INTERNATIONAL COMPETITIVE ADVANTAGE OF THE TURKISH MINING SECTOR: A WORLDWIDE AND BRICS COUNTRIES COMPARISON*

TÜRK MADENCILIK SEKTÖRÜNÜN ULUSLARARASI REKABET GÜCÜ: DÜNYA VE BRICS ÜLKELERİ İLE KIYASLAMA

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ABSTRACT

It is irrefutable that the mining sector, which has played an essential role in the development of civilizations throughout history and has been one of the vital elements of the Industrial Revolution, made outstanding contributions to shaping humanity in the last two centuries. The demand for mining assets, which have particular importance due to the inputs they provide to the manufacturing industry, is increasing day by day, and this increases their value even more. In addition to its high added value and employment creation capacity, the mining sector significantly contributes to the national economy as a unique sector that accelerates regional development. Due to the importance of the mining sector in the Turkish economy, its employment creation, and its export share, the competitive dynamics and performance persistence have received considerable scholarly attention. The study's main aim is to investigate the competitiveness of the Turkish and BRICS countries' mining industries in international markets. Accordingly, using the annual import and export data between 2017 and 2022, indices of the Disclosed Comparative Advantage Index (RCA), Relative Export Advantage Index (RXA), Relative Import Advantage Index (RMA), Relative Trade Advantage Index (RTA), Export Specialization Index (ES), Export Similarity Index (XS), Relative Competitive Advantage Index (RC) and Grubel-Lloyd Index (GLI) were calculated, and the sector competitiveness was evaluated. The results reveal a consistent low competitive advantage globally and specifically compared to BRICS countries. While there have been occasional improvements, Turkish mining sector faces disadvantages in exports, imports, and overall trade compared to both the world and BRICS countries.

Keywords: Export, Import, Competitiveness, Mining, BRICS.

ÖZET

Tarih boyunca uygarlıkların gelişiminde önemli bir rol oynayan ve Sanayi Devriminin başat unsurlarından biri olarak ifade edilen madencilik sektörünün son iki yüzyılda insanlığın şekillenmesinde yaptığı muazzam katkının varlığını yadsımak mümkün değildir. İmalat sanayine sağladığı girdiler nedeniyle özel bir öneme sahip olan maden varlıklarına olan talep her geçen gün daha da artmakta ve maden varlıklarının değerini daha da yükseltmektedir. Katma değeri ve istihdam yaratma kapasitesinin yüksek olmasının yanı sıra madencilik sektörü bölgesel kalkınmayı hızlandıran yegâne sektör olarak ülke ekonomilerine önemli bir katkı sunmaktadır Türk madencilik sektörünün ulusal ekonomideki önemi, oluşturduğu istihdam ve ihracattaki payı nedeniyle sektördeki rekabet dinamikleri ve performansın sürekliliği konuları araştırılmaya değer görülmüştür. Türkiye madencilik sektörünün uluslararası pazarlardaki rekabet gücünü araştırmak çalışmanın başlıca amacıdır. Bu doğrultuda, Türk madencilik sektörünün 2017 ve 2022 yılları arasındaki ithalat ve ihracat değerleri kullanılarak; Açıklanmış Karşılaştırmalı Üstünlükler Endeksi (RCA), Göreli İhracat Avantaj Endeksi (RXA), Göreli İthalat Avantaj Endeksi (RMA), Göreli Ticaret Avantaj Endeksi (RTA), İhracatta Uzmanlaşma Endeksi (ES), İhracat Benzerlik Endeksi (XS) Göreli Rekabet Üstünlüğü Endeksi (RC), Grubel-Lloyd Endeksi (GLI) hesaplanmış ve sektörün uluslararası ticarette rekabet gücü değerlendirilmiştir. Sonuçlar, küresel olarak ve spesifik olarak BRICS ülkeleri ile karşılaştırıldığında tutarlı düşük rekabet avantajını ortaya koymaktadır. Zaman zaman iyileşmeler yaşansa da, Türk madencilik sektörü ihracat, ithalat ve genel ticarette hem dünyaya hem de BRICS ülkelerine göre dezavantajlı konumdadır.

Anahtar Kelimeler: İthalat, İhracat, Rekabet Gücü, Madencilik, BRICS

1. INTRODUCTION

The global economy relies heavily on mining, which supplies various mineral commodities. The mining industry plays a critical role in the economic development of countries worldwide, as it provides essential raw materials for various industries (Azapagic, 2004). Although the mining sector has been significant throughout history, it has never been as vital as it is now, primarily due to an increase in mineral prices since the 2000s and successful mining sector reforms in the late 1980s and 1990s, with many countries viewing the mining sector as an instrument for sustainable development and economic gains (McMahon, 2010). As in other sectors, there are also several leading actors in mining. Mineral resource sectors of BRICS countries, along with the United States, Canada, and Australia (Dergachev, 2021). By extracting most types of raw materials and recovering solid commercial minerals, BRICS countries generate more than half the global production value of mineral raw materials (United States Geological Survey [USGS], 2021). Therefore, mining significantly impacts their economies. For example, as of 2023, China produced more than two-thirds of the total global rare earth mining production, mining contributes about 2.4% of Brazil's gross domestic product (GDP), and the mining sector in South Africa contributed an added value of approximately 11 billion U.S. dollars ($) (Garside, 2022). On the other hand, Türkiye possesses substantial mineral and metal reserves, including significant quantities of chrome ore, copper ore, iron ore, lead, magnesite, manganese ore, nickel ore, perlite, phosphate ore, and zinc, and it holds a dominant position in global boron production, while also being the 10th largest coal producer worldwide (Republic of Turkey Ministry of Energy and Natural Resources [MENR], 2019; 2021). In parallel, the mining sector is crucial in Türkiye's economic development, particularly in industrialization, employment generation, and technological advancement (Yılmaz & Şenol, 2019). Although mining has a relatively small (1.2 %) direct contribution to Türkiye's GDP (MENR, 2021), it employs around 190,000 people (Turkish Statistical Institute [TURKSTAT], 2021) and has significant indirect effects on other sectors of the economy, the sector has forward solid linkages with manufacturing, particularly in producing essential metals and fabricated metal products (Yılmaz & Şenol, 2019).

