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Assessment of the Determinants of Revealed Comparative Advantages in Türkiye's Manufacturing Sector in the Context of Selected European Countries

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ABSTRACT

This study examines Türkiye's trade competitiveness in manufacturing sector (SITC5-8) with 21 European economies from 1996 to 2021. The Balassa index results reveal that Türkiye's strongest competitiveness is in miscellaneous manufactured articles (SITC8) and manufactured goods (SITC6). Econometric models are employed to explore the factors influencing competitiveness across sectors. According to analysis, increase in GDP of trading partners generally weakens Türkiye's position in SITC5, 7 & 8 sectors. It is seen that economies of scale arising from free trade between trading countries do not significantly increase competitiveness. Geographic proximity increases the trade competitiveness of SITC5 and SITC7 sectors and when evaluated together with GDP data, it shows that the gravity model better explains these sectors. Investment in research and development has an impact on competitiveness in SITC7, aligning with Ricardian comparative advantages. Product differentiation and impact of Linder hypothesis appear more relevant for SITC6. Trade openness of partners presents a double-edged sword, harming competitiveness in SITC 8 due to increased partner productivity, while increasing competitiveness in SITC 7. While the appreciation of the currencies of trading partners reduces the competitiveness of SITC8 due to its dependence on intermediate goods, it has no statistical impact on other sectors. Periods of Turkish Lira depreciation (1999-2001 & 2018-2021) are found to negatively impact SITC8 competitiveness, highlighting its vulnerability to import dependence.

Keywords: Competitiveness, Revealed Comparative Advantages, Trade, Panel Data Analysis.

Türkiye İmalat Sanayinin Açıklanmış Karşılaştırmalı Üstünlüklerinin Belirleyicilerinin Seçilmiş Avrupa Ülkeleri Açısından Değerlendirilmesi

ÖZ

Bu çalışma, Türkiye'nin imalat sektöründeki (SITC5-8) 1996-2021 dönemi ticaret rekabet gücünü seçilmiş 21 Avrupa ekonomisiyle incelemektedir. Balassa endeksi sonuçları, Türkiye'nin en güçlü rekabet gücünün çeşitli imalat mallarında (SITC8) ve imalat mallarında (SITC6) olduğunu ortaya koymaktadır. Sektörler arası rekabet gücünü etkileyen faktörleri araştırmak için ekonometrik modeller kullanılmaktadır. Analize göre ticaret ortaklarının GSYH'sindeki artış genel olarak Türkiye'nin SITC5, 7 ve 8 sektörlerindeki konumunu zayıflatmaktadır. Ticaret yapan ülkeler arasındaki serbest ticaretle ortaya çıkan ölçek ekonomilerinin rekabet gücünü anlamlı bir düzeyde artırmadığı görülmektedir. Coğrafi yakınlık, SITC5 ve SITC7 sektörlerinin ticaret rekabetçiliğini artırmakta ve GSYİH verileriyle birlikte değerlendirildiğinde, gravity modelin bu sektörleri daha iyi açıkladığını göstermektedir. Araştırma ve geliştirmeye yapılan yatırımın, Ricardocu karşılaştırmalı üstünlüklerle uyumlu olarak SITC7'deki rekabet gücü üzerinde etkisi bulunmaktadır. Ürün farklılaştırması ve Linder hipotezinin etkisi, SITC6 daha alakalı görünmektedir. Ortakların ticari açıklığı, iki ucu keskin bir kılıç teşkil etmekte ve ortakların üretkenliğinin artması nedeniyle SITC 8'deki rekabet gücüne zarar verirken SITC7'de rekabet artışı sağlamaktadır. Ticaret ortaklarının para birimlerinin değer kazanması, ara mallara olan bağımlılık nedeniyle SITC8'nin rekabet gücünü azaltırken, diğer sektörlere istatistiki açıdan bir etkide bulunmamaktadır. Türk Lirası'nın değer kaybı dönemlerinin (1999-2001 ve 2018-2021) SITC8'in rekabet gücünü olumsuz etkileyerek ithalat bağımlılığına yönelik kırılganlığı işaret ettiği görülmektedir.

Anahtar Kelimeler: Rekabetçilik, Açıklanmış Karşılaştırmalı Üstünlükler, Ticaret, Panel Veri Analizi.

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1. Introduction

After World War II, the surge in economic liberalization and globalization ushered in a period of significant growth and complexity in world trade. Traditional trade theories struggled to fully explain the intricate dynamics of modern global production, investment, and preferences. Consequently, new theories emerged to address these complexities. Despite these advancements, the concept of comparative advantage remains a guiding principle in international trade, informing nations' strategic economic decisions and trade policies. For Türkiye, a key player in the global market, understanding the determinants of its Revealed Comparative Advantage (RCA) in manufacturing sectors is essential.

Our research aims to examine the underlying factors shaping Türkiye's comparative advantage in manufacturing, shedding light on its trade dynamics. Leveraging the RCA index pioneered by Balassa (1965), we quantitatively assess Türkiye's comparative advantage in each manufacturing sub-sector for Standard International Trade Classification (SITC) codes 5, 6, 7, and 8. Additionally, we evaluate competitiveness within these sectors using the framework proposed by Hinloopen and Van Marrewijk (2001), employing panel data analysis to discern the impact of various determinants on Türkiye's manufacturing competitiveness.

Using a dataset spanning 1996-2021 and employing SITC rev. 4 standardization for 21 European economies[1], we calculate RCA values for Türkiye's SITC-5, SITC-6, SITC-7, and SITC-8 sectors. Our econometric analysis examines the influence of key variables such as GDP, distance, difference in GDP per capita between trading partners, research and development expenditures, trade openness, and real effective exchange rates on Türkiye's comparative advantage in manufacturing.

The selected countries are European Union members, with Türkiye as a candidate and in a Customs Union with the EU since 1996. This selection provides geographical diversity, economic relevance, and significant trade relationships, allowing for a comprehensive analysis of Türkiye's trade competitiveness within the European context, capturing insights from both advanced and emerging economies across different manufacturing sectors. Notably, EU members Belgium, Estonia, Greece, Lithuania, Luxembourg, Malta, and Slovenia were excluded due to a lack of macroeconomic data for certain years.

Despite numerous studies on Türkiye's competitiveness in various sectors, the literature on determinants of competitiveness remains limited compared to global research. Our study addresses this gap by focusing on the manufacturing sector, crucial in Türkiye's trade with Europe. Given the significance of European economies as trading partners, our findings offer actionable insights for policymakers and decision-makers seeking to enhance competitiveness across sectors.

1.1. Theoritical Background

Adam Smith (1776), who is considered the father of classical economics, explained the trade between two countries with the concept of absolute advantages in his work known as The Wealth of Nations. David Ricardo (1817), on the other hand, explained trade and comparative advantage between countries in terms of productivity in the production of goods by building on absolute advantages, which later came to be known as the Ricardian approach. Heckscher (1919) – Ohlin (1933) explained trade between countries by differences in the intensity of factors of production. Leontieff (1951) tested the H-O theory for the US with the input-output approach, but contrary to expectations, the US was found to be labor-intensive while its trading partners were capital-intensive. Linder (1961) argued that similarity in preferences can also be used to explain trade between two countries and introduced a demand-based approach. Krugman (1979) developed a model in which economies of scale under imperfect competition can lead to trade without similarity in technology, factor endowments and preferences.

With these and other new theories of foreign trade, the competitiveness of countries' foreign trade has gained importance. Although Liesner (1958) was the first to calculate the competitiveness of foreign trade between countries, Balassa (1965) developed the index that is still the most widely used and accepted today. In his seminal work, Balassa (1965) mentions about two main doctorines that can determine the trade pattern among countries in case of absence of production data of individual countries: Heckscher-

[1] Austria, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, United Kingdom.

Ohlin theory and classical comparative advantages. Balassa (1965) adds that RCA can be influenced by differences in non-price factors as well. Uniformity of tastes and custom tariffs and duties may affect the trade patterns. Based on this approach, it is important to analyze and identify the determinants of competitiveness of Türkiye's manufacturing sub-sectors.

1.2. Literature Review

There are many studies measuring Türkiye's competitiveness in different countries and sectors with Balassa index and similar indices. Some of these studies are summarized below:

Kösekahyaoğlu (2003) analyzed the trade between Türkiye and the European Union in 1978-1980 and 1988-1990 with the RCA index. The study concludes that after the 1980 liberalization, some of Türkiye's traditional export industries lost competitiveness, but competitiveness increased in sectors with mainly include physical capital such as plastics, paper, cement and in all sectors based involving human capital.

Çakmak (2005) analyzed Türkiye's textile trade with the world for the period 1989-2003 using Balassa and Vollrath's RCA models. According to the study, Türkiye maintains its comparative advantage in exports in textile and clothing industries, but this competitive advantage has been declining over the years.

Vergil (2006) calculated Türkiye's exports of 215 goods with the EU for the period 1993-2002 by using RCA. The author finds that the EU Customs Union has a positive effect on Türkiye's competitiveness in research-intensive goods that contain advanced technology and are difficult to imitate, but has a negative effect on Türkiye's competitiveness in intermediate technology goods and capital-intensive goods.

Serin and Civan (2008) measured competition in the tomato, olive oil and fruit juice industries in trade between the EU and Türkiye. The study, which covers the period 1995-2005 and was conducted by using the RCA model, shows that Türkiye has a comparative advantage in olive oil and fruit juice sectors but a disadvantage in tomato sector.

Erkan (2011) calculated the trade between Türkiye and N-11 countries for the period 1993-2009 by using the SITC Technology Classification. It is determined that capital-intensive goods as well as labor-intensive goods have a significant impact on the increase in Türkiye's export share in world markets. The highest coefficients of RCA in the goods exported by N-11 economies were found to be mostly in the exports of raw materials and labor-intensive goods. However, it was found that the Philippines ranked highest in the exports of high value-added, difficult to imitate research-based goods, followed by South Korea and Mexico.s

Yalçınkaya et al. (2014) analyzed the role of the Chinese economy in global trade and its effects on the Türkiye's economy for the years 2002-2013. Türkiye's competitiveness against China was assessed using Balassa's Index of RCA. Within the framework of the findings, 5 industries with an index value above 0.5 were identified at the end of 2013. These industries include metal ore mining, manufacture of food products, manufacture of beverages, water supply, sewerage waste management and remediation activities, other mining and quarrying.

Kalaycı (2017) analyzed Türkiye's foreign trade with the European Union and third countries with which Türkiye has signed free trade agreements. According to the results of the analysis for the period 2012-2016, Türkiye has a comparative advantage in food and live animals, beverages and tobacco, and miscellaneous manufactured articles. However, comparative disadvantage was observed in the commodity groups of crude materials, inedible, except fuels, animal, vegetable oils and fats and waxes, and chemicals and related products, n.e.s..

Kuşat and Denli (2021), in their study conducted between 2008 and 2019 with the RCA index, concluded that Türkiye gained a competitive advantage in its trade with BRICS countries only in the 'Food and live animals Commodity Group'.

Yalçın and Bakan (2021) examined Türkiye's trade volume with the 10 countries to which Türkiye exports the most and analyzed their competitiveness for 97 product groups. As a result of the analysis conducted for the period 2005-2018 by using Balassa's method, it was found that Türkiye has comparative advantage in 42 of 97 product groups on average and has high competitiveness in 19 products within this group.

Tümer (2021) investigated in which products the elimination of customs duties would be more profitable for Türkiye in the event that Türkiye signs an alternative customs union with the Shanghai Cooperation Organization by using Balassa index. As a result of the analysis with 2010-2015 and 2020 data, it is concluded that Türkiye has a comparative advantage in the exports of labor and capital intensive goods against the countries in the region and that the removal of customs duties on these products would be in Türkiye's favor with the establishment of a customs union.

