and the reduction of costs. This can be expressed as follows (Gültaş and Yücel, 2015: 77).

Given that the transportation sector accounts for approximately one-quarter of global carbon emissions (Li et al., 2022: 1), the utilization of green products in this field has intensified and gained prominence. Moreover, the high economic value of these products, which are produced primarily in developed countries, has also contributed to the importance that countries ascribe to this product group. In order to maintain or enhance their competitive advantage in the global market, countries have increasingly allocated resources to green transformation initiatives and accelerated research and development activities in the field of green products. It is of great importance to the Turkish economy that the sector of transportation and equipment be able to compete effectively in order to maintain its position in the global market. In this context, Figure 1 presents an overview of Türkiye's foreign trade data on transportation technologies.

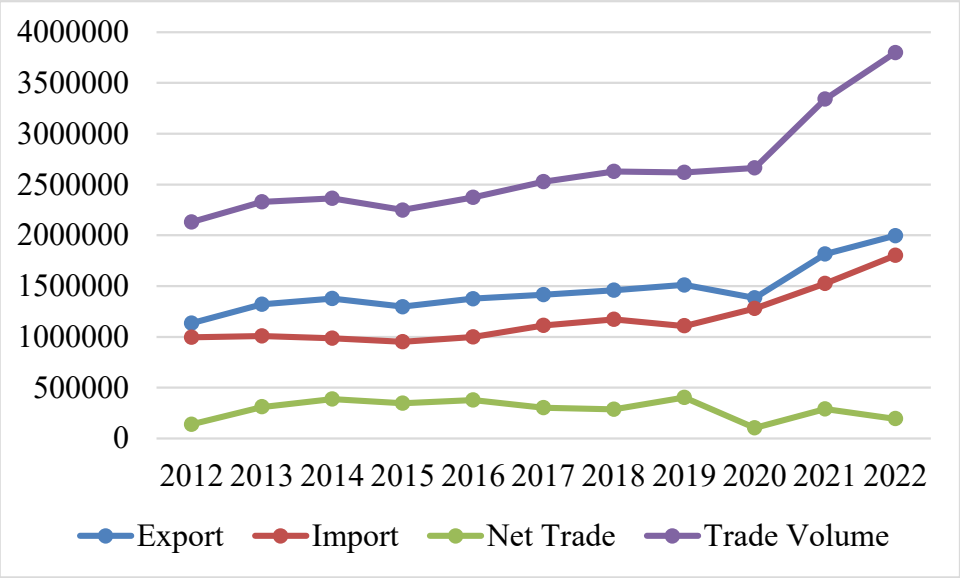


Figure 1. Türkiye's Transportation Technologies Foreign Trade Data (Thousand USD)

Source: Created by the authors using TÜİK (2024) data

According to Figure 1, there has been no significant increase in Türkiye's export and import of transportation technologies and related foreign trade volume until 2020. Significant growth was observed in 2021 and 2022, with total foreign trade reaching approximately 4 billion dollars, while export and import figures approached 2 billion dollars. Additionally, in the realm of transportation technology, the net export surplus reached approximately $200 million in 2022.

LITERATURE REVIEW

Marjan et al. (2012) conducted a study in which they examined comparative advantage in transportation services through the case of Slovenia. The results of the study indicate that Slovenian transportation services are among the top three importers of transportation services from Austria, Italy, and Germany. During the 2005-2009 period, there was an increase in the export of transportation services from Germany and Austria, while the export of transportation services from Italy decreased by approximately 4%. The highest growth in transportation services exports was recorded in Hungary, yet Hungary's transportation services imports from Slovenia were only 3% of its transportation services exports.

Hudakova (2016) analyzed the trade competitiveness of Slovakia's automotive industry using data from 2010-2015. In order to achieve this objective, the RCA, RCA1, RCA2, Michaley Index, and Grubel-Lloyd Index were employed. The results indicate that Slovakia has a comparative advantage in the commercial vehicle sector. The RCA1 index value increased from 1, indicating an intensification of competition. The RCA2 index value also increased, demonstrating that the country was a net exporter of vehicles during the period under analysis. Moreover, the Michaley Index has validated the competitiveness of Slovakia.