To achieve a competitive advantage in an industry, it is crucial to evaluate countries in terms of competitiveness (Bofinger & Guderjan, 2018). Discussing the notions of competitiveness and comparative advantage, Porter (1990) states that comparative costs are the foundation. In this sense, a nation's competitiveness might be considered its comparative advantage in global markets (Erkan, 2012). The current study aims to investigate how Türkiye's mining industry in terms of competitiveness, as measured by import and export indices (Revealed Comparative Advantage (RCA), Relative Export Advantage Index (RXA), Relative Import Penetration Index (RMP), Relative Trade Advantage Index (RTA), Export Specialization Index (ES), Export Similarity Index (XS), Relative Competitive Advantage Index (RC), and Grubel-Lloyd Index (GLI)) and compare Türkiye's competitiveness with the world and BRICS countries for the period 2017-2022. By asking the question, "Does the Turkish mining sector have a competitive advantage in international markets?" this study can contribute to a better understanding of the competitiveness of the Turkish mining sector on a global scale. By investigating this question, researchers could identify the factors contributing to Türkiye's competitive advantage or disadvantage in the mining industry and suggest strategies to improve the country's competitiveness. The findings of this research could be valuable to policymakers and industry stakeholders, providing insights into the challenges and opportunities facing the Turkish mining sector. Furthermore, by comparing Türkiye's competitiveness with BRICS countries, the research could contribute to the broader academic literature on the competitiveness of the

mining sector in emerging economies. Türkiye is a significant player in the global mining industry, and research on the country's competitiveness could provide insights into the challenges and opportunities facing other emerging economies in the sector. Overall, investigating the research question of whether the Turkish mining sector has a competitive advantage in international markets could provide valuable insights into the sector's competitiveness and inform policy decisions to support the industry's growth and development.

2. LITERATURE REVIEW

2.1. Mining Industry in Türkiye

Türkiye has considerable mineral and metal reserves. The estimated reserves of different minerals and metals as of 2021 are as follows: 840 million tons of chrome ore, 128 million tons of copper ore, 3.3 million tons of copper, 34.5 million tons of iron ore, 2.2 million tons of lead, 51 million tons of magnesite, 25.7 million tons of manganese ore, 3.4 million tons of nickel ore, 56 million tons of perlite, 850 million tons of phosphate ore, and 1.9 million tons of zinc (MENR, 2021).

According to TURKSTAT data, the mining sector, which received a 2.53% share of Türkiye's total exports of $235 billion in 2022, increased by 7.13% compared to 2021, reaching approximately $6 billion. 36.64% of these exports are metallic ores (9.58 million tons and $2.18 billion), 35.40% are natural stones (7.7 million tons and $2.1 billion), 24.91% are industrial raw materials (19.80 million tons and $1.48 billion), and 3.05% is energy raw materials (804 thousand tons and $182 million) (General Directorate of Mineral Exploration and Research [MTA], 2022).

Table 1. Mining Exports of Türkiye (Year 2022)

Groups	Amount (Million Tons)	Value ($ Million)
Metallic Ores	9,58	2185,41
Natural Stones	7,77	2111,65
Industrial Raw Materials	19,80	1485,82
Energy Raw Materials	0,80	182,13
Top Exported Products	**Amount (Million Tons)**	**Value ($ Million)**
Processed Marble	2,82	1211,30
Block Marble Travertine	4,08	652,96
Zinc Ores	0,86	546,06
Copper Ores	0,38	498,72
Ferro Chrome	1,36	340,30
Top Export Countries	**Value ($ Million)**	**Share by Total Value (%)**
China	1407,68	23,60
USA	565,18	9,47
Bulgaria	382,96	6,42
Spain	250,00	4,19
Italy	246,94	4,14
Belgium	237,32	3,98
India	186,75	3,13

Source: MTA, 2022

As given in Table 1, the most exported products are processed marble, block marble travertine, zinc ores, copper ores, and ferro chrome, respectively. Among the important countries to which mineral exports were carried out in 2022, the China ranked first with $1.4 billion. China is followed by the USA, Bulgaria, Spain, Italy, Belgium, and India (IMIB, 2022; MTA, 2022).

On the other hand, mining sector imports, which had a 3.40% share of our country's total imports of $342 billion in 2022, increased by 52.03% compared to 2021 and reached $11.6 billion. The most imported mineral group in 2022 is energy with 38.94 million tons and $8.98 billion (MTA, 2022) (Table 2).

Table 2. Mining Imports of Türkiye (Year 2022)

Groups	Amount (Million Tons)	Value ($ Million)
Energy Raw Materials	38,94	8982,22
Metallic Ores	10,36	1661,85
Industrial Raw Materials	3,33	917,58
Natural Stones	0,22	92,70
Top Imported Products	**Amount (Million Tons)**	**Value ($ Million)**
Coal	37,62	8319,92
Iron Ores	9,46	1392,25
Coking Coals	1,23	637,36
Precious Stones	0,00005	184,2
Phosphates	0,89	127,47
Top Import Countries	**Value ($ Million)**	**Share by Total Value (%)**
Russia	4351,48	37,34
Colombia	2568, 38	22,04
Australia	1057,39	9,07
USA	635,90	5,46
Brazil	511,71	4,39
India	317,95	2,73
South Africa	317,10	2,72

Source: MTA, 2022

As seen in Table 2, where 2022 import data is reported, energy raw materials are the leading group, followed by metallic ores, industrial raw materials, and natural stones. The most imported mineral in total mineral imports was hard coal with 37.61 million dollars and 8.31 billion dollars. The Russian Federation, which is among the important countries from which mining sector imports are made, ranks first with 4.35 billion dollars and a share of 37.34 percent, followed by Colombia, Australia, the USA, Brazil, India and South Africa, respectively (MTA, 2022).

With its abundant resources and strategic location, Turkish mining sector has significant potential for growth and expansion in the future. Therefore, Türkiye has invested significantly in the mining industry for several decades, and in recent years, the Turkish government has increased its investment in the mining sector, focusing on exploration and developing new mining projects (Global Business Reports, 2020; MENR, 2021). On the other hand, although Türkiye is described as rich in minerals, and reserve size may offer a competitive advantage, it cannot realize its potential in terms of producing its resources and bringing them into the economy (Koçoğlu & Kantar, 2016), as evidenced by $4.1 billion in mining exports compared to $4.7 billion in imports, with 62% of mineral imports being energy raw materials from geographically disadvantaged sources (Ministry of Energy and Natural Resources & Union of Chambers and Commodity Exchanges of Turkey [MENR & TOBB], 2020). There are geological, technical, economic, and political challenges for the Turkish mining sector to overcome to bring y significant economic benefits to the country (Özdemir, 2014).