In Özbaş and Yıldırım's (2022) study, Türkiye's competitiveness between 2001 and 2019 was determined using the Balassa and Vollrath indicies. In both indices, the top ten goods with the highest competitiveness, the top ten goods with the highest share in Türkiye's exports and the top ten goods with the highest increase in competitiveness were identified and evaluated. It was found that the export goods with the highest increase in Türkiye's competitiveness consisted of products with low and medium-low level technology. It is observed that Türkiye has a comparative advantage in only 4 of the top 10 products with the highest share in Türkiye's exports, and these products contain low and medium-low technology.

Sarıçoban (2022) investigated Türkiye's comparative advantage in exports with 15 countries that are parties to the Regional Comprehensive Economic Partnership (RCEP) agreement in the period 2011-2020. According to the findings of the study using the Balassa index, RCEP countries are mostly specialized in agricultural product groups. This sector was followed by manufacturing industry and raw material intensive goods. Many countries also specialized in easy imitation and difficult imitation groups and high technology groups and gained comparative advantage in exports. China, Vietnam, Malaysia, South Korea, Thailand, Singapore, the Philippines, and Japan have shown superiority in the groups of research-based goods.

Although there are many empirical studies in the literature analyzing Türkiye's competitiveness with Balassa and similar indices, the number of studies analyzing the determinants of this competitiveness and its relationship with other variables is limited. On the other hand, there has been an increase in these studies in recent years. These studies are summarized as follows:

Dinç and Kılıçaslan (2021) examined the relationship between Türkiye's competitiveness in the service sector and productivity with 30 selected economies in the period 2000-2015 using dynamic panel data analysis. The findings show that competitiveness has a positive effect on productivity in all service sectors except the information and communication sector.

Demirtaş and Artık (2022) examined the impact of FDI on Türkiye's competitiveness with quarterly data between 2005 and 2019 using a lagged autoregressive time series model based on least squares method. The findings show that FDI does not have a statistically significant effect on competitiveness in the short or long run.

Türkmen and Yiğitler (2022) examined the relationship between Türkiye's competitiveness in medium and high technology products in the manufacturing industry and economic growth in the period 1989-2017. Using co-integration test and vector error correction model, the study concluded that Türkiye has a competitive advantage in medium technology products and a disadvantage in high technology products. An increase in competitiveness in medium and high technology products has a positive effect on growth.

Adıgüzel (2022) analyzed the relationship between Türkiye's intra-industry trade and announced comparative advantages in the period 2001-2019. Using 97 HS/GTIP chapters, it is found that there is a very high positive correlation in 27 chapters and a high positive correlation in 24 chapters, and a very high negative correlation in 24 chapters and a high negative correlation in 6 chapters between intra-industry trade and declared comparative advantages.

It is observed that the number of studies in the international literature on the determinants of RCA remains relatively limited. However, the recent increase in such studies is noteworthy.

Marconi and Rolli (2007) calculated the revealed comparative advantages of 16 selected developing countries with high exports and examined their determinants. According to the study, RCAs are positively affected by GDP and gross fixed capital formation, and negatively by unit labor cost, country's average years of schooling, and ratio of machinery imports to GDP.

Yonghua (2010) examined the competitiveness of 26 manufacturing exports of China in the period 2001-2007. The study concluded that technological innovation and foreign direct investment positively affected RCA.

Yue and Zhou (2018) revealed that the RCA index of democratic countries was higher than that of autocratic countries in a study covering 140 countries in the period 1962-2010. It is seen that the variables GDP per capita, GDP growth, and population used in the study also have a positive effect on RCA.

Chang etal. (2019) examined the determinants of RCAs of shrimp-exporting countries with monthly data from 2003-2014. It was observed that RCA index was negatively affected by shrimp prices and positively affected by US income per capita, while shrimp disease, domestic US shrimp quantity, exchange rates and US antidumping laws did not have statistically significant effects.

Lee (2020) examined the comparative advantages of crustacean exports of 6 ASEAN (Vietnam, Thailand, Indonesia, Myanmar, Malaysia, the Philippines) countries to Japan in the period of 2010-2016. The study concluded that per capita income and domestic Japanese shrimp production had no statistically significant effect on RCA, while exchange rate and Acute Hepatopancreatic Necrosis Disease had negative effects.

Ahmed *etal.* (2023) used the RCA index to measure the effects of the free trade agreement between Pakistan and China. Then, they examined the trade of products that they found to be highly competitive with econometric analysis. In the study where the gravity model was used, it was concluded that the product of China and Pakistan's GDPs, the difference in GDP per capita, trade openness, FTA positively affected Pakistan's exports, while distance negatively affects it.

Hu *etal.* (2024) examined the competitiveness of high-technology products exported by 30 regions of China for the period 2011-2021. It has been found that technological innovation, industrial upgrading, government support, education level and market openness have positive effects on RCA.

In this study's econometric model, GDP, per capita GDP differences, R&D, trade openness, and real effective exchange rates are used as independent variables, all of which are commonly employed in the literature to explain RCA.

2. Methodology

2.1. Calculation and Classification of Revealed Comparative Advantages

Vollrath (1991) explained the first studies on the calculation of comparative advantages. He stated that one of the first formulas for the calculation of RCA was developed by Liesner (1958) as follows:

$$RCA1_a^i = \frac{X_a^i}{X_a^e} / \frac{X_a^d}{X_a^e} = \frac{X_a^i}{X_a^d} \quad (1)$$

Where X is exports, a is any tradable product, i is the UK, d is any European country, e is all seven European countries studied.

Balassa (1965) was the first to use the term RCA and developed Liesner's (1958) method of calculating comparative advantage:

$$RCA2_a^i = \frac{X_a^i}{X_a^c} / \frac{X_m^i}{X_m^c} \quad (2)$$

Where m represents the total exports of 74 products, i represents one of the 11 developed countries used in the analysis, and c represents all 11 developed countries.

Vollrath (1991) stated that these indices should not be limited to the countries and products used in the above analysis, and that the index developed by Balassa (1965) can be used for all countries and product groups:

$$RCA3_a^i = \frac{X_a^i}{X_t^i} / \frac{X_a^w}{X_t^w} \quad (3)$$

Where a stands for any product, t stands for all tradables, i stands for the country under study and w stands for the whole world.

In his study, Balassa (1965) developed not only the above index but also an index that includes import flows in addition to exports, which can be expressed as follows:

$$RCA4 = \frac{X_a^i}{M_a^i} \Big/ \frac{X_m^c}{X_m^c} \tag{4}$$

Where M stands for imports.

Balassa index value greater than 1 indicates a competitive advantage, while a value less than 1 indicates a competitive disadvantage. On the other hand, Hinloopen and Van Marrewijk (2001) stated that index values can be categorized and divided them into 4 classes:

Class a (Comparative disadvantage) $0 < RCA \leq 1$;
Class b (Weak comparative advantage) $1 < RCA \leq 2$;
Class c (Medium comparative advantage) $2 < RCA \leq 4$;
Class d (Strong comparative advantage) $4 < RCA$.

In this study, the RCA4 index is used since it also takes import flows into account.

Yu etal. (2009) created an index based on the Balassa index for measuring revealed comparative advantages. They state that the new method, which they call the normalized revealed comparative advantage index (NRCA), is more consistent and precise in revealing the comparative advantages of a country in a product compared to other indices in the literature. The NRCA index allows comparison of product and country groups as well as comparison in terms of time. By adding the time dimension to the model, it is possible to say that the classical index is static, while the NRCA index is dynamic.

In the Balassa (1965) index, which we call RCA2, Yu et al. (2009) stated that if the equivalence result is below 1, there is disadvantage, and if it is equal to 1, there is a neutral situation, and expressed this as $\hat{E}_j^i$. The authors state that $\hat{E}_j^i$ is equal to $(E^i E_j) \,/\, E$:

$$\Delta E_j^i \equiv E_j^i - \hat{E}_j^i = E_j^i - (E^i E_j)/E \tag{5}$$

E_j^i: export commodity j of country i,
E_j: export commodity j of all countries,
E^i: total export commodities of country i,
E : total commodities exported by all countries.

NRCA can be expressed as follows:

$$NRCA_j^i \equiv \Delta E_j^i/E = E_j^i \,/\, E - E_j E^i/EE \tag{6}$$

The NRCA index is used to measure the deviation of the country's real export value from the comparative-neutral value to the world market. This provides an appropriate presentation of comparative advantages. The equivalence results take values between -1/4 and 1/4, with 0 representing a neutral value.

Comparisons between different commodities, countries and times can be made through this basic equivalence.

Cross Commodity Comparison:

$$\Delta NRCA_{1-2}^i \equiv NRCA_1^i - NRCA_2^i = \frac{E^i}{E}\left[\left(\frac{E_1^i}{E^i} - \frac{E_1}{E}\right) - \left(\frac{E_2^i}{E^i} - \frac{E_2}{E}\right)\right] \tag{7}$$

The above equation shows the relative specialization between two products by comparing the product 1 of country i measured by $\left(\frac{E_1^i}{E^i} - \frac{E_1}{E}\right)$ and product 2 measured by $\left(\frac{E_2^i}{E^i} - \frac{E_2}{E}\right)$.

Cross Country Comparison:

$$\Delta NRCA_j^{1-2} \equiv NRCA_j^1 - NRCA_j^2 = \frac{E_j}{E}\left[\left(\frac{E_j^1}{E_j} - \frac{E_1}{E}\right) - \left(\frac{E_j^2}{E_j} - \frac{E_2}{E}\right)\right] \quad (8)$$

The above equation analyzes the competitiveness between two countries by comparing the export performance of commodity j measured by $\left(\frac{E_j^1}{E_j} - \frac{E_1}{E}\right)$ and product 2 measured by $\left(\frac{E_j^2}{E_j} - \frac{E_2}{E}\right)$.

Temporal Comparison:

$$\Delta NRCA_{j,t+1}^i \equiv NRCA_{j,t+1}^i - NRCA_{j,t}^i = \left(\frac{E_{j,t+1}}{E_{t+1}} - \frac{E_{j,t}^i}{E_t}\right) - \left(\frac{E_t^i}{E_t}\frac{E_{j,t}}{E_t} - \frac{E_{t+1}^i}{E_{t+1}}\frac{E_{j,t+1}}{E_{t+1}}\right) \quad (9)$$

In the equation above, measures the change in the export level $\left(\frac{E_{j,t+1}}{E_{t+1}} - \frac{E_{j,t}^i}{E_t}\right)$of commodity j of country i between times t and t+1. $\frac{E_t^i}{E_t}\frac{E_{j,t}}{E_t}$ and and $\frac{E_{t+1}^i}{E_{t+1}}\frac{E_{j,t+1}}{E_{t+1}}$are the expected export level of commodity j of country i at times t and t+1 under the comparative-advantage-neutral condition, respectively. This equivalence compares the actual change in the export level of a country of a certain good under the comparative advantage at times t and t+1 with the expected change in the export level under the condition that the comparative advantage is neutral.

In the above equation, $\left(\frac{E_{j,t+1}}{E_{t+1}} - \frac{E_{j,t}^i}{E_t}\right)$ measures the change in the export level of commodity j of country i between time t and t+1. $\frac{E_t^i}{E_t}\frac{E_{j,t}}{E_t}$ and $\frac{E_{t+1}^i}{E_{t+1}}\frac{E_{j,t+1}}{E_{t+1}}$ express the expected export level of country i's commodity j at times t and t+1, respectively, under the comparative-advantage-neutral condition. This equivalence compares the actual change in a country's export level of a certain good due to comparative advantage at times t and t+1 with the expected change in export level when comparative advantage is neutral.