Vosta and Kocourek (2017) conducted a study using standard statistical analysis methods of revealed symmetric comparative advantage indices to identify the shape and long-term development trends of the automobile industry in Europe. The selected 39 countries were analyzed using RSCA to calculate the data from 1995 to 2015. According to the findings, only Germany and the United Kingdom have demonstrated positive developments in terms of the competitiveness of their automotive industries over the past twenty years, as compared to other Western European countries. The automotive industries of the Netherlands, France, Portugal, Belgium, and Spain have experienced significant declines in their competitive advantages. The new members of the European Union, namely Slovakia, the Czech Republic, Hungary, Romania, and Poland, have made significant advances in the field of automotive production. In particular, countries such as India, Türkiye, Thailand, Indonesia, Argentina, South Africa, and Mexico, which are experiencing economic growth, have demonstrated comparative advantages. A

similar situation is observed in the automotive parts and accessories manufacturing sector, where the aforementioned countries also demonstrate comparable circumstances.

Luo et al. (2018) conducted a study in which they used the RSCA index to analyze the current problems in the manufacturing industry of Guangzhou, China and compare the situation with six different areas along the Belt and Road. The study compared the sector's performance across six key areas. The results indicate that Guangzhou's apparel and textile sector, as well as its metal and leather products industries, have demonstrated a long-term and consistent comparative advantage. The metal casting and processing sector, the chemical products sector, and the non-metallic mineral sector have demonstrated comparative disadvantage. When viewed from the perspective of regional competition, Guangzhou is perceived to possess the strongest competitive edge in comparison to both ASEAN countries and South East Asia, while the relationship with Central and Western Asia is characterised as more complementary in nature.

In a study conducted by Nagy and Jambor (2018), the authors employed the Balassa Index and Kaplan-Meier survival function to assess the comparative advantage of global automotive trade. The data set comprised global automotive exports at the HS6 level between 1997 and 2016. During the period under analysis, China, the United States, Japan, and Germany were the leading countries in terms of automobile production, while Germany, Canada, and Japan were the most prominent exporters. Notwithstanding, the United States, Germany, and the United Kingdom have emerged as the leading importers of re-exported goods. Together, the United States, Germany, and the United Kingdom have emerged as the leading exporters of goods re-imported for sale. The analysis revealed that internal combustion engine vehicles with a cylinder capacity of between 1,500 and 3,000 cc (870323) constituted the most traded automobile, accounting for over 40% of all vehicle exports. According to the Balassa index, it was observed that the countries with the highest comparative advantage in all periods analyzed were Spain and Japan. Furthermore, the RTA, InRCA, and SRCA indices yielded comparable results, indicating that Japan and Spain exhibited the greatest comparative advantage. However, according to the RC index, Japan and South Korea are the most competitive countries. With regard to the comparative advantage observed in global automotive exports, it is also pertinent to consider the duration of this phenomenon. The results of the analysis of the survival periods indicate that there was inconsistency during this period, and that the decline observed during this period is indicative of the intense global competition in the automotive industry.

Soyyiğit and Yavuzaslan (2020) employed the Revealed Comparative Advantage (RCA) index to ascertain Türkiye's comparative advantage in motor vehicle production. The findings indicate that, particularly in Eastern European countries, international investments currently pose a significant challenge to Türkiye. It has been predicted that these investments will intensify competition between countries and that, following the lifting of sanctions, Iran will become a significant competitor. Among the countries of Eastern Europe, Slovakia has emerged as the most competitive, with the Czech Republic, among others, experiencing an increase in production. The results of the RCA analysis of the entire automotive industry, conducted between 1989 and 2016, indicate that the category of "motorized freight vehicles" experienced a period of stability between 1989 and 2000, followed by a period of accelerated growth from 2000 onwards. In general, the most competitive subcategories within the broader category of "motorized freight vehicles" and "vehicles designed for the transportation of goods" have been identified as "motorized freight vehicles" and "motorized vehicles designed for the transportation of goods," respectively.