2.2. Competitive Advantage in Mining

The competitive advantage has been extensively studied in international trade literature (e.g., Grant, 1991; Gupta, 2015; Porter, 1990, 2011; Witt & Jackson, 2016). It continues to be a significant topic of discussion in trade negotiations between nations since it arises from a combination of factors, including a skilled workforce, favourable infrastructure, advanced technology, natural resources, and supportive government policies (Porter, 1990) From a micro perspective, Rumelt (2003) defines competitive advantage as a company's ability to outperform its competitors over a sustained period. Superior resources, skills, and position were identified as three sources of competitive advantage. Superior resources refer to a company owning valuable, rare, and inimitable resources. Superior skills refer to a company's ability to use its resources effectively to create customer value. Superior position refers to a company's ability to control a unique and valuable position in the market. On the other hand, from a macro perspective, Porter (1990) defines competitive advantage as the ability of a nation or a firm to create and sustain a higher level of value for its customers than its competitors. Porter explains why some countries are more successful in specific industries than others with four interconnected factors that determine the national competitive advantage: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry.

There are a number of studies conducted to evaluate the global mining industry's competitiveness and identify the challenges that could impact its competitiveness. Andrews-Speed & Ma (2015) point to issues such as environmental concerns, social issues, and increasing competition from other emerging mining countries, while Castells-Quintana & Royuela (2016) point to issues such as high production costs, declining productivity, and environmental concerns. On the other hand, various national-level strategies are suggested to enhance competitiveness. Those strategies cover issues such as innovation and technology (Gu & Huang, 2017; Kinnear & Bamber; 2016; López-Bernardo & Fernández-Villacañas, 2017), sustainability efforts (Bogusz & Sulich, 2020; O'Connor, 2015; Mudd, 2017) Also aligning the mining sector's strategies with national and regional development plans, fiscal projections, macroeconomic policies, and infrastructure and human resource development plans is considered vital and the importance of consistency among these plans, policies, strategies, and legislation for effective integration and coordination is highlighted (United Nations Development Programme & United Nations, [UNDP & UN] Environment, 2018). For example, referring to mining exploration expenditure as the leading indicator of mining competitiveness, Cordano & Zevallos (2021) and Jara (2017) both point out that the competitiveness of a country in attracting mining exploration investment depends not only on its mineral resources but also on its ability to provide a favourable institutional climate for mining companies. They conclude that a stable business investment environment encourages investment, which points out the importance of strategic policy planning and the contextual fit of the policies. Moreover, international collaborations can play a role in the competitiveness of the mining sector. Using the revealed comparative advantage index (RCA) for analysis and gathering export data from 2010 to 2015 across the BRICS countries, Wang, Zhao, & Chu (2018) examine the competitive landscape and synergies among these countries. The study reveals that each nation has distinct comparative advantages in natural resources. Consequently, within the BRIC, there exists not only competition but also enduring complementary relationships, notably observed between China, Brazil, and South Africa.

In line with its importance, in recent years, there has been a growing interest in studies analysing the competitiveness of the Turkish industries, as in mining. In many studies, it is observed that indirect or partial mining-related assessments are made and/or that general assessments provide insights into the mining sector. As an example of earlier studies, Kösekahyaoğlu (2003) examines the pre-liberalism (1978-1980) vs. post-liberalism (1988-1990) comparative advantage by using the RCA index. Based on the study results, despite the decline in the share of mining exports to the EU (from 7,5 to 2,1), there is an increase in comparative advantage in mineral products (from 2,9 to 5,7). Küçükkiremitçi (2006) carries out the competitiveness analysis of the sub-sectors of the industrial sector (mining and quarrying, manufacturing industry, electricity-gas, and water) within the framework of import-export figures for the period 1995-2005. Among the 120 sub-sectors analysed in the study, iron ore is the ore with the lowest competitiveness. Erkan's (2009) study focuses on the revealed comparative advantages in the exports of commodity groups according to technology classification among the emerging economies (25 countries) from 1993 to 2005. The study reports that Türkiye is 16th in raw material-intensive goods, 2nd in labour-intensive goods, 7th in capital-intensive goods, 18th in easily imitated research-based goods, and ranked 15th in research-based goods that are difficult to imitate. These results show that Türkiye is competitive in exporting mainly labour-intensive and partly capital-intensive goods and cannot compete in international markets in the export of goods with the highest added value. The study also reveals that Türkiye is in greater competition, especially with India and China, in exporting the 20 products in which Türkiye's declared comparative advantage is strongest. In their study, Leromain & Orefice (2014) analysed the comparative advantages across 70 industries in 20 OECD countries during the 1995-2010 period, and their study reveals that Türkiye exhibited the highest comparative advantage in the textile, minerals, and glass working sectors in that particular period. Aiming to determine Türkiye's competitiveness in key sectors such as textiles, clothing, iron and steel, electrical machines, and motor vehicles from 2000 to 2014, Altay Topcu & Sümerli Sarıgül (2015) use indices including Balassa, Vollrath, RSCA, and TBI. According to the RCA index, their findings reveal that Türkiye demonstrated a weak comparative advantage in the iron and steel sector during the investigated period. Also, based on comparative advantage and trade balance, the iron and steel sector is the fourth most competitive sector among those measured. Another study on the steel industry is conducted by Günay (2008). Approaching the industry competitiveness from a different theoretical approach, Günay (2008) develops a competitiveness model for the steel industry, encompassing factors such as cost, quality, technology, market accessibility, location, the role of government, domestic market, and firm characteristics. In the research where primary data was used, the relationship between these factors and the competitiveness of the Turkish steel industry is measured with the survey data obtained from the participants consisting of industry executives. Results indicate a positive correlation between all eight factors and industry competitiveness. Additionally, the study highlights the growing focus on higher value-added products, balancing production ratios, reducing energy costs, etc., within the Turkish steel industry.