2.2. Data and Variables

Table 1. Variables and Description

Variable Abbreviation	Description	Source	Expected Coefficient Sign
RCA_5	Calculated by Balassa Import-Export Index for Türkiye's SITC (rev. 4) 5 Category Trade	Trade data obtained from UNCOMTRADE (2024)	X
RCA_6	Calculated by Balassa Import-Export Index for Türkiye's SITC (rev. 4) 6 Category Trade	Trade data obtained from UNCOMTRADE (2024)	X
RCA_7	Calculated by Balassa Import-Export Index for Türkiye's SITC (rev. 4) 7 Category Trade	Trade data obtained from UNCOMTRADE (2024)	X
RCA_8	Calculated by Balassa Import-Export Index for Türkiye's SITC (rev. 4) 8 Category Trade	Trade data obtained from UNCOMTRADE (2024)	X
ln_gdp	Natural Logarithm of Türkiye's trading partners' GDP (constant 2015 US$)	Worldbank (2024)	-
ln_gdp_tr	Natural Logarithm of Türkiye'nin GSYİH'i (constant 2015 US$)	Worldbank (2024)	+
dist_gdp	GDP weighted distance (Calculation methodology provided below in the text)	EU Commission (2024)	+
ln_gdp_av	Natural logarithm of the average of Türkiye's trading partner's GDP and Türkiye's GDP. (constant 2015 US$)	Calculated with the data obtained from Worldbank (2024)	+
ln_gdppc_dif	Natural logarithm of the absolute value of the difference between Türkiye's trading partner's GDP per capita and Türkiye's GDP per capita (constant 2015 US$)	Calculated with the data obtained from Worldbank (2024)	-
rd	Türkiye's Trade Partners - Research and development expenditure (% of GDP)	Worldbank (2024)	-
rd_tr	Türkiye's Research and development expenditure (% of GDP)	Worldbank (2024)	+
to	Türkiye's Trade Partner – Trade Openness (Trade % of GDP)	Worldbank (2024)	-
to_tr	Türkiye's Trade Openness (Trade % of GDP)	Worldbank (2024)	+
reer	Türkiye's Trade Partner – Real Effective Exchange Rate Index (2010 = 100)	Worldbank (2024)	+/-
d1999_2001	Dummy variable representing crisis years for Türkiye (1999-2001)	-	+
d2008_2009	Dummy variable representing crisis years for Türkiye & EU (2008-2009)	-	+
d2018_2021	Dummy variable representing heterodox policies followed by Türkiye (2018-2021)	-	+

In the analysis of Türkiye's foreign trade competitiveness with selected 21 European economies in the manufacturing sector, import and export data for 1996-2021 were obtained in SITC rev.4 categorization and calculations were made. Among the European economies, Luxembourg, Belgium, Lithuania, Slovenia, Greece, Malta, Estonia were excluded due to lack of certain dataset.

2.3. Indepenent Variables and Theoretical Background

Linder Hypothesis: In empirical studies, the GDP per capita difference between trading partners is used as a variable to test the Linder hypothesis. This variable represents the development gap between countries. As the development gap between countries increases, competition in the sector under scrutiny is expected to decrease.

McPherson et al. (2001) and Hallak (2010) tested the relationship between trade intensity and Linder hypothesis. The authors used GDP per capita differences in their studies and concluded that there is a negative relationship between these differences and trade intensity. Fajgelbaum et al. (2015) examined the

impact of GDP per capita differences on FDI and found a negative relationship between the two variables. On the other hand, Jošić and Metelko (2018) found that the Linder hypothesis is not valid for Croatia and that the gravity model is more successful in explaining international trade.

Gravity Model: The seminal work of Tinbergen (1963) paved the way for the application of Newton's Law of Gravity to international trade. The so-called Gravity model is constructed using the GDP of trading countries and the distance between countries. As the GDP of trading countries increases and the physical distance between them decreases, trade is expected to increase.

Sahu and Heng (2017) used the gravity model and found that Indian exports are positively affected by its own GDP and negatively affected by the GDP of its trading partner. Renjini et al. (2017) found that the GDP of both India and its trading partner positively affects its total trade.

In calculating the distance between countries, the GDP-weighted distance of Balassa and Bauwens (1987):

$$dist\_gdp = \frac{GDP_{it}\ x\ DIST_i}{\sum GDP_{kt}} \tag{10}$$

Where i represents Türkiye's trade partner, t denotes relevant year, k represents all countries in the analysis. The DIST represents the distance between the capital city of the partner country and Türkiye's capital city, measured as the crow flies.

The reason for not using normal distance is that the package program used in econometric calculation detects a dependency between the distance variable and other independent variables and omit these variables.

Turkcan and Ates (2010), who use GDP-weighted distance to examine the relationship between distance and intra-industry trade, conclude that there is a negative relationship between these variables, while Stone and Lee (1995) conclude that there can be both negative and positive relationships. As geographical distance increases, trade between countries is expected to decrease. However, it is possible to detect a positive relationship between competition and distance due to reasons such as low transportation costs in trade between countries, small volume or weight of traded products and shipment in bulk, and trade overlap as a result of countries engaging in mutual trade (intra-industry trade) in similar areas.

The formula given in equation (5) can be said to represent economic proximity rather than economic distance. Indeed, in the numerator of the equation, the value of the fraction will increase as GDP or geographical distance increases. Considering that the geographical distance to each country does not change over the period, the change in the GDP of the trading country has a determining role on this variable.

Scale economies: As trade between the two countries intensifies, production structure will be changed. Competition will force firms to produce more efficiently, while those that cannot compete will be eliminated. Therefore economies of scale will emerge with relatively larger firms. Due to economies of scale, costs are expected to decrease as production expands. This, in turn, will be reflected in trade, leading to an increase in competition. The averages of the GDPs of the two countries are used to represent these economies of scale. Turkcan and Ates (2010) use the average GDP of the US and its trading partners to represent economic size and hence economies of scale.

Ricardian Comparative Advantages: According to Ricardo's theory of comparative advantage, the source of trade is production differences and specialization between countries. Authors such as Dornbusch etal. (1977), Taylor (1993) , Trabold (1994), Ricci (1997), Eaton etal. (2002) have created a Ricardian framework that includes models that base production differences between countries on technology. In this Ricardian framework, the reason for the emergence of comparative advantage in trade between countries is the differences in technology and techniques used (Kerr, 2013). In this study, analyses will be based on this Ricardian framework model. As the budget allocated to research and development increases, the quality and quantity of production is expected to increase with new techniques and technologies. When Türkiye invests more in R&D, its competitiveness is expected to rise, while its trading partners' increased expenditures are likely to lower its competitiveness.

Braunerhjelm and Thulin (2006), covering 19 countries, find that R&D has a positive effect on total exports. Márquez-Ramos and Martínez-Zarzoso (2010) conclude that the effect of technological innovation on exports is non-linear and a certain threshold value must be reached for this relationship to be positive. Pereira et al. (2013) examined the impact of technological changes on export competitiveness and found that the impact of research and development expenditures on export competitiveness may vary according to technology classification (low, medium and high). In this context, even if the level of investments in sectors with low technology structure is high, it may not increase competitiveness.

Trade Openness: As the trade openness of countries increases, their competition with each other is expected to increase and to lead to an increase in productivity and thus increase comparative advantages (Chen *etal.* (2009). Similarly, as the trade openness of the trading country increases, the competitiveness and RCA of the exporting country will decrease. On the other hand, as trade openness increases, firms that cannot compete and increase their productivity may lose their advantage in trade (Wong, 2007). Moreover, in line with Mundell's (1957) model, increased factor mobility between countries may also reduce competitiveness due to increased production costs. Increased trade and hence increased external dependence in production may also lead to a decline in competitiveness in previously competitive sectors as it affects specialization (Aigheyisi, 2021).

Ahmed *etal.* (2023) concluded that an increase in trade openness positively affects Pakistan's exports. Pilinkiene (2016) found that trade openness has a positive impact on growth and competition in Central and Eastern European Countries.

Real Effective Exchange Rates: The real effective exchange rate index reflects how a country's currency is valued relative to its trading partners, considering both exchange rate movements and differences in price levels.

Siddique et al. (2020) examined the impact of Pakistan's real effective exchange rate on RCA and concluded that the appreciation of Pakistan's real effective exchange rate has a negative impact on RCA and trade balance, while depreciation has a positive impact. On the other hand, Begović and Kreso (2017) find that the depreciation of the real effective Exchange rates of European transition economies has a negative impact on the trade balance. Authors state that this effect is presumably due to these countries' high import dependence and lack of export capacity. The rapid impact of high import values on local prices was also found as another difficulty.

Kharroubi (2011), on the other hand, found that the effect of real effective exchange rate on the balance of trade can be explained by the import content of exports and intra-industry trade indices. In the study, it is stated that in countries with low intra-industry trade and high import content of exports, the devaluation of the real effective exchange rate will not contribute significantly to improving the trade balance. The opposite would be the case in countries with high intra-industry trade and low import content of exports.

In this study, the real effective exchange rates of Türkiye's trading partners are added to the model. Thus, it can be examined how Türkiye's competitiveness will be affected as the currencies of Türkiye's trading partners appreciate. An appreciation of the currencies of Türkiye's trading partners may increase the quantity of goods imported from Türkiye, but it may also lead to a trade diversion effect, causing demand to be met from other countries. Moreover, since Türkiye's exports depend on its imports, the effect of exchange rate changes may also be negative. Therefore, the impact of this variable on Türkiye's competitiveness is expected to be uncertain.

Dummy variables: To control for time effects, d1999_2001 and d2008_2009 dummy variables are used to represent the economic crisis and recession between 1999-2001 and 2008-2009, respectively. In addition, d2018_2021 dummy variable is included to represent the heterodox policies pursued by Türkiye between 2018-2021. The economic effects of COVID-19 pandemic conditions are also represented in this period.

2.4. Econometric Models

Stata package software used in the econometric analysis automatically detects multicollinearity and excludes the relevant variables. However, in order to avoid multicollinearity that the program cannot

detect, the relationship between the variables was examined with the correlation matrix. Relationships where the correlation between variables is above 0.70 are added to the model using the interaction term. Thus, it is aimed to prevent the errors that the possible relationship between variables may cause on the model estimation. In addition, since the GDPs of the countries in the gravity model and the GDP averages of the countries may have a similar interaction, separate models were used.

Model 1

$$RCA_{(SITC5_{i,t}, SITC6_{i,t}, SITC7_{i,t}, SITC8_{i,t})} = \beta_0 + \beta_1 \ln\_gdp_{i,t} + \beta_2 \ln\_gdp\_tr_{i,t} + \beta_3 dist\_gdp_{i,t} + \beta_4 \ln\_gdppc\_dif_{i,t} + \beta_5 rd_{i,t} + \beta_6 rd\_tr_{i,t} + \beta_7 to_{i,t} + \beta_8 to\_tr_{i,t} + \beta_9 REER_{i,t} + \beta_{10} d1999\_2001_{i,t} + \beta_{11} d2008\_2009_{i,t} + \beta_{12} d2018\_2021_{i,t} + \beta_{13} to\_tr\#rd\_tr_{i,t} + \beta_{14} ln\_gdp\_tr\#rd\_tr_{i,t} + \beta_{15} ln\_gdp\_tr\#to\_tr_{i,t} + \beta_{16} ln\_gdp\#dist\_gdp_{i,t} + \varepsilon_{i,t} \quad (11)$$

Model 2

$$RCA_{(SITC5_{i,t}, SITC6_{i,t}, SITC7_{i,t}, SITC8_{i,t})} = \beta_0 + \beta_1 \ln\_gdp_{i,t} + \beta_2 \ln\_gdp\_tr_{i,t} + \beta_3 dist\_gdp_{i,t} + \beta_4 \ln\_gdppc\_dif_{i,t} + \beta_5 rd_{i,t} + \beta_6 rd\_tr_{i,t} + \beta_7 to_{i,t} + \beta_8 to\_tr_{i,t} + \beta_9 REER_{i,t} + \beta_{10} d1999\_2001_{i,t} + \beta_{11} d2008\_2009_{i,t} + \beta_{12} d2018\_2021_{i,t} + \varepsilon_{i,t} \quad (12)$$

Model 3

$$RCA_{(SITC5_{i,t}, SITC6_{i,t}, SITC7_{i,t}, SITC8_{i,t})} = \beta_0 + \beta_1 \ln\_gdp\_av_{i,t} + \beta_2 dist\_gdp_{i,t} + \beta_3 \ln\_gdppc\_dif_{i,t} + \beta_4 rd_{i,t} + \beta_5 to_{i,t} + \beta_6 REER_{i,t} + \beta_7 d1999\_2001_{i,t} + \beta_8 d2008\_2009_{i,t} + \beta_9 d2018\_2021_{i,t} + \beta_{10} \ln\_gdp\_av\#\ln\_gdppc\_dif_{i,t} + \beta_{11} ln\_gdppc\_dif\#rd_{i,t} + \varepsilon_{i,t} \quad (13)$$

Model 4

$$RCA_{(SITC5_{i,t}, SITC6_{i,t}, SITC7_{i,t}, SITC8_{i,t})} = \beta_0 + \beta_1 \ln\_gdp\_av_{i,t} + \beta_2 dist\_gdp_{i,t} + \beta_3 \ln\_gdppc\_dif_{i,t} + \beta_4 rd_{i,t} + \beta_5 to_{i,t} + \beta_6 REER_{i,t} + \beta_7 d1999\_2001_{i,t} + \beta_8 d2008\_2009_{i,t} + \beta_9 d2018\_2021_{i,t} + \varepsilon_{i,t} \quad (14)$$

Where,
i denotes each country,
t denotes the time period,
ε denotes the error term. Error term captures unobserved random variation and unobserved country-specific effects that affect the RCA for a specific country in a particular time period.

