



Dynamics of High-Tech Investment and Export Growth in Turkey: A Multidisciplinary Analysis



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Abstract: This investigation delves into the dynamics of Turkey's high-technology investments and their influence on export expansion. In an evolving global economy, the pivotal role of high technology industries for sustained economic success is increasingly acknowledged. This research explores Turkey's strategic endeavors and investments in high-tech sectors, highlighting their impact on export-driven economic development. Through a multidisciplinary lens, encompassing economic, technological, and policy perspectives, the dynamics of Turkey's foray into high technology are scrutinized. A fusion of quantitative and qualitative methodologies aids in dissecting the trends, challenges, and prospects associated with the high-technology sector in Turkey. Findings indicate a marked escalation in high-tech investments over the past decade, driven by targeted policy frameworks and synergies among government, industry, and academia. These investments have catalyzed advancements in key sectors, including information technology, aerospace, biotechnology, and renewable energy. A discernible positive correlation between high-tech investments and the augmentation of Turkey's export market is observed, underscoring the criticality of innovation in enhancing global competitiveness. Nonetheless, challenges such as the necessity for robust regulatory frameworks, talent cultivation, and infrastructure enhancement persist, crucial for the sustained growth of high-tech exports. The study proffers an analysis of these challenges, along with actionable recommendations for policymakers, industry leaders, and scholars to effectively address them.

Keywords: High technology; Export development; Innovation, Economic growth; Turkey

1. Introduction

Technology is defined as the entirety of necessary knowledge, organization, and methods related to the production of goods or services (Smith, 1994). According to another definition, technology refers to the knowledge and expertise related to methods contributing to the creation of scientific knowledge or new product production processes (Köseoğlu & Erdem, 2014). Throughout history, technology has significantly transformed production processes and industries. As economies strive to adapt to this process, businesses aim to generate income and achieve growth from rapidly changing and evolving industrial sectors. This process has directed the elements present in the economy to benefit from technological development and to optimally integrate technology into production processes. In the competitive environment created by new technologies and globalization, it has been revealed that the ability to achieve international competitiveness is fundamentally dependent on competence in technological innovation. Thus, the general consensus is that technological innovation is a fundamental determinant for both productivity increases in production and obtaining international competitiveness (Zincirkiran & Tiftik, 2014). Due to the high probability of profitability in the trade of products requiring high technology in the production process, there is an increasing interest in high-tech trade worldwide. It should not be overlooked that increased competition can create a favorable environment for innovation and research and development (R&D), leading to some positive externalities in the economy (Akyol & Mete, 2021). In other words, high-tech products are considered high-value-added products that require qualified labor in their production, contributing to increased investments in the country. In this sense, especially in contemporary times, countries consider progress in this field as a primary objective (Sey & Aydın, 2021).

According to the classification by the OECD (2011), products falling into the high technology group include:

- Aircraft and spacecraft
- Medical instruments, precision optical instruments, and watches
- Chemical and plant-based products used in medicine and pharmacy
- Radio, television, communication equipment, and devices
- Office, accounting, and information processing machines.

The aforementioned high-tech products, such as aircraft and spacecraft, drugs, medical precision, and optical instruments, not only represent high-value-added and high-profit margin products but also provide information about the levels of development of countries. It is possible to say that countries specialized in these sectors are in a leading position in technology development (Haseki & Avşar, 2023).

The topic in the chapter revolves around the strategic efforts Turkey has taken to create a vibrant high-technology industry within its economy. The story follows the development of Turkey