Koçoğlu & Kantar (2016) examine the competitive structure of Turkish mining industry using Porter's Five Forces Model, aiming for a macro-level evaluation. They find that existing firms face high rivalry while the threat of new entrants is low. However, the analysis doesn't provide clear conclusions regarding the bargaining power of suppliers, buyers, and the threat of substitutes. Yet, the study highlights some important issues that affect the competitiveness of Turkish mining sector. For example, in terms of buyer power, which is generally considers high

in mining, the recent economic growth in countries like China, India, and Brazil has increased demand, counteracting this power. Moreover, selling certain minerals as raw materials (such as boron) reduces profit margins and diminishes supplier power. Additionally, technological limitations leading to shallow excavations and incomplete reserve utilization weaken the industry's position against firms providing advanced technology. In a recent study, Başyiğit (2021) conducted market diversity analyses to determine the market structure with Türkiye's leading export partner, China, to which it carries out more than 30% of its mineral exports. Market analysis reveals that Türkiye's mineral export market is moderately concentrated, with China having a significant share. The relationship between the two countries is asymmetrical; while Türkiye exports a significant portion of its minerals to China, this could potentially jeopardize Türkiye's export stability, as China can easily seek alternative sources or reshape market share distributions. The study of Çeştepe & Koç Yıldız (2022) assesses the competitiveness of the Turkish mining industry in foreign trade using Balassa's RCA Index, analysing export and import data from 1990 to 2021. Findings show that sub-sectors with low added value, such as copper ore and nickel ore, demonstrate high competitiveness, whereas high value-added sub-sectors like copper, nickel, coal, and petroleum oils show low competitiveness. Repeating the earlier study results, the study reveals that there has not been an important improvement in value creation.

After conducting a thorough literature review, several key observations have emerged. It is clear that Turkish mining sector has some weaknesses, including insufficient infrastructure and low investment in research and development. To improve its competitiveness, the industry must address its weaknesses, capitalize on its strengths, enhance its innovation capacity, develop new technologies, and strengthen its mining business climate and sustainability performance. Also, previous studies show that BRICS countries are important global actors in mining and have powerful export and import ties with Turkish mining sector. Balassa (1965) suggests that rather than solely relying on general principles to explain trade patterns, it might be more beneficial to begin with the observed trade patterns and explore the various measurable and immeasurable factors contributing to comparative advantages. The current study set out to shine new light on these debates through an up-to-date sectoral examination of the international competitiveness of mining in Türkiye by using several competitiveness indices.

3. DATA SET AND METHODOLOGY

This study, which aims to determine Türkiye's international competitive advantages or disadvantages, examines the competitiveness of Türkiye and BRICS countries through foreign trade figures of the mining sector. The data were obtained from secondary data from the World Trade Organization. A comparison of foreign trade data according to the Institute of Mineral Research and Exploration classification reveals that import and export values were relatively similar in 2016. However, in subsequent years, there was a divergence in these values, resulting in a foreign trade deficit. This study examines the changes in competitiveness indices over the period 2017-2022 (Turkey Mining Sector Development Report (2020)). Using the annual import and export data between 2017 and 2022, the study utilizes international competitiveness indices widely used in the literature as a methodology. Accordingly, the leading indices used to measure international competitiveness in the study are as follows:

- Revealed Comparative Advantage (RCA)
- The Relative Export Advantage Index (RXA)

- Relative Import Penetration Index (RMP)

- Relative Trade Advantage Index (RTA)

- Export Specialization Index (ES)

- Relative Competitiveness Index (RC)

- Grubel-Lloyd Index (GLI)

3.1. Revealed Comparative Advantage (RCA)

The concept of "Revealed Comparative Advantage," first introduced by Liesner (1958) and later developed by Balassa (1965), is an indicator that allows calculating the relative advantage of a country in the production of a product (Mansourzadeh et al., 2019) and is widely used in the literature to reveal the competition of countries against each other in certain item products. To measure the comparative advantage of a country in a specific good or industry, Balassa created an index that gives the ratio of the share of this good or industry in total world exports to the country's share in total exports (Gacener Atış, 2014: 319). Balassa (1965) formulated the revealed comparative advantage as follows:

$$RCA_{ij} = \frac{\left(\frac{X_{ij}}{X_{it}}\right)}{\left(\frac{X_{wj}}{X_{wt}}\right)} = \frac{\left(\frac{X_{ij}}{X_{wj}}\right)}{\left(\frac{X_{it}}{X_{wt}}\right)} \tag{1}$$

Here, X_{ij} and X_{wj} are the country i's exports of good j and world exports of good j, respectively, while X_{it} and X_{wt} are the country's total exports and world total exports, respectively. The Balassa index is the ratio of the share of industry exports in total country exports to the industry's share in total world exports. An index greater than 1 indicates the country has a comparative advantage in that industry. Conversely, the contrary situation indicates that the country does not have an announced comparative advantage in that industry. In other words, if RCA>4, there is a strong comparative advantage; 2<RCA<4 is a moderate comparative advantage; 1<RCA<2 is a weak comparative advantage; 0<RCA<1 is a comparative disadvantage (Bashimov, 2017; Hinloopen & Marrewijk, 2001).

3.2. Relative Export Advantage Index (RXA)

Vollrath (1991) criticized RCA for considering only exports and ignoring imports and included exports, imports, and net trade effects in the index calculation. The Relative Export Advantage Index is defined as the ratio of a country's export share in world markets for a given product to its share in world exports for all other goods (Kara, Şahin, Bekar, & Kayacan, 2019: 22). The most significant advantage of this index is that it increases the efficiency of competitiveness by not including the foreign trade data to be calculated twice in the calculation (Bağcı, 2016: 76).

The Vollrath relative export advantage index is calculated as follows:

$$RXA_{ij} = \frac{\left(\frac{X_{ij}}{X_{-ij}}\right)}{\left(\frac{X_{iw}^{-ij}}{X_w^{-j}}\right)} \tag{2}$$

Here, X_{ij} is country j's exports of good i and X_{-ij} is country j's total exports excluding country j's exports of good i, X_{iw}^{-ij} is world total exports of good i excluding country j's exports of good i and X_w^{-j} is the world total exports excluding country j's total exports of goods i. RXA greater than 1

indicates comparative advantage, RXA less than 1 indicates comparative disadvantage and RXA equal to 1 indicates a neutral situation (Altay & Gürpınar, 2008: 264).

3.3. Relative Import Penetration Index (RMP)

Although the Relative Import Penetration index is similar to the Relative Export Advantage index, the main difference between the two indices is the inclusion of imports (M) instead of exports in the Relative export advantage index (Hambalkova, 2006) and vice versa (Müftüoğlu & Kayacan, 2019; İnce & Yücel, 2014; Frohberg & Hartmann, 1997). This index is given below:

$$RMP_{ij} = \frac{\left(\frac{M_{ij}}{M_{-ij}}\right)}{\left(\frac{M_{iw}^{-ij}}{M_w^{-j}}\right)} \tag{3}$$

RMP_{ij} is the relative import penetration index of country j in good i, M_{ij} is the imports of country j in good i, M_{-ij} is the total imports of country j excluding imports of good i, M_{iw}^{-ij} is the total world imports of good i excluding imports of country j, and M_w^{-j} is the total world imports excluding total imports of country j. RMP greater than 1 indicates comparative disadvantage, while RMP less than 1 indicates comparative advantage.