2.5. Hausman Test

Hausman (1978) specification test is used to determine the most efficient estimator in panel data analysis. Hausman test helps to choose between fixed effects or random effects models. Individuals or entities within a panel set may include unobserved heterogeneity. The fixed effects model assumes that unobserved individual-specific effects are correlated with the independent variables, leading to potential endogeneity issues. These fixed effects are typically modeled as dummy variables for each individual or

entity in the panel. In contrast, the random effects model assumes that these unobserved effects are uncorrelated with the independent variables, allowing for more efficient estimation.

The hausman test provides information to practitioners to select most appropiate model by testing whether the difference in coefficients estimated by the two models is systematic or random. Null hypothesis of the test is that the random effects model is efficient, if null hypothesis is rejected there is a potential endogeneity issue, therefore fixed effects model should be preferred. The test statistic for the Hausman test follows a chi-square distribution, with the degree of freedom equal to the difference in the number of parameters estimated by the two models (StataCorp, 2024a):

$$H = (\beta_c - \beta_e)'(V_c - V_e)^{-1}(\beta_c - \beta_e) \quad (15)$$

β_c denotes the coefficient vector from the consistent estimator,
β_e denotes the coefficient vector from the efficient estimator,
V_c denotes the covariance matrix of the consistent estimator,
V_e denotes the covariance matrix of the efficient estimator.

3. Results and Discussion

3.1 Results and Discussion of Revealed Comparative Advantages for Selected Countries

Türkiye's trade with selected European countries in SITC sectors 5, 6, 7 and 8 is classified and colored according to the value ranges specified by Hinloopen and Van Marrewijk (2001) using Balassa's (1965) RCA index values which were calculated with import and export data.

Table 2. Revealed Comparative Advantages in SITC 5. Chemicals and related products, n.e.s. Classified by Competitiveness Levels

SITC_5 Year / Country	Austria	Bulgaria	Croatia	Cyprus	Czechia	Denmark	Finland	France	Germany	Hungary	Ireland	Italy	Latvia	Netherlands	Poland	Portugal	Romania	Slovak Republic	Spain	Sweden	United Kingdom
1996	0.18	0.91	0.07	2.66	0.64	0.07	0.65	0.12	0.03	0.54	0.04	0.31	1.41	0.06	0.66	0.13	0.61	0.05	0.39	0.42	0.12
1997	0.07	0.68	0.01	0.58	0.80	0.11	0.80	0.13	0.03	0.62	0.08	0.31	1.20	0.06	0.54	0.28	0.39	0.22	0.57	0.34	0.11
1998	0.06	0.68	0.24	0.48	0.91	0.10	0.99	0.15	0.03	0.50	0.01	0.29	0.59	0.05	0.44	0.18	0.45	0.49	0.41	0.24	0.09
1999	0.06	0.59	0.03	0.59	0.67	0.08	1.09	0.10	0.02	0.25	0.02	0.24	4.04	0.05	1.10	0.05	0.49	0.29	0.32	0.45	0.10
2000	0.04	0.68	0.15	0.56	0.67	0.04	0.14	0.07	0.04	0.54	0.05	0.17	4.78	0.08	0.72	0.18	0.40	0.36	0.33	0.13	0.13
2001	0.05	0.47	0.20	0.70	0.77	0.02	0.29	0.07	0.06	0.17	0.04	0.20	0.18	0.06	0.92	0.13	0.44	0.22	0.25	0.06	0.06
2002	0.08	0.50	0.09	2.48	1.28	0.01	0.28	0.07	0.06	0.17	0.04	0.19	0.00	0.06	0.59	0.07	0.34	0.98	0.20	0.06	0.06
2003	0.09	0.39	0.08	0.59	0.67	0.01	0.27	0.07	0.06	0.18	0.04	0.19	1.44	0.05	0.38	0.05	0.35	0.49	0.18	0.04	0.05
2004	0.09	0.42	0.08	2.76	0.48	0.02	0.20	0.07	0.07	0.18	0.04	0.21	0.00	0.06	0.42	0.06	0.35	0.09	0.26	0.03	0.04
2005	0.09	0.48	0.14	4.17	0.49	0.09	0.21	0.06	0.08	0.18	0.05	0.14	0.00	0.06	0.57	0.09	0.35	0.14	0.14	0.03	0.05
2006	0.13	0.54	0.08	4.02	0.73	0.08	0.11	0.08	0.09	0.25	0.05	0.22	0.44	0.07	0.57	0.16	0.33	0.21	0.12	0.07	0.07
2007	0.09	0.49	0.05	5.73	0.73	0.05	0.14	0.07	0.10	0.22	0.04	0.17	2.86	0.06	0.51	0.10	0.42	1.05	0.16	0.07	0.08
2008	0.12	0.51	0.08	3.24	0.71	0.07	0.15	0.08	0.11	0.21	0.05	0.22	0.42	0.12	0.55	0.15	0.55	1.23	0.17	0.09	0.08
2009	0.08	0.67	0.14	5.66	0.59	0.06	0.24	0.07	0.13	0.24	0.06	0.17	1.73	0.10	0.49	0.16	0.74	1.32	0.17	0.11	0.08
2010	0.13	0.86	0.39	4.21	0.61	0.07	0.15	0.10	0.14	0.31	0.07	0.27	9.87	0.13	0.70	0.20	0.88	0.85	0.21	0.07	0.10
2011	0.16	1.18	0.46	5.10	0.62	0.07	0.16	0.12	0.14	0.33	0.08	0.26	11.28	0.11	0.64	0.30	0.84	1.01	0.19	0.09	0.13
2012	0.16	1.44	0.50	11.79	0.97	0.05	0.14	0.12	0.15	0.25	0.09	0.39	12.13	0.19	0.54	0.47	0.82	1.46	0.23	0.13	0.12
2013	0.18	1.23	0.19	19.58	0.87	0.07	0.23	0.12	0.16	0.18	0.09	0.30	40.37	0.12	0.57	0.33	1.17	1.34	0.22	0.12	0.14
2014	0.17	1.40	0.34	13.40	0.81	0.08	0.20	0.13	0.15	0.25	0.09	0.40	38.45	0.12	0.50	0.63	1.05	0.60	0.15	0.13	0.12
2015	0.20	1.35	0.28	13.11	1.07	0.08	0.23	0.15	0.16	0.30	0.09	0.42	12.52	0.14	0.67	0.50	1.16	0.33	0.21	0.12	0.14
2016	0.18	1.11	0.21	12.81	1.49	0.08	0.20	0.15	0.15	0.30	0.08	0.33	11.01	0.14	0.73	0.51	1.39	0.43	0.20	0.11	0.13
2017	0.20	1.22	0.32	20.25	1.45	0.08	0.29	0.14	0.13	0.19	0.08	0.35	4.34	0.17	0.55	0.69	1.25	0.65	0.20	0.12	0.19
2018	0.24	1.10	0.40	6.86	1.46	0.15	0.30	0.14	0.14	0.19	0.08	0.29	9.23	0.15	0.51	0.30	1.21	0.70	0.18	0.15	0.25
2019	0.24	0.87	0.44	2.32	1.56	0.13	0.39	0.11	0.12	0.18	0.11	0.27	18.53	0.16	0.48	0.32	1.58	1.13	0.17	0.14	0.23
2020	0.28	0.89	0.62	10.17	1.50	0.10	0.25	0.16	0.16	0.23	0.13	0.33	22.49	0.21	0.54	0.65	1.50	1.18	0.22	0.19	0.29
2021	0.39	1.16	1.21	1.29	1.28	0.12	0.39	0.15	0.16	0.29	0.10	0.43	5.05	0.22	0.70	0.42	2.15	1.01	0.23	0.16	0.30

0 < RCA ≤ 1 | 1 < RCA ≤ 2 | 2 < RCA ≤ 4 | 4 < RCA

Source: Author's calculations.

Table 3. Revealed Comparative Advantages in SITC 6. Manufactured Goods Classified by Competitiveness Levels