In their study, Çetin and Uğur (2021) aimed to compare the global competitiveness of Türkiye, Poland and Czechia in the motor vehicles sector and to compare the changes in the period between 2001-2019. They aimed to analyze the changes that occurred between 2001 and 2019. In order to ascertain the competitive strength of a given entity, the Revealed Comparative Advantage (RCA) index has been employed. In the study, RCA2 indices were calculated for the automotive sector using the four-digit Harmonized System (HS) classification system. The indices were calculated for Poland in 2004. With regard to the RCA1 index, which measures the competitive strength of countries, it can be observed that since 2001, the Czech Republic has demonstrated a stronger competitive advantage than Türkiye and Poland. The automotive sector's four-digit HS codes, as calculated by the RCA1 index, also indicate that Türkiye has a greater potential for competitiveness in the export of passenger and cargo vehicles than Poland and the Czech Republic.

This study differs from previous research in that it focuses on the competitive advantage of green transportation technologies in Türkiye. It is anticipated that this contribution will enrich the existing body of literature.

MATERIALS AND METHODS

In this study, not all transportation vehicles and equipment, but especially transportation vehicles and equipment considered within the scope of green products were taken into consideration. In this direction, in establishing the scope of transportation technologies, Tulan et al. (2021) was acted upon. In this context, Harmonized System (HS 6) codes and definitions are included (Table 1).

Table 1. Transportation Technologies According to HS Codes

HS Kodu	**HS Tanımı**
850110	Electric motors; power=<37,5 w
850690	Primary (non-rechargeable) batteries and parts of them
850720	Lead-acid storage batteries
850760	Lithium-ion batteries
851680	Electric heater resistors
870390	Passenger motor vehicles, others
870899	Parts and accessories for motor vehicles

The HS-coded product groups representing selected transportation technologies for the 2012-2022 period, as depicted in Table 1, were derived from the Trade Map (2024) database.

In this study, we employed the revealed comparative advantage (RCA) and trade balance index (TBI) indices to identify the comparative advantage of Türkiye in international trade. The Balassa (1965) proposed RCA index is a method of measuring a country's export performance relative to other countries in the same product category or group (Utkulu & İmer, 2009). The graphical representation of this index is shown in Figure 1.

$$RCA_{ij} = \frac{\frac{X_{ij}}{X_{it}}}{\frac{X_{nj}}{X_{nt}}} = \frac{\frac{X_{ij}}{X_{nj}}}{\frac{X_{it}}{X_{nt}}} \quad (1)$$

X_{ij}= country i's exports of good j,

X_{it}= total exports of country i,

X_{nj}= total world exports of good j,

X_{nt}= It indicates the world's total exports.

The resulting evaluation of the RCA index is; If it is less than 1, it indicates comparative disadvantage, and if it is greater than 1, it indicates comparative advantage (Çeştepe and Tunçel, 2018).

According to the second index, the TBI index developed by Lafay (1992), it is revealed that a country is a net exporter or net importer of a certain product or product group. The representation of this index (Equation 2):

$$TBI_{ij} = \frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}} \quad (2)$$

X_{ij}= country i's exports of good j,

M_{ij}= It represents the import of good j of country i.

This index assumes values between -1 and 1. The value between -1 and 0 represents the net import position, while the value between 0 and 1 represents the net export position (Widodo, 2008).

FINDINGS AND DISCUSSION

This section presents the findings resulting from the RCA and TBI indices, along with a discussion of these findings. Firstly, the RCA values are presented in Table 2.

Table 2. RCA Analysis Results

	850110	**850690**	**850720**	**850760**	**851680**	**870390**	**870899**
2012	0.16	0.05	0.12	0.04	1.85	1.94	1.22
2013	0.15	0.01	0.27	0.40	1.93	0.36	1.40
2014	0.11	0.00	0.37	0.02	1.81	0.00	1.49
2015	0.07	0.01	0.28	0.02	1.65	0.00	1.55
2016	0.07	0.02	0.25	0.03	1.57	0.00	1.70
2017	0.09	0.00	0.27	0.03	1.57	0.00	1.67
2018	0.06	0.05	0.34	0.02	1.44	0.00	1.69
2019	0.06	0.04	0.41	0.02	1.34	0.01	1.66
2020	0.07	0.03	0.28	0.01	1.38	0.01	1.76
2021	0.07	0.03	0.37	0.01	1.42	0.01	1.80
2022	0.09	0.04	0.43	0.02	1.44	0.00	1.84
2012-2022 avg.	0.09	0.03	0.31	0.06	1.58	0.21	1.62

Source: Based on our own calculations.