3.4. Relative Trade Advantage Index (RTA)

This index is constructed by the difference between the Relative Export Advantage and Relative Import Penetration indexes. The RTA index aims to measure the contribution of exports and imports to the comparative advantage of a particular product/goods group or industry (Erkekoğlu, Kılıçarslan, & Göknar, 2014).

$$RTA_{ij} = RXA_{ij} - RMP_{ij} \tag{4}$$

A positive value of the index indicates competitive advantage, and a negative value indicates competitive disadvantage (Erkekoğlu et al., 2014; Kocaefe, 2023). An RTA index greater than 0 indicates a comparative advantage.

3.5. Export Specialization Index (ES)

This index, which considers countries' trade performance, is obtained using a country's import and export data in a specific product/product group (Ateş, 2021). The degree of specialization in exports is found by taking the ratio of the (Export-Import) difference to the sum of (Export+Import) for each commodity group (Erkekoğlu & Koçer, 2022).

$$ES = \frac{(X_{ij} - M_{ij})}{(X_{ij} + M_{ij})} \tag{5}$$

Here, X refers to exports, M to imports, i to the country, and j to the commodity group. While the index values are between -1 and +1, if the index is positive, it indicates that the country specializes in exports of that product. If the value is negative for that country, there is no export specialization. If the index value is 0, there is an uncertainty that can mean both (Kara et al., 2009).

3.6. Relative Competitiveness Index (RC)

RC index is the index calculation made by taking the natural logarithm differences of RXA and RMA indices (Kocaefe, 2023). It allows for the comparison of the competitiveness of those who want to increase their export levels in similar markets in a competitive environment with both

asymmetry and similar factor intensity (Erkekoğlu et al., 2014). This index is preferred as it includes the supply and demand balance (Altay & Gürpınar, 2008).

$$RC_{ij} = ln(RXA_{ij}) - ln(RMA_{ij}) \tag{6}$$

It shows the relative competitive advantage index of country j in good i. A positive index value indicates a competitive advantage, while a negative index value indicates a competitive disadvantage (Kara et al., 2009).

3.7. Grubell-Lloyd Index (GLI)

The term 'intra-industry trade' is defined as the value of an industry's exports equalling its imports (Grubel & Lloyd, 1975). It is a frequently used indicator in the literature to enable comparison between different countries in measuring intra-industry trade (Shahbaz & Leitão, 2010). To measure the intensity of intra-industry trade, this study utilised the classical Grubel-Lloyd Index (GLI) according to the data for the foreign trade of whole World, BRICS and Türkiye. The GLI is calculated by examining imports and exports of goods within the same industry group. This index has become increasingly important with the rise of free trade.

$$GLI_t = 1 - \frac{(X_t - M_t)}{(X_t + M_t)} \tag{7}$$

In the formula, X_t represents a country's exports of a specific good or group of goods, while M_t represents its imports. The vertical lines in the denominator indicate absolute values. As the index approaches 0, it indicates no intra-industry trade, while approaching 1 indicates an increasing intensity of intra-industry trade.

4. FINDINGS

The trend of the international competitiveness indices calculated to see the developments in the competitiveness of the Turkish mining sector with the world and BRICS is given below.

Graph 1. Comparison of the Turkish Mining Industry with the World and BRICS by Revealed Comparative Advantage Index (RCA)
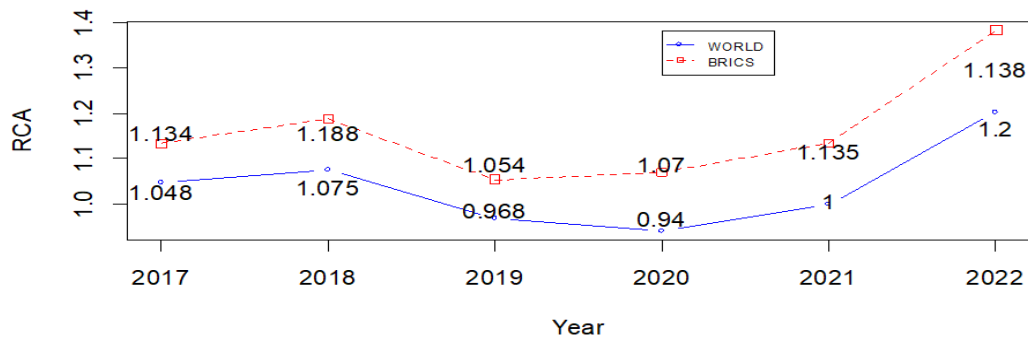
The mining sector is a crucial component of Turkish economy, and it is essential to examine its competitive advantage compared to the rest of the world. According to Graph 1, Turkish mining sector has consistently remained below a value of 1 in Revealed Comparative Advantage (RCA), except for the years 2017, 2018, 2021, and 2022. Although the sector displayed a weak competitive advantage in 2017 and 2018, it became disadvantaged in 2019 and 2020. However, in 2020, the mining sector showed an upward trend, shifting from a disadvantaged position to a weak competitive advantage. Turkish mining sector maintains a low, competitive advantage compared to the rest of the world. When comparing Turkish mining sector with the RCA values of BRICS countries, all values are above 1, indicating a higher competitive advantage. The RCA

value for Turkish mining sector showed an increasing trend in 2017-2018, followed by a decrease in 2019 but remained above 1. An upward trend was observed again in 2020-2022. Hence, it is clear that Turkish mining sector has a low, competitive position compared to BRICS countries throughout the analysed period. Improving the sector's competitive advantage is crucial to enhance its economic contribution.