SITC_6 Year / Country	Austria	Bulgaria	Croatia	Cyprus	Czechia	Denmark	Finland	France	Germany	Hungary	Ireland	Italy	Latvia	Netherlands	Poland	Portugal	Romania	Slovak Republic	Spain	Sweden	United Kingdom
1996	0.46	0.68	2.22	5.37	0.53	2.17	0.43	1.22	0.91	1.46	4.80	1.51	1.22	1.55	0.23	1.71	2.63	0.39	1.96	1.36	2.58
1997	0.48	0.77	1.22	2.64	0.42	2.88	0.58	1.15	0.96	1.22	5.18	2.09	0.85	1.56	0.41	4.12	2.21	0.35	1.89	1.52	2.61
1998	0.62	1.13	25.22	1.77	0.63	2.77	0.71	1.37	1.00	2.81	6.86	2.13	0.19	1.33	0.43	4.72	1.15	0.35	1.95	1.56	2.67
1999	0.71	1.47	2.82	3.71	0.78	2.62	0.87	1.57	0.92	1.68	5.49	2.04	0.15	1.38	0.60	3.94	1.32	0.39	2.11	2.94	3.05
2000	0.69	1.51	18.00	1.56	0.86	2.63	1.10	1.62	1.08	6.04	6.54	2.29	0.57	1.65	1.44	2.88	1.16	0.55	2.04	3.00	2.74
2001	0.62	1.76	8.58	6.62	1.19	2.57	0.68	1.36	1.07	3.90	9.49	1.77	0.33	1.20	2.83	2.01	1.14	0.53	1.74	1.66	1.77
2002	0.53	1.17	0.60	5.15	1.32	2.10	0.46	1.29	0.98	3.52	8.63	1.40	0.20	1.24	2.08	2.33	1.09	0.45	1.62	0.90	1.74
2003	0.72	0.99	0.85	32.48	1.45	1.70	0.36	1.14	1.08	3.29	6.90	1.46	0.23	1.29	2.35	2.08	1.26	0.48	1.85	0.81	1.83
2004	0.84	0.97	3.65	50.64	1.57	1.34	0.41	1.08	1.17	6.78	9.19	1.36	0.50	1.42	4.29	1.88	1.13	0.48	2.24	0.77	1.65
2005	0.75	0.94	3.65	54.28	1.31	1.89	0.42	0.93	1.19	5.74	5.88	1.09	0.92	0.98	3.74	2.97	0.91	0.54	1.63	0.89	1.42
2006	0.78	0.71	0.79	26.91	1.60	1.56	0.42	0.98	1.23	7.73	9.13	1.10	2.49	1.26	3.48	3.51	1.09	0.53	1.49	0.77	1.82
2007	0.79	0.80	2.08	27.84	1.73	1.83	0.40	0.86	1.30	12.00	9.65	1.07	7.29	1.51	2.37	3.36	1.10	0.55	1.53	0.88	1.62
2008	0.82	1.21	3.85	10.45	1.44	2.52	0.46	0.80	1.39	9.80	11.30	1.06	1.78	1.86	3.36	2.80	1.43	0.64	1.09	0.82	1.60
2009	1.06	0.92	7.71	11.06	1.12	2.21	0.61	0.75	1.44	7.81	13.70	1.06	5.10	1.80	2.74	2.80	1.57	1.22	0.98	0.82	1.34
2010	1.18	0.91	6.33	13.17	1.03	2.20	0.58	0.89	1.57	7.21	27.08	1.31	1.98	2.25	2.69	1.70	1.22	0.74	0.92	0.71	1.77
2011	1.20	1.27	6.74	12.20	1.79	2.15	0.61	1.04	1.90	6.96	33.83	1.88	3.10	1.82	3.67	2.08	1.44	1.11	0.89	0.85	2.03
2012	1.15	1.68	7.34	6.94	1.45	2.92	0.65	1.00	1.67	4.14	20.96	1.66	1.41	1.53	1.97	2.37	1.44	0.92	0.64	0.61	1.50
2013	1.22	1.51	1.33	9.00	1.87	3.22	0.72	0.93	1.67	3.24	11.47	1.55	2.08	1.68	1.69	2.44	1.60	0.73	0.66	0.66	1.18
2014	1.08	1.30	1.55	6.20	2.31	3.36	0.61	0.87	1.61	3.43	9.54	1.48	1.32	2.19	1.48	1.92	1.70	0.76	0.64	0.76	0.96
2015	1.09	1.52	1.46	9.44	2.45	2.43	0.74	1.15	1.63	3.32	13.11	1.42	1.13	1.55	1.76	1.72	1.36	1.28	0.75	0.77	0.91
2016	1.02	1.75	1.36	14.15	2.53	3.37	0.73	1.14	1.59	3.28	8.76	1.28	1.06	1.99	1.75	1.22	1.39	1.40	0.93	0.64	1.21
2017	0.96	1.52	2.10	10.34	2.23	3.31	0.88	1.02	1.50	2.90	19.57	1.53	0.99	2.23	1.67	1.19	1.43	1.55	0.90	0.74	1.93
2018	0.98	1.36	1.62	9.26	1.93	2.35	0.93	0.96	1.34	2.87	16.03	1.70	1.27	2.02	1.27	1.91	1.89	1.32	0.90	0.77	2.14
2019	0.94	1.54	2.18	7.41	1.83	2.70	0.84	0.81	1.31	2.35	12.30	1.39	2.21	1.28	1.27	1.78	1.66	1.44	0.77	0.72	1.82
2020	0.96	1.12	3.19	13.10	2.20	3.28	0.91	1.00	1.63	2.70	12.05	1.52	0.93	2.15	1.44	2.07	1.84	1.79	0.96	0.71	1.89
2021	1.20	1.04	3.32	12.23	1.87	3.75	1.25	1.03	1.71	2.74	18.45	1.87	1.55	2.62	1.84	2.60	2.14	1.43	1.25	0.89	2.32

0 ≤ RCA ≤ 1 | 1 ≤ RCA ≤ 2 | 2 ≤ RCA ≤ 4 | 4 ≤ RCA

Source: Author's calculations.

Table 4. Revealed Comparative Advantages in SITC 7. Machinery and transport equipment Classified by Competitiveness Levels

SITC_7 Year / Country	Austria	Bulgaria	Croatia	Cyprus	Czechia	Denmark	Finland	France	Germany	Hungary	Ireland	Italy	Latvia	Netherlands	Poland	Portugal	Romania	Slovak Republic	Spain	Sweden	United Kingdom
1996	0.24	2.57	2.32	4.17	0.06	0.34	0.50	0.33	0.21	0.24	1.20	0.44	5.13	0.27	0.10	0.66	1.77	0.91	0.24	0.12	0.28
1997	0.35	1.78	1.10	1.89	0.12	0.38	0.59	0.39	0.23	0.06	1.19	0.25	2.15	0.20	0.27	0.59	0.85	0.08	0.36	0.15	0.33
1998	0.27	1.47	0.29	1.71	0.17	0.36	0.45	0.36	0.30	0.14	1.02	0.30	15.91	0.20	0.27	0.42	0.74	0.13	0.57	0.26	0.41
1999	0.30	4.03	1.58	0.59	0.38	0.32	0.31	0.63	0.42	0.56	2.13	0.37	1.57	0.34	0.38	0.69	1.37	0.33	0.61	0.16	0.35
2000	0.48	3.92	1.63	0.74	0.79	0.41	0.30	0.68	0.35	0.34	1.40	0.43	8.68	0.28	0.40	1.38	4.85	0.32	0.45	0.20	0.34
2001	0.69	9.45	3.26	0.47	0.51	0.50	0.66	0.84	0.45	0.71	2.55	0.56	9.28	0.39	0.39	1.76	4.00	1.17	0.71	0.34	0.48
2002	0.74	4.91	3.89	1.77	0.49	0.63	1.07	0.80	0.48	0.93	2.02	0.76	3.61	0.43	0.59	1.72	7.41	1.53	0.81	0.68	0.59
2003	0.68	6.57	6.78	4.27	0.54	0.52	1.42	0.83	0.50	0.85	1.65	0.73	6.19	0.74	0.69	2.14	5.70	0.90	0.80	0.94	0.69
2004	0.81	4.07	3.87	6.42	0.56	0.84	1.27	0.83	0.53	0.70	1.71	0.81	12.13	0.92	0.57	1.51	4.07	1.38	0.66	0.85	0.79
2005	0.89	3.74	0.57	6.77	0.58	0.60	1.09	0.85	0.58	0.62	2.16	0.83	0.35	1.21	0.52	0.93	3.50	1.26	0.69	0.90	0.73
2006	0.84	5.32	1.41	4.70	0.55	0.71	1.19	0.90	0.61	0.57	1.90	0.87	0.54	0.97	0.54	0.77	3.87	1.41	0.75	1.19	0.79
2007	0.99	5.65	1.96	4.70	0.58	0.71	1.20	1.06	0.66	0.50	2.43	0.96	22.71	1.00	0.52	0.93	3.08	1.02	0.76	0.98	0.82
2008	0.93	6.67	3.83	7.25	0.66	0.74	1.41	1.22	0.69	0.52	3.33	1.02	4.49	0.99	0.52	1.33	2.08	0.92	0.80	0.92	0.97
2009	0.89	2.83	5.44	12.07	0.56	0.37	0.99	1.22	0.57	0.42	2.43	1.04	44.46	1.19	0.65	1.12	1.21	0.50	0.64	0.99	0.87
2010	0.83	2.73	1.69	23.40	0.71	0.45	0.94	1.03	0.59	0.58	3.76	1.03	27.12	1.09	0.61	1.55	1.20	0.82	0.72	1.20	0.89
2011	0.90	3.00	5.88	8.14	0.48	0.63	0.93	1.06	0.57	0.57	3.78	0.87	21.10	1.06	0.55	1.22	1.38	0.68	0.69	1.34	0.88
2012	0.84	2.77	1.56	2.53	0.51	0.72	1.27	1.12	0.64	0.82	2.82	0.96	13.95	1.36	0.53	1.11	1.20	0.72	0.78	1.43	0.92
2013	0.76	2.62	1.75	22.20	0.48	0.72	1.42	1.17	0.60	0.99	3.78	0.79	7.53	1.05	0.62	0.73	0.91	0.58	0.61	1.52	1.01
2014	0.89	2.33	2.11	8.31	0.51	0.81	1.46	1.16	0.66	0.74	3.72	0.84	8.78	1.13	0.63	1.13	0.98	0.60	0.75	1.47	1.10
2015	0.84	1.69	1.61	20.96	0.50	0.80	1.15	1.02	0.64	0.80	4.17	0.87	3.85	0.99	0.52	0.96	0.73	0.38	0.67	1.49	0.91
2016	0.96	1.27	1.85	40.77	0.47	0.70	1.30	1.08	0.70	0.80	3.66	0.95	6.06	1.64	0.54	1.41	0.82	0.57	0.70	1.62	0.63
2017	1.17	1.46	1.20	10.23	0.50	1.45	1.52	1.16	0.77	0.84	4.36	0.97	6.13	1.98	0.67	1.45	0.80	0.54	0.71	1.67	0.94
2018	1.23	1.44	2.70	2.13	0.53	1.37	2.24	1.26	0.85	0.94	4.08	0.99	4.77	1.91	0.88	1.44	0.87	0.65	0.74	1.67	1.14
2019	1.22	1.70	1.47	3.60	0.53	0.74	2.03	1.49	0.88	0.94	4.40	0.99	5.40	2.40	0.88	1.50	0.87	0.48	0.91	2.06	0.93
2020	0.93	1.58	2.44	15.78	0.48	1.20	2.00	1.22	0.69	0.77	5.54	0.89	6.12	1.41	0.80	0.86	0.64	0.41	0.72	1.50	0.86
2021	0.82	1.46	2.21	17.17	0.41	1.43	1.86	1.24	0.72	0.78	6.88	0.81	7.96	1.17	0.72	0.72	0.52	0.51	0.62	1.42	0.89

Source: Author's calculations.

Table 5. Revealed Comparative Advantages in SITC 8. Miscellaneous manufactured articles Classified by Competitiveness Levels