As illustrated in Table 2, the RCA values exhibited a fluctuating pattern between 1 and 2 throughout the observation period for products with the following codes: 851680 and 870899. It is possible to discuss the concept of comparative advantage in these product groups, although the advantage is relatively limited. Concurrently, while the competitive advantage in the 851680 product group diminished over time, it was observed that the comparative advantage increased in the 870899 product group. It has been determined that there is a comparative disadvantage in other products. Given that the RCA values of these products are considerably below 1, it can be concluded that they are unlikely to exhibit potential for comparative advantage in the near future. Among these product groups, it is observed that Türkiye's comparative disadvantage has decreased over time only in the 850720 product group.

Table 3. TBI Analysis Results

	850110	850690	850720	850760	851680	870390	870899
2012	-0.80	0.56	-0.88	-0.88	-0.34	0.97	0.26
2013	-0.84	-0.60	-0.76	0.13	-0.37	0.87	0.35
2014	-0.87	-0.76	-0.63	-0.89	-0.34	-1.00	0.41
2015	-0.91	-0.58	-0.71	-0.91	-0.33	-0.97	0.41
2016	-0.92	-0.10	-0.76	-0.85	-0.31	-0.96	0.42
2017	-0.90	-0.77	-0.73	-0.85	-0.33	-0.92	0.36
2018	-0.93	-0.11	-0.66	-0.89	-0.33	-0.66	0.34
2019	-0.92	0.23	-0.53	-0.89	-0.32	0.80	0.43
2020	-0.92	-0.72	-0.70	-0.97	-0.33	-0.48	0.39
2021	-0.92	-0.17	-0.59	-0.95	-0.31	0.00	0.47
2022	-0.88	0.55	-0.57	-0.95	-0.27	-0.97	0.49
2012-2022 avg.	-0.89	-0.22	-0.68	-0.81	-0.33	-0.30	0.39

Source: Based on our own calculations.

The TBI values are presented in Table 3. It was observed that Türkiye was a net exporter for the product code 870899 throughout the period. Concurrently, Türkiye has become a net exporter in this product group. Türkiye, which is a net importer of other products compared to the period average, has been found to be a net exporter in some years in the product group coded 870390. Furthermore, it has been demonstrated that the export potential of Türkiye, which is a net importer of the product coded 850720, has increased over time.

CONCLUSION AND RECOMMENDATIONS

The significance of green products is on the rise, both at the national and individual levels. In order to remain competitive on the global stage, countries are implementing measures to enhance the production and international trade of green products, while also providing support to relevant sectors. In order for these supports to be realized without wasting resources, it is necessary to determine which priority sectors should be the focus of these efforts. In this context, the objective of the study is to analyze the status of transportation vehicles and equipment evaluated in the green product group according to the RCA and TBI indices for Türkiye.

Türkiye's foreign trade volume of selected green transportation products is experiencing a period of rapid growth. Concurrently, there is a net trade surplus in these products. Despite this, the analysis revealed that two of the seven product groups (parts and accessories for motor vehicles and electrical heater resistors) exhibited a comparative advantage, while the others demonstrated a comparative disadvantage. The TBI analysis has determined that Türkiye is a net exporter of parts and accessories for motor vehicles and a net importer of other product groups. The combined indices indicate that Türkiye has a comparative advantage and is a net exporter in the product group of parts and accessories for motor vehicles. Nevertheless, it has been observed that Türkiye's comparative advantage in this product group has diminished over time. Türkiye, which is a net importer in the electrical heating resistors product group, has a comparative advantage. It has been demonstrated that Türkiye's

comparative advantage in this product group has increased over time. In other product groups, Türkiye appears to be at a disadvantage in terms of both comparative advantage and net imports. It is noteworthy that the comparative disadvantage in the lead-acid storage batteries product group, one of the product groups in question, has decreased and the net importer position has weakened.

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