Graph 2. Comparison of the Turkish Mining Industry with the World and BRICS by The Relative Export Advantage Index (RXA)
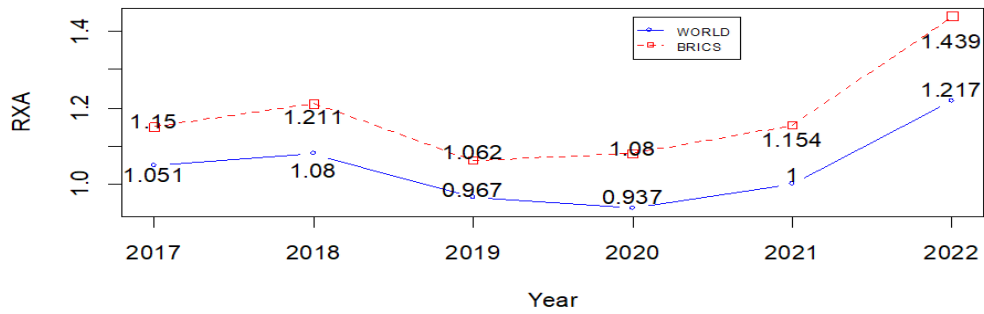

Vollrath's approach to analysing a country's export competitiveness is unique and sets his Relative Export Advantage (RXA) index apart from Balassa's Revealed Comparative Advantage (RCA) index. By subtracting the world's export values, Vollrath provides a more accurate picture of a country's export performance (Fidan, 2020). The RXA index value is crucial to determine a product's competitive edge. A value above 1 indicates a competitive advantage, while a value below 1 suggests a competitive disadvantage. Graph 2 compares the RXA index values for the Turkish mining sector with those of the world and BRICS countries. The RXA values of the Turkish mining sector from 2017 to 2022 were compared with those of the world. It was observed that the RXA value was below 1 in 2018-2019, increased above 1 between 2017 and 2018, and declined between 2019 and 2020. The value returned to the level of 1 in 2021. Despite not reaching the 1.43 value in 2022, the Turkish mining sector still maintains a relatively low competitive advantage compared to the world. Comparing the Turkish mining sector with the BRICS countries reveals an increasing trend between 2017 and 2018. Despite showing a decreasing trend between 2019 and 2020, the RXA value remains above 1. It was observed that the RXA value increased between 2020 and 2022, but it remained within the peak value reached in 2022. In conclusion, the RXA index value is a reliable benchmark in determining a product's competitive advantage. Based on the RXA values, the Turkish mining sector maintains a relatively low competitive advantage compared to the world. However, compared to BRICS countries, the Turkish mining sector maintains a competitive advantage by having an RXA value above 1.

Graph 3. Comparison of the Turkish Mining Industry with the World and BRICS by The Relative Import Penetration Index (RMP)
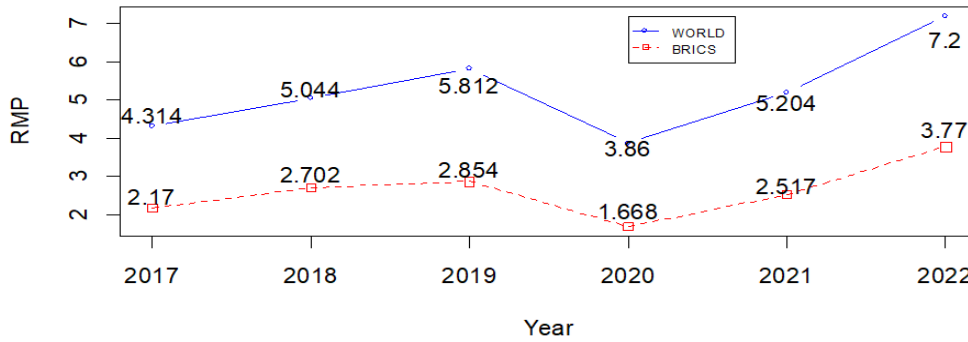

The Relative Import Advantage Index (RMP) determines a country's competitiveness in specific sectors or goods. A value greater than one suggests that the nation has a comparative disadvantage, while values less than one mean a comparative advantage. In this regard, Graph 3 compares the Turkish mining sector with the world and BRICS countries from 2017 to 2022, indicating an upward trend in RMP values. Compared to the world, the sector's RMP values reached 5.81 from 2017 to 2019, with a reduction in the RMP value in 2020, followed by an increase in 2021 and 2022. The results show that Turkish mining sector has lower RMP values than the world and BRICS countries. Although the RMP value decreased in 2020, it rose again in 2021 and 2022. However, the RMP index value greater than one in all years indicates that the Turkish mining sector is at a disadvantage in competitiveness with both the world and BRICS countries according to the Relative Import Advantage Index.

Graph 4. Comparison of the Turkish Mining Industry with the World and BRICS by The Relative Trade Advantage Index (RTA)
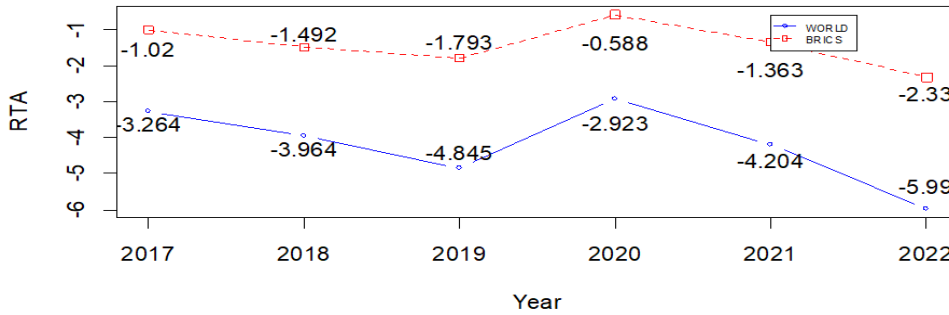

The Relative Trade Advantage Index (RTA) is derived from the RXA and RMP index values. The RTA index values above zero indicate a competitive edge for the sector or product. On the other hand, values less than zero indicate a competitive disadvantage. Graph 4 shows the Relative Trade Advantage Index (RTA) values for Türkiye's global mining sector and BRICS countries. As seen in Graph 4, a comparison of the Turkish mining sector with the world and BRICS countries is presented for the years 2017-2022. When compared to the world, the Turkish mining sector showed a declining trend from 2017 to 2019, experienced an increase in 2020, but again declined in 2021 and 2022. Compared to BRICS countries, the sector decreased from 2017 to 2019, entering an increasing trend in 2020 but again declined in 2021. Despite having a negative RTA value when compared to both the world and BRICS countries, indicating a competitive disadvantage, the Turkish mining sector's disadvantage is less pronounced compared to BRICS countries.