SITC_8 Year / Country	Austria	Bulgaria	Croatia	Cyprus	Czechia	Denmark	Finland	France	Germany	Hungary	Ireland	Italy	Latvia	Netherlands	Poland	Portugal	Romania	Slovak Republic	Spain	Sweden	United Kingdom
1996	12.01	10.47	49.28	1.43	8.63	4.65	10.08	6.29	8.54	44.89	1.39	0.75	12.69	7.70	42.44	1.20	10.96	74.86	2.04	14.14	3.43
1997	8.21	19.65	3.00	0.40	3.47	4.14	12.64	4.80	7.47	42.09	1.44	0.91	3.19	6.30	31.64	0.77	10.43	80.65	1.91	15.70	3.36
1998	9.68	11.09	17.01	1.53	7.66	5.47	7.19	4.33	6.73	24.55	1.87	0.85	1.68	6.25	10.18	0.81	9.85	28.83	1.54	16.66	3.13
1999	5.45	20.39	3.71	0.75	3.92	5.00	11.29	4.37	5.73	7.25	1.66	0.81	3.77	5.01	18.87	0.52	5.93	40.74	1.86	28.88	3.88
2000	5.37	4.87	9.76	0.69	4.90	4.60	10.91	4.03	6.80	8.59	1.05	1.00	2.91	3.52	7.69	0.55	13.27	15.65	2.57	10.54	5.38
2001	5.13	7.26	0.43	3.14	6.61	6.10	4.31	3.09	6.32	5.82	2.11	0.81	0.51	5.62	2.31	0.35	15.07	2.75	2.52	2.84	5.22
2002	5.69	7.87	1.71	2.68	15.15	9.45	5.22	3.77	7.33	6.60	3.53	1.04	0.68	7.55	4.19	0.55	13.21	9.76	2.43	4.22	4.60
2003	9.64	5.41	0.99	1.97	14.02	9.43	7.33	4.62	7.84	4.56	4.09	1.18	2.49	9.34	3.51	0.55	12.03	14.49	3.38	3.89	5.47
2004	5.81	3.44	2.65	1.54	9.42	6.70	9.38	4.70	7.08	5.95	2.23	1.10	0.85	7.25	4.15	0.30	10.34	2.59	4.94	6.34	4.24
2005	4.06	3.86	4.11	3.07	7.22	5.57	7.06	4.42	6.14	7.82	2.10	1.06	5.39	6.47	3.16	0.33	10.82	1.67	5.94	3.66	4.91
2006	4.54	6.26	1.89	1.79	6.00	4.60	6.29	4.12	5.62	14.76	1.73	0.99	4.86	5.73	2.73	0.25	8.50	1.53	5.87	3.15	4.89
2007	4.46	4.76	1.89	4.03	6.42	6.73	6.20	3.44	5.10	13.48	1.72	1.02	8.52	6.36	2.38	0.29	7.56	3.20	5.65	3.19	5.33
2008	4.90	4.45	2.15	4.34	5.62	8.56	5.16	3.32	4.57	7.08	1.44	1.01	7.54	7.33	2.61	0.43	9.33	2.74	6.78	4.24	4.69
2009	4.23	3.97	1.45	12.76	6.86	10.73	5.95	3.13	5.39	5.51	2.74	1.16	8.22	7.51	2.30	0.62	7.50	5.34	8.91	4.67	5.20
2010	3.06	5.29	1.58	8.14	4.49	9.78	8.08	3.53	5.58	5.80	1.85	1.30	15.55	7.49	3.27	0.72	8.32	4.70	9.29	6.02	5.64
2011	3.11	5.08	3.01	9.54	3.39	8.08	5.59	3.07	5.20	5.38	1.26	1.37	17.50	7.04	3.93	0.62	5.82	3.15	10.21	4.12	5.17
2012	3.28	4.37	2.96	10.36	3.92	7.75	7.14	3.10	4.86	3.83	1.14	1.64	27.31	7.30	4.76	0.63	5.24	3.12	10.69	4.86	4.95
2013	2.61	4.03	1.94	11.36	3.82	8.46	11.55	2.94	4.90	2.20	0.92	1.18	24.17	5.23	4.42	0.45	5.65	5.04	9.29	4.24	5.04
2014	2.84	3.56	1.54	12.62	2.91	7.74	10.69	3.17	4.27	2.48	0.83	1.22	27.56	6.37	4.13	0.49	7.46	4.61	8.55	3.70	5.27
2015	2.61	3.09	1.86	15.03	2.85	7.02	7.78	3.01	4.18	2.43	0.73	1.08	19.93	5.75	4.10	0.44	5.75	4.72	9.67	2.80	4.65
2016	3.08	3.72	2.39	48.83	3.01	7.83	6.91	2.91	4.23	1.83	0.98	0.98	54.25	4.82	4.07	0.44	2.98	2.68	8.58	3.03	3.90
2017	2.33	2.70	2.96	6.30	3.27	6.07	2.60	2.94	3.71	2.73	1.39	0.91	24.69	6.51	3.45	0.39	2.69	1.99	6.95	4.52	5.01
2018	2.45	1.54	2.22	5.42	3.77	6.11	2.65	2.80	3.78	2.03	0.97	0.76	43.39	6.55	2.81	0.35	2.70	1.78	6.29	5.09	5.95
2019	3.54	2.36	2.11	1.76	3.72	7.83	2.77	2.47	3.98	2.67	1.30	0.74	28.31	7.19	2.61	0.49	2.67	2.23	4.46	3.95	4.70
2020	4.19	1.74	2.67	2.82	4.22	6.95	3.22	2.61	4.83	3.15	1.45	0.97	11.81	8.75	2.75	0.66	2.67	2.22	6.26	5.94	5.29
2021	4.17	2.27	3.72	0.60	5.80	7.09	4.40	3.27	3.92	2.91	1.43	0.80	10.32	10.27	3.09	0.73	2.80	1.99	5.86	7.24	5.09

0 < RCA ≤ 1 | 1 < RCA ≤ 2 | 2 < RCA ≤ 4 | 4 < RCA

Source: Author's calculations.

In the SITC-5 category, Türkiye's competitiveness is quite low compared to other categories. Türkiye's competitiveness in this category is high with relatively small economies such as Cyprus and Latvia. It is also found that Türkiye's competitiveness in trade with neighboring countries such as Bulgaria and Romania has increased after their accession to the European Union. On the other hand, competitiveness in Türkiye's trade with other countries in this category is low.

When the overall period is examined in the SITC-6 category, it can be said that there is a competitive disadvantage in Finland and Sweden. In countries such as Austria, Spain, Slovakia, Latvia and France, the advantage and disadvantage situation changes over the period. When examined at the end of the period, it is seen that there is a disadvantage only with Sweden. It can be said that there is a strong competitive advantages in trade with Southern Cyprus in general and in the trade with Ireland for all period. It is observed that there is a medium level of competitiveness from time to time with Croatia, Denmark, Hungary, Poland, Portugal and England. There is a general advantage in trade with the remaining countries.

In the SITC-7 category, there is a trade disadvantage with the Czech Republic, Germany, Hungary, Poland, Spain throughout the period. With Austria, Denmark, Italy, Slovakia and the UK, there is an advantage in certain years but a disadvantage throughout the period. Trade with Croatia varied between weak, medium and strong throughout the period and was medium at the end of the period. With Portugal, there was a weak trade advantage throughout the period but a disadvantage at the end of the period. It is seen that trade turned into an advantageous situation after 2002 in Finland, 2005 in the Netherlands, 2006 in Sweden, and 2007 in France. There is a strong superiority in trade with Southern Cyprus and Latvia throughout the period, with Bulgaria and Romania at the beginning of the period, and with Ireland at the end of the period. It is seen that competitiveness with Bulgaria and Romania has decreased especially after these countries entered the EU.

There appears to be a generally moderate to strong level of RCA in trade in the SITC-8 category. The exception to this situation is the trade with Portugal, and there was no year with a trade competitiveness except 1996. It is noteworthy that there is weak, medium and strong competitiveness in trade with Ireland, Croatia and Cyprus from time to time. It can be said that Türkiye has the most advantageous situation in terms of competition with selected European countries in terms of trade in SITC8 category compared to SITC5, 6 and 7.

3.2 Econometric Analysis and Determinants of Revealed Comparative Advantages

Table 6. Correlation Matrix for Variable Coefficients

Variables	ln_gdp_av	ln_gdp	ln_gdp_tr	ln_gdppc_dif	dist_gdp	rd	rd_tr	to	to_tr	reer	RCA_5	RCA_6	RCA_7	RCA_8
ln_gdp_av	1													
ln_gdp	0.59	1												
ln_gdp_tr	0.33	0.09	1											
ln_gdppc_dif	0.90	0.55	0.06	1										
dist_gdp	0.40	0.82	-0.08	0.45	1									
rd	0.45	0.54	0.20	0.68	0.32	1								
rd_tr	0.31	0.09	0.95	0.05	-0.08	0.20	1							
to	0.06	-0.43	0.32	-0.02	-0.47	-0.15	0.30	1						
to_tr	0.25	0.08	0.76	0.04	-0.06	0.17	0.82	0.24	1					
reer	0.50	0.40	0.16	0.41	0.40	0.34	0.10	-0.16	0.06	1				
RCA_5	-0.11	-0.35	0.16	-0.16	-0.17	-0.23	0.13	0.16	0.09	0.01	1			
RCA_6	0.10	-0.26	0.02	0.10	-0.16	-0.21	0.01	0.37	-0.01	0.03	0.13	1		
RCA_7	-0.14	-0.41	0.08	-0.14	-0.22	-0.27	0.07	0.16	0.02	-0.05	0.45	0.28	1	
RCA_8	-0.23	-0.22	-0.15	-0.23	-0.13	-0.09	-0.12	-0.01	-0.08	-0.32	0.32	-0.08	0.19	1

Source: Author's calculations.

High correlation between coefficients may lead to multicolinearity problem. Therefore, interaction terms of variables with high correlation coefficients were used and presented in the relevant models.

3.2.1. Likelihood Ratio Test

Prior to the Hausman test and diagnostics, it is important to analyze whether there are individual unit and time effects in the models. In this context, the Likelihood Ratio (LR) test is used to test whether the models are fit. In LR test, the restricted model is analyzed by comparing it with the unrestricted model. The LR test statistic is based on the difference between the log-likelihoods of the two models (Wooldridge, 2019), p.564-565):

$$2[log - likelihood\ of\ unrestricted\ model - log - likelihood\ of\ restricted\ model]$$

The null hypothesis of the LR test is that the restricted model is significantly better, while the alternative hypothesis is that the unrestricted model is significantly better. In this context, time dummies were created for each year in the unrestricted model to test which models the time effects fit in. Thus, the same variables were used in the restricted model without the time dummy. A similar process was performed for the individual unit using unit dummies. The unit and time effects test results applied for the 4 models under each SITC sector are shown in Table 7.

Table 7. LR Test Results

Model / Independent Variable	RCA5 Time	RCA5 Unit	RCA6 Time	RCA6 Unit	RCA7 Time	RCA7 Unit	RCA8 Time	RCA8 Unit
Model 1	0.7148	0.0000	0.7512	0.0000	0.6646	0.0000	0.0464	0.0000
Model 2	0.3500	0.0000	0.8382	0.0000	0.2205	0.0000	0.0160	0.0000
Model 3	0.2149	0.0000	0.8413	0.0000	0.0086	0.0000	0.0090	0.0000
Model 4	0.0772	0.0000	0.7997	0.0000	0.0039	0.0000	0.0127	0.0000

Source: Author's calculations

The test results show that individual unit effects are fit in each model, and time effects are fit in 3rd and 4th models of SITC7 and all models of SITC8. The fit of individual unit dummy variables indicates that estimation should not be done with pooled OLS. In this context, panel data estimation will be performed and Hausman test will be performed to determine whether random or fixed effects is the most efficient. Time dummies were used in the models where time effects were found to be fit, and these variables were not included in the other models.

3.2.2. Heteroskedasticity and Autocorrelation Tests

4 models for each sector were tested for heteroskedasticity and autocorrelation which can cause inefficient estimators and incorrect standard errors leading to misleading conclusions and inference from hypothesis tests. For heteroskedasticity, the Breusch–Pagan (1979) and Cook–Weisberg (1983) tests and for autocorrelation, the Wooldridge (2002) test were applied where null hypothesis indicate absence of heteroskedasticity and autocorrelation, respectively. As it is presented in Table 8, all models suffer from heteroskedasticity and all models, except SITC7 (RCA7) sector, have autocorrelation issues. Therefore, a robust estimation was conducted using the vce(cluster id) option in Stata which applies the sandwich estimator to adjust for clustering of standard errors (StataCorp, 2024b).

Table 8. Heteroskedasticity and Autocorrelation Tests

	Heteroskedasticity (p-values)				Autocorrelation (p-values)			
Model / Independent Variable	RCA5	RCA6	RCA7	RCA8	RCA5	RCA6	RCA7	RCA8
Model 1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5781	0.0602
Model 2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5733	0.0432
Model 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5645	0.0398
Model 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.5586	0.0571

Source: Author's calculations

3.2.3. Hausman Test Results

Hausman test results for each dependent variable and the examined submodel are shown in Table 9. RE is the abbreviation of random effects and FE is the abbreviation of fixed effects model, and the value next to the expression indicates the p-value. In calculating the results in Table 10 and Table 11, the most efficient estimator shown in Table 9 was used.

Table 9. Hausman Test Results

Model / Independent Variable	RCA_5 SITC5	RCA_6 SITC6	RCA_7 SITC7	RCA_8 SITC8
Model 1	0.8722 (RE)	0.0070 (FE)	0.7639 (RE)	0.1458 (RE)
Model 2	0.9824 (RE)	0.0018 (FE)	0.4479 (RE)	0.0584 (RE)
Model 3	0.0157 (FE)	0.0378 (FE)	0.3185 (RE)	0.0000 (FE)
Model 4	0.2185 (RE)	0.0010 (FE)	0.7023 (RE)	0.0029 (FE)

Source: Author's calculations

3.2.4. Panel Data Analysis Results and Discussion

When the models are examined, it is seen that the added interaction terms make some variables statistically significant and others insignificant. This shows that it is important for a correct analysis to take into account the correlations between variables in the analysis and to eliminate the effects of these correlations by adding their interactions to the model.