Graph 5. Comparison of the Turkish Mining Industry with the World and BRICS by Export Specialization Index (ES)
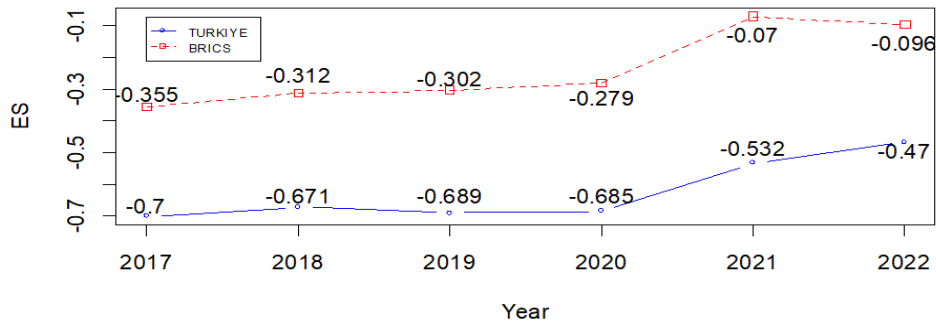

The Export Specialization Index (ES) determines a country's degree of specialization in exports or imports. The index provides information about the degree of specialization in the goods of a country's export sector. The value of the index ranges from -1 to +1. A positive value indicates specialization in exports, while a negative value suggests a lack of specialization. As the value increases, it signifies an increased level of specialization for that country. Graph 5, when comparing the Turkish mining sector to the world, shows that the values between 2017 and 2022 are negative. When compared to BRICS countries, the RC value for the Turkish mining sector is negative between 2017 and 2022 but approaches a positive value. The results indicate that Turkish mining sector has no competitive advantage in the world or BRICS countries. However, upon closer examination of the figures, our disadvantage in the mining sector over time compared to BRICS countries has decreased.

Graph 6. Comparison of the Turkish Mining Industry with the World and BRICS by Relative Competitiveness Index (RC)
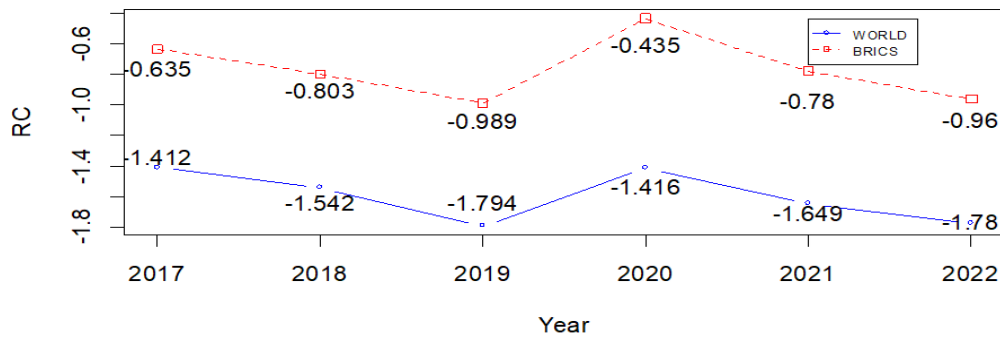
The Relative Competitiveness Index (RC) is a measure that calculates the difference between the Relative Export Advantage Index (RXA) and the Relative Import Penetration Index (RMP) using logarithmic values. If the index value is positive, it implies a competitive advantage, while a negative value indicates a competitive disadvantage. Graph 6 shows the RC Index values for Turkish mining sector compared to the world and BRICS countries. The mining sector has been experiencing a competitive disadvantage in both the world and BRICS countries from 2017 to 2022.

Graph 7. Comparison of the Turkish Mining Industry with the BRICS and World by Grubel Lloyd Index (GLI)
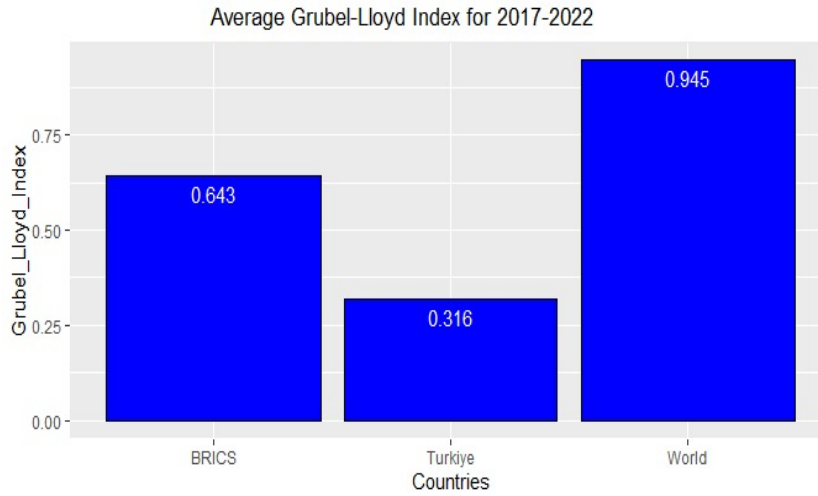
Graph 7 presents the average Grubel-Lloyd index data for Türkiye, the BRICS, and the world for the period 2017-2022. The results of the study show that the average GLI value is 0.945 for the global mining industry, 0.643 for BRICS countries and 0.316 for Türkiye during the period 2017-2022. According to the findings, the values of global exports and imports are close to each other, indicating the existence of intra-industry trade in the mining industry. Looking at the mining industry globally, there is no comparative advantage in this sector. However, the low average value of intra-industry trade that BRICS countries and Türkiye proves the existence of comparative advantage. On the other hand, due to the industry classification, mining production and exports in Türkiye are underestimated in the official statistics, which gives the impression that the mining industry has an insignificant weight in the country's economy in terms of production and exports.