Table 10. Panel Data Analysis Results for SITC 5 and SITC 6

VARIABLES	(1) RCA 5	(2) RCA 5	(3) RCA 5	(4) RCA 5	(1) RCA 6	(2) RCA 6	(3) RCA 6	(4) RCA 6
ln_gdp	-2.146**	-1.923***			5.395	6.174		
	(0.889)	(0.718)			(4.407)	(4.570)		
ln_gdp_tr	-32.84	3.713			39.91	-2.718		
	(26.93)	(2.379)			(25.76)	(1.888)		
dist_gdp	0.745	0.0325**	-0.00247	-0.00819	0.694	-0.0407	-0.00787	-0.00478
	(0.575)	(0.0150)	(0.00235)	(0.00601)	(0.571)	(0.0319)	(0.0207)	(0.0223)
ln_gdp_av			16.89	2.488			-21.92	0.0752
			(11.31)	(1.732)			(12.90)	(3.347)
ln_gdppc_dif	0.341	0.348	13.38	-0.290	0.404	0.414	-21.84*	0.934**
	(0.292)	(0.278)	(9.031)	(0.256)	(0.299)	(0.294)	(11.14)	(0.375)
RD	-0.462	-0.457	-4.292	-0.692	1.132	1.197	5.922	0.699
	(0.317)	(0.283)	(4.803)	(0.488)	(1.019)	(0.973)	(9.185)	(0.594)
rd_tr	0.777	-0.433			137.6	-0.723		
	(22.69)	(1.341)			(184.1)	(1.834)		
TO	-0.00805	-0.00433	0.0107	0.0106	-0.0197	-0.0197	-0.0302	-0.0114
	(0.0104)	(0.00892)	(0.0102)	(0.0117)	(0.0506)	(0.0501)	(0.0642)	(0.0627)
to_tr	-18.93	0.0119**			19.87	0.0255*		
	(14.88)	(0.00602)			(13.86)	(0.0142)		
REER	0.0106	0.0169	-0.0138	0.00931	0.0263	0.0355	0.0761	0.0434
	(0.0230)	(0.0220)	(0.0187)	(0.0222)	(0.0418)	(0.0368)	(0.0472)	(0.0358)
d1999_2001	0.0998	0.346	-0.0872	-0.124	0.156	-0.232	-0.0907	-0.256
	(0.127)	(0.332)	(0.339)	(0.312)	(0.640)	(0.682)	(0.544)	(0.614)
d2008_2009	-0.332	-0.410	-0.466	-0.626	-0.991	-0.755	-0.716	-0.333
	(0.344)	(0.367)	(0.379)	(0.475)	(0.866)	(1.029)	(1.041)	(0.914)
d2018_2021	1.220	-0.844	-0.440	-0.361	-1.799**	-0.468	-0.666	-0.428
	(1.544)	(0.738)	(0.424)	(0.386)	(0.799)	(0.532)	(0.568)	(0.435)
c.to_tr#c.rd_tr	-0.955				1.002*			
	(0.746)				(0.519)			
c.ln_gdp_tr#c.rd_tr	1.684				-6.861			
	(1.601)				(6.419)			
c.ln_gdp_tr#c.to_tr	0.725				-0.760			
	(0.570)				(0.525)			
c.ln_gdp#c.dist_gdp	-0.0247				-0.0259			
	(0.0195)				(0.0201)			
c.ln_gdp_av#c.ln_gdppc_dif			-1.543				2.596	
			(1.040)				(1.528)	
c.ln_gdppc_dif#c.RD			0.383				-0.516	
			(0.456)				(0.896)	
Constant	906.9	-54.35	-145.8	-20.87	-1,190	-92.07	177.5*	-10.39
	(717.4)	(49.14)	(98.21)	(15.24)	(760.2)	(96.66)	(89.77)	(31.14)
Observations	537	537	537	537	537	537	537	537
R-squared					0.053	0.047	0.067	0.030
Number of pid	21	21	21	21	21	21	21	21

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Author's calculations.

SITC-5 consists of Chemicals and related products, n.e.s.. According to the first model, the increase in the GDP of Türkiye's trading partner reduces Türkiye's competitiveness. This situation can be interpreted from two different points. The first of these points is the emergence of internal economies of scale as a result of the increase in the GDP of Türkiye's trading partner, thus reducing costs and increasing consumer demand by increasing product and brand diversity. In short, it means increasing the competitiveness of the competing country. The second point is that the demand for intermediate and final goods from Türkiye decreases and shifts to other countries as the welfare level of producers and consumers increases with the increase in GDP.

Table 11. Panel Data Analysis Results for SITC 7 and SITC 8

VARIABLES	(1) RCA_7	(2) RCA_7	(3) RCA_7	(4) RCA_7	(1) RCA_8	(2) RCA_8	(3) RCA_8	(4) RCA_8
ln_gdp	-2.444***	-2.279***			-2.525*	-3.138		
	(0.939)	(0.737)			(1.400)	(5.155)		
ln_gdp_tr	28.83	1.287			-110.6**	-1.369		
	(18.30)	(0.917)			(55.08)	(4.153)		
dist_gdp	0.246	0.0323**	-0.0117	-0.00879	0.256	0.129	0.0626	0.0966
	(0.653)	(0.0138)	(0.00881)	(0.00843)	(0.863)	(0.0879)	(0.0507)	(0.0741)
ln_gdp_av			-6.611	-0.453			-21.07	5.904
			(5.045)	(1.582)			(31.40)	(8.734)
ln_gdppc_dif	0.570**	0.633**	-5.600	0.276	-1.251	-1.494	-25.76	-2.167
	(0.237)	(0.248)	(3.547)	(0.324)	(1.359)	(2.522)	(26.56)	(2.043)
RD	-0.476*	-0.510**	1.395	-0.354	2.341	2.477	42.56	3.021
	(0.274)	(0.241)	(3.026)	(0.272)	(1.829)	(3.457)	(41.66)	(3.289)
rd_tr	298.8	2.898			-168.4	6.505		
	(208.6)	(2.628)			(153.2)	(4.322)		
TO	-0.00919	-0.00843	0.0128**	0.0135**	-0.0346	-0.125**	-0.158**	-0.144**
	(0.0120)	(0.0109)	(0.00634)	(0.00653)	(0.0223)	(0.0571)	(0.0651)	(0.0650)
to_tr	11.22	-0.0358			-50.78*	0.0651		
	(8.001)	(0.0347)			(26.59)	(0.0792)		
REER	-0.0286	-0.0152	-0.00477	-0.0158	-0.183	-0.174	-0.179*	-0.204*
	(0.0263)	(0.0236)	(0.0310)	(0.0286)	(0.123)	(0.108)	(0.103)	(0.111)
d1999_2001	-0.446	-0.530	-0.742*	-0.716	-3.958**	-2.333**	-2.124*	-2.203*
	(0.441)	(0.440)	(0.444)	(0.455)	(1.560)	(1.116)	(1.211)	(1.270)
d2008_2009	0.187	0.986*	0.955	1.023*	-0.0603	-0.583	-0.398	-0.588
	(0.178)	(0.526)	(0.632)	(0.604)	(0.619)	(0.719)	(0.816)	(0.847)
d2018_2021	-1.682	-1.117	-0.0898	-0.158	1.257	-3.331*	-1.710	-1.205
	(1.343)	(0.895)	(0.367)	(0.351)	(1.543)	(1.712)	(1.066)	(1.073)
c.to_tr#c.rd_tr	0.691				-2.534*			
	(0.439)				(1.333)			
c.ln_gdp_tr#c.rd_tr	-12.00				11.02			
	(8.109)				(7.391)			
c.ln_gdp_tr#c.to_tr	-0.434				1.946*			
	(0.307)				(1.018)			
c.ln_gdp#c.dist_gdp	-0.00725				-0.00735			
	(0.0222)				(0.0294)			
c.ln_gdp_av#c.ln_gdppc_dif			0.663				2.934	
			(0.418)				(2.950)	
c.ln_gdppc_dif#c.RD			-0.197				-4.002	
			(0.297)				(3.981)	
Constant	-695.2	22.71	58.54	4.979	2,997**	152.2	209.3	-5.408
	(457.9)	(31.50)	(40.94)	(10.38)	(1,462)	(110.6)	(282.7)	(88.05)
Observations	537	537	537	537	537	537	537	537
R-squared						0.177	0.193	0.172
Number of pid	21	21	21	21	21	21	21	21

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Author's calculations.

In the second model, it is concluded that an increase in weighted distance enhances competitiveness. This variable incorporates not only the geographical distance but also the GDP of the trading partner countries. The numerator is calculated as the product of GDP and geographical distance, which balances economic size with distance. As a result, countries like Germany, the UK, France, and Spain, which are geographically distant from Türkiye yet have large economies, naturally exhibit higher weighted distance values. Therefore, in our analysis, the positive correlation between weighted distance and competitiveness is expected. Moreover, since the analysis focuses on European countries, transportation costs are unlikely to significantly impact competitiveness.

In the first model, Türkiye's GDP, weighted distance, income level differences, research and development expenditures, trade openness of the trading and host countries, real effective exchange rates and dummy variables were found to be statistically insignificant.

In the 2nd model, Türkiye's trade openness was found to be statistically insignificant compared to the 1st model. On the other hand, it has been concluded that the increase in Türkiye's GDP positively affects

competitiveness. As mentioned in the impact of increasing the GDP of the trading partner on Türkiye's competitiveness, the competitiveness of the country whose GDP increases is expected to increase as a result of the emerging economies of scale and product differentiation. In this context, it can be said that Türkiye's competitiveness increases as its GDP increases. The coefficient sign and statistical significance of all other variables are consistent with the results of Model 1. In the 3rd and 4th models, all variables are found as statistically insignificant.

It is seen that different models related to SITC5 sector are not very effective in explaining the revealed comparative advantages in foreign trade. The statistically significant result of the country's GDP and the distance weighted by GDP from macro variables may be an indication that this sector is more affected by the sector-specific internal dynamics. However, in the second model, the significant result of Türkiye's trade partner, Türkiye's GDP and the distance weighted by GDP together indicates that the gravity model is more successful in explaining the trade of this sector.

SITC-6 consists of Manufactured goods. In the 1st and 2nd models, all variables are found to be statistically insignificant. However, in the 3rd model, as the average GDP of both Türkiye and its trading partners increases, Türkiye's competitiveness decreases. One possible explanation is that rising GDP levels can lead to increased domestic consumption in Türkiye and its trading partners, which may drive up demand for imported goods. If this rising demand for imports—both in Türkiye and its trading partners—exceeds Türkiye's capacity to increase its exports, it could result in a reduction in Türkiye's competitiveness in export markets. Essentially, if trading partners and Türkiye themselves start consuming more of their own production or rely more on imports from countries other than Türkiye, Türkiye's ability to compete in these export markets may diminish.

In the 3rd and 4th models, it is seen that the development differences between countries affect competitiveness negatively and positively, respectively. The main reason for this difference is that interaction terms are added to the model and thus the correlation between variables is eliminated. For this reason, it would be more accurate to interpret the result in model 3. It is compatible with the Linder hypothesis that an increase in the development gap reduces trade and therefore competitiveness between countries. As the income gap of consumers in the two countries widens significantly, their preferences will differ according to their income. While consumers in high-income trading partners will prefer high-quality, brand-differentiated and capital-intensive products and services, those in low-income countries will make the opposite choice.

SITC-7 refers Machinery and transport equipment sector. In models 1 and 2, it is seen that the increase in GDP differences between trading countries positively affects competitiveness. In this context, it can be said that the Linder hypothesis cannot explain the trade in SITC-7, at least in terms of increased competition. On the other hand, when viewed from the perspective of comparative advantages, it is seen that the development difference between countries has a statistically significant and positive effect in the 1st and 2nd model. According to the Linder hypothesis, as the development gap between countries increases, trade is expected to be negatively affected. However, an opposite result may indicate that there is a situation indicating a comparative advantage structure. As a matter of fact, countries with higher GDP per capita are expected to be more developed in terms of capital and human resources. This positive effect contradicts the Linder hypothesis but aligns with the comparative advantage theory, where more developed countries, with their stronger capital and human resources, can enhance their trade competitiveness. In addition, in the same models, it is seen that the research and development activities of the trading partner negatively affect Türkiye's competitiveness. Whether the research and development investments made by the countries in the sample are productive can affect the results of the analysis. While Márquez-Ramos and Martínez-Zarzoso (2010) state that innovation has a non-linear structure and does not provide the desired benefit unless a certain threshold value is exceeded, Pereira et al. (2013) stated that these investments affects the export competitiveness differently based on the sector in low, medium or high technology sectors. It can be deduced that Türkiye's research and development activities do not create a positive effect in this category. This situation may be related to the fact that Türkiye's R&D investments are not at a level that will positively affect competitiveness or that they are not used correctly. On the other hand, the positive effect on the competitiveness of the trading partner may be an

indicator of a Ricardian type trade. Examining the impact of technology with sector-specific variables will enable a more detailed inference on this issue and is beyond the scope of this study.

When the 1st and 2nd models are examined, it is seen that as the GDP of Türkiye's trading partner increases, Türkiye's competitiveness in trade decreases. A similar result was reached in the analysis made in the SITC-5. The reason for such a result is that, as a result of the increase in GDP, the competitiveness of Türkiye's trading partner increases and therefore Türkiye's decreases. In addition, the shift in demand to different countries as a result of the increase in welfare may be another factor in the emergence of this result. Another indicator of Ricardian type trade in this category is that the increase in Türkiye's GDP increases competitiveness. Since the use of new processes, management tools, innovation, technologies, patents, brands and digital infrastructure will also increase with the increase in GDP, it can be said that the foreign trade competitiveness of companies in this sector is positively affected.

In the 1st model, it is seen that Türkiye's trade openness positively affects trade competitiveness. Trade openness can be an indicator of access to global markets, import of advanced technologies, integration into the global value chain, and increased productivity and experience. This may also imply that the trade in this sector can be better explained with technological differences.

In the 2nd model, unlike the 1st model, it is seen that Turkey's trade openness is statistically insignificant, but GDP-weighted distance give a significant and positive result. Except for these variables, the coefficient signs and statistical significance of the other variables are similar.

GDP-weighted distance gave a similar result in the 2nd model of SITC-5 category trade competitiveness. Türkiye's competitiveness increases as distance weighted by GDP increases. As mentioned in the explanation of this model, since this distance variable is related to GDP, such a result is possible because Türkiye's major trading partners, whose economies are more developed compared to others, are located in the northern and western parts of Europe.

In the 3rd model, variable d1999_2001 is statistically significant and affects trade competitiveness negatively. Since the Turkish Lira depreciated during the period represented by this variable, it can be inferred that this change had a decreasing effect on competition in foreign trade. This occurred because the sector's exports depended on imports. With the depreciation of the Turkish Lira, imports became more expensive, thus causing a loss of competitiveness in import-based exports.

In the 4th model, d2008_2009 is the statistically significant and has a positive impact on trade competitiveness. It is seen that this variable, which represents the crisis that occurred in 2008 and 2009 and is also known as the EU Debt crisis, makes a positive contribution to Türkiye's competitiveness. Since our analysis covers European countries, it is normal for Türkiye's competitiveness to European countries to increase in the relevant period. Although the Turkish economy was also negatively affected by this period, it was not as heavily as Europe, especially the Eurozone countries, because Türkiye was able to carry out an independent monetary policy. It is seen that the crisis in this period increased Türkiye's competitiveness.

In all 2nd, 3rd and 4th models, it is seen that the trade openness of Türkiye's trading partner negatively affects Türkiye's trade competitiveness. As the trade openness of the trading partners increases, there is a deviation in their trade with Türkiye in this category and it is seen that products are supplied from different countries. In addition, since the trade openness will tend to increase exports to Türkiye by its trading partner, companies engaged in production and trade in Türkiye will be negatively affected by this situation. Another reason for this situation may be that Türkiye's production and trade are dependent on imports. The trade openness variable is calculated by dividing the total of exports and imports to GDP. Considered from this perspective, since the increase in imports will increase trade openness, Türkiye's competitiveness can decrease.

In the first model, it is seen that Türkiye's trade openness also negatively affects its competitiveness. The reason why competitiveness decreases as trade openness increases may be Türkiye's dependence on foreign input in SITC8 sector. Since the increase in imports will increase the total trade, trade openness will also increase. This will cause an inverse relationship between competitiveness and trade openness.

It is seen that the increase in the real effective exchange rates in the trading countries in the 3rd and 4th models and has a positive impact on Türkiye's competitiveness. The appreciation of the currency of

the trading country primarily increases the real value of wages in the country and therefore the production costs. Conversely, if Türkiye's real wages decrease compared to the trading country, production costs will decrease. This will increase Türkiye's competitiveness. The appreciation of the currency of the trading country will cause Türkiye's currency to become cheaper compared to that country. Kharroubi (2011) and Begović and Kreso (2017) revealed that the depreciation of the country's currency will have a negative impact on the trade balance in cases where there is a high level of import dependence.

In the 2nd, 3rd and 4th models, it is seen that the increase in the trade openness of the trading country negatively affects Türkiye's trade competitiveness. Increasing the trade openness of the trading partner may lead the country to import from different countries instead of Türkiye. In addition, increasing trade openness may increase the amount of products coming to Türkiye from its trading partner, resulting in import penetration. This will negatively affect the production and trade sectors in Türkiye.

It was concluded that d1999_2001 dummy variable negatively affected SITC-8 trade competitiveness in all 4 models. Additionally, it was determined that the d2018_2021 dummy variable had a similar effect in the 2nd model. It is possible to say that the crisis and/or policies followed in these years caused a significant and rapid depreciation of the Turkish Lira. As mentioned above, Türkiye's exports are significantly dependent on imports, making its competitiveness in this sector highly sensitive and fragile to exchange rate changes. In case of exports dependent on domestic production, the depreciation of the Turkish Lira would be expected to increase competitiveness as it reduces the cost of the labor factor. Since the opposite situation exists here, competitiveness has been negatively affected.

In the first model, it was concluded that the increase in Türkiye's trading partner and Türkiye's GDP negatively affected competitiveness. The main reason why Türkiye's trading partner's GDP increase has a negative impact on Türkiye's competitiveness is that the trading partner's competitiveness increases. Additionally, as a result of increasing GDP, companies may have preferred to trade with a different country other than Türkiye. The fact that the increase in Türkiye's GDP negatively affects trade competitiveness can be explained by the fact that economic growth increases inward production and consumption rather than foreign trade. On the other hand, growth in GDP may trigger imports with the increase in consumer welfare, thus leading to an insufficient increase in export performance.

4. Conclusion

This study analyzed Türkiye's foreign trade competitiveness in the manufacturing sector with 21 selected European economies during 1996-2021. Using SITC Rev.4 and the Balassa (1965) index, Türkiye's competitiveness is evaluated in four manufacturing sectors: SITC5 (Chemicals and related products, n.e.s), SITC6 (Manufactured Goods), SITC7 (Machinery and Transport Equipment), and SITC8 (Miscellaneous Manufactured Articles). Results show Türkiye's strongest competitive advantage in SITC8, followed by SITC6, while it faces competitive disadvantages in SITC5 and SITC7, except in certain cases and with smaller economies.

Econometric models using RCA index values as the dependent variable identified several key determinants of Türkiye's competitiveness. These include partner countries' GDP, weighted distance, R&D expenditures, trade openness, and real effective exchange rate and time dummies. The analysis reveals that an increase in the GDP of trading partners reduces Türkiye's competitiveness in SITC5, SITC7, and SITC8 sectors by enhancing their own competitiveness through increased production and investment.

Weighted distance increases competitiveness in SITC5 and SITC7 but is statistically insignificant for SITC6 and SITC8. Geographic distance does not negatively affect competitiveness when the partner's GDP increases, likely due to similar transport costs within Europe. These results align with the gravity model, especially for SITC5 and SITC7 sectors. Other macroeconomic factors for SITC5 and SITC6 were largely insignificant, suggesting that these sectors are more influenced by internal dynamics, which should be considered by policymakers.

R&D expenditures in Türkiye did not significantly affect any sector, but R&D spending by trading partners reduced competitiveness in SITC7. This supports the Ricardian comparative advantage framework in SITC7, while GDP per capita differences support the Linder hypothesis in SITC6.

Policymakers should consider horizontal differentiation strategies to boost competitiveness in SITC6 and focus on R&D in SITC7.

Trade openness of Türkiye's partners negatively impacted competitiveness in SITC8, while it had no significant effect on SITC5 and SITC6. Türkiye's own trade openness reduced SITC8 competitiveness, likely due to dependence on foreign inputs. In SITC7, however, both Türkiye's and its partners' trade openness improved competitiveness, potentially due to productivity gains.

The real effective exchange rate had no significant effect on SITC5, SITC6, and SITC7, but negatively impacted SITC8, reflecting its dependency on intermediate goods imports. Furthermore, dummy variables for the 1999-2001 and 2018-2021 periods indicate that the depreciation of the Turkish Lira did not boost SITC8 competitiveness as expected, possibly due to the sector's import-dependent structure.

While this study contributes to understanding the competitiveness of Türkiye's manufacturing sectors, more research is needed to explore sector-specific determinants. Future studies could integrate industry-specific variables to offer more targeted insights for policymakers.

Çıkar Çatışması Beyanı / Conflict of Interest

Çalışmada herhangi bir kurum veya kişi ile çıkar çatışması bulunmamaktadır.
There is no conflict of interest with any institution or person in the study.

İntihal Politikası Beyanı / Plagiarism Policy

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In this study, the rules specified within the scope of the Higher Education Institutions Scientific Research and Publication Ethics Directive were followed.

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Appendix
STANDARD INTERNATIONAL TRADE CLASSIFICATION, REVISION 4

SITC 5 - Chemicals and related products, n.e.s.
Organic chemicals
Inorganic chemicals
Dyeing, tanning and colouring materials
Medicinal and pharmaceutical products
Essential oils and resinoids and perfume materials; toilet, polishing and cleaning preparations
Fertilizers (other than those of group 272)
Plastics in primary forms
Plastics in non-primary forms
Chemical materials and products, n.e.s.

SITC 6 - Manufactured goods classified chiefly by material
Leather, leather manufactures, n.e.s., and dressed Furskins
Rubber manufactures, n.e.s.
Cork and wood manufactures (excluding furniture)
Paper, paperboard and articles of paper pulp, of paper or of paperboard
Textile yarn, fabrics, made-up articles, n.e.s., and related products
Non-metallic mineral manufactures, n.e.s.
Iron and steel
Non-ferrous metals
Manufactures of metals, n.e.s.

SITC 7 - Machinery and transport equipment
Power-generating machinery and equipment
Machinery specialized for particular industries
Metalworking machinery
General industrial machinery and equipment, n.e.s., and machine parts, n.e.s.
Office machines and automatic data-processing machines
Telecommunications and sound-recording and reproducing apparatus and equipment
Electrical machinery, apparatus and appliances, n.e.s., and electrical parts thereof (including nonelectrical counterparts, n.e.s., of electrical household-type equipment)
Road vehicles (including air-cushion vehicles)
Other transport equipment

SITC 8 - Miscellaneous manufactured articles
Prefabricated buildings; sanitary plumbing, heating and lighting fixtures and fittings, n.e.s.

Furniture and parts thereof; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings
Travel goods, handbags and similar containers
Articles of apparel and clothing accessories
Footwear
Professional, scientific and controlling instruments and apparatus, n.e.s.
Photographic apparatus, equipment and supplies and optical goods, n.e.s.; watches and clocks
Miscellaneous manufactured articles, n.e.s.
Source: https://unstats.un.org/unsd/publication/SeriesM/SeriesM_34rev4E.pdf