5. DISCUSSION AND CONCLUSION

The mining sector, which plays a vital role in developing countries, constitutes the basic raw materials of industries such as energy and construction. Besides being a driving force in the development efforts of developed countries from the past to the present, the sector has become even more significant in recent times due to the need for higher-quality minerals required by the digital transformation (Türkiye Mining Sector Development Report, 2020). On the other hand, the sector, which can create high-added value and employment, prevents migration, and increases rural development due to its extraction in rural areas (Şahiner, Gençbay, & Dinlen, 2021). Türkiye, which has significant potential in natural resources, ranks 10th among 152 countries in terms of production in 29 types of minerals. As of 2023, the mining sector reached an export figure of 5 billion 241 million dollars, and its share of total exports ranges between 2 and 2.5 (Alhan, 2023, 16 Aralık). For 2022, imports amounted to 11 billion 654 million dollars, accounting for around 26% of total imports (MTA, 2022). The ratio of export averages between 2017-2022 to the total exports of countries is as follows: World (%4.6), Brazil (%3.4), China (%12), India (%5), Russia (%2.7), South Africa (%29.3), and Türkiye (%4.3). In terms of imports, the situation is as follows: World (%4.1), Brazil (%14.6), China (%1.3), India (%4), Russia (%6.9), South Africa (%2.2), and Türkiye (%19.4). When examined in terms of export and import figures, in exports, Türkiye (2017: 31st place; 2022: 26th place), China (2017: 7th place; 2022: 3rd place), Russia (2017: 9th place; 2022: 7th place), Brazil (2017: 6th place; 2022: 8th

place), South Africa (2017: 10th place; 2022: 9th place), and India (2017: 14th place; 2022: 19th place) are ranked, while in imports, Türkiye (2017: 5th place; 2022: 5th place), China (2017: 1st place; 2022: 1st place), Russia (2017: 24th place; 2022: 30th place), Brazil (2017: 26th place; 2022: 26th place), South Africa (2017: 41st place; 2022: 47th place), and India (2017: 7th place; 2022: 7th place) are ranked.

The study examines Türkiye's mining industry competitiveness using various indices and compares it to the world and BRICS countries, aiming to understand if Türkiye has a competitive edge in international markets. Some essential findings emerge through indices when examining Turkish mining sector between 2017 and 2022. The Revised Comparative Advantage (RCA) index shows that Turkish mining sector has a low competitive advantage compared to the world, despite occasional improvements in 2017, 2018, and 2021. Besides, the industry consistently showed lower competitiveness than the BRICS countries throughout the period. The Relative Export Advantage (RXA) index indicates that Turkish mining sector has a relatively low competitive advantage compared to the world, but it maintains its advantage compared to BRICS countries. The Relative Import Advantage Index (RMP) shows that Turkish mining sector consistently experiences a comparative disadvantage against both the world and BRICS countries. The Relative Trade Advantage Index (RTA) indicates that Turkish mining sector has a competitive disadvantage against both the world and BRICS countries, but the disadvantage compared to BRICS countries is less pronounced. Furthermore, the Export Specialization Index (ES) demonstrates that Turkish mining sector needs a competitive advantage globally or within BRICS countries and has experienced a decreasing disadvantage over time compared to BRICS countries. Lastly, the Relative Competitiveness Index (RC) indicates that Turkish mining sector experienced a competitive disadvantage against the world and BRICS countries from 2017 to 2021. These findings highlight the need for Turkish mining sector to enhance its competitive advantage, particularly compared to BRICS countries, to contribute more significantly to the economy.

The mining sector is a crucial component of the global economy. However, the sector's competitive advantage position has been a topic of discussion for some time. After conducting a study, we discovered that less developed countries face technological limitations and processing inefficiencies, which lead them to sell raw materials to more developed countries at lower prices. Additionally, stringent environmental regulations in developed countries often force less developed countries to rely on imports instead of mining. This results in less developed countries buying back final mineral products at much higher prices from more developed countries (Sahoo & Rout, 2019). Türkiye is facing a similar situation. The mining sector predominantly exports raw products but needs to adequately supply intermediate/final products (TMSDR, 2020). Detailed studies should be conducted on the supply-demand balance in the industrial sector to address this issue. Establishing more facilities to supply raw materials to industry could directly contribute to reducing the trade deficit. Despite the literature highlighting the importance of creating added value in the trade of these goods since the early 1990s (Erkan, 2009), the issue still persists. To achieve the desired qualitative transformation in this area, attractive integrated policies, and a favourable business climate (UNDP & UN Environment, 2018) in the mining sector are essential (Cordano & Zevallos, 2021; Jara, 2017). It is time for us to take action and develop effective policies that support growth and development in the mining sector. Doing so can improve the trade balance, create more jobs, and enhance economic prosperity for everyone.

More specifically, one reason why we cannot establish a competitive advantage over the BRICS countries may be that we are not in this union from which we would benefit commercially. In recent years, there has been a debate about Türkiye's membership in BRICS, especially after President Erdoğan participated in the 2018 BRICS summit held in the capital of South Africa. Bacık (2012) notes that although Türkiye shares similarities with BRICS countries regarding economic growth, political influence, and strategic importance, there are significant differences in economic structure, political systems, and foreign policy orientation. The study shows that Türkiye's more assertive foreign policy and close ties with the United States can complicate its relations with BRICS countries. This is because BRICS countries are generally viewed as challenging Western dominance. Additionally, while Türkiye's economy relies heavily on services and construction, BRICS countries have more diversified economies with a stronger emphasis on manufacturing and natural resource extraction. Therefore, it is natural for these differences to also manifest in institutional structures, which can create a conducive environment for more efficient and effective mining activities. If Türkiye becomes a member of a particular group, there is potential for significant changes in its mining sector. This could be due to the collaborative effect (Wang, Zhao, & Chu, 2018) it could bring and the resulting benefits. However, it may not always be possible for all members to realize the potential benefits. For example, a study by Altay Topcu & Kılavuz (2012) examined Türkiye's manufacturing sector competitiveness between 1996-2006 after the Customs Union Agreement with the EU. Despite expectations of similar competitive advantages, they found no significant improvement in competitiveness in high-tech sectors. The mining sector in Türkiye faces challenges such as extended permit approval times, investment insecurity, negative public perception, high costs, and employment-related issues. A modern industrial structure that can be produced internationally is needed to minimize import dependency and maximize national security. This structure should integrate energy and non-energy mineral resources, and a strategic policy framework should be developed to integrate local and external resources (TMSGR, 2020). Moreover, policies should incorporate decarbonization plans, sustainability, environmentally conscious mining practices, social impact assessments in mining projects, and integration of Industry 4.0 and Internet of Things technologies (KPMG, 2023).

The mining sector is a crucial part of our economy, and ensuring its competitiveness is essential. That is why it is worth noting that after conducting "5th Mining Workshops" with sector representatives, it has been clearly stated that establishing a Ministry of Mining would be a significant step towards achieving this goal (Madencilik Türkiye, 2023, 3 Ocak). By creating a dedicated ministry for mining, we can better focus our efforts and resources on supporting this vital industry, ultimately benefiting our entire economy. In sum, it is crucial to implement strategies that will boost Turkish mining sector's competitiveness. The government should focus on improving the sector's infrastructure, investing in research and development, and creating favourable policies to attract investors. Turkish mining sector may overcome its comparative disadvantage and become more competitive globally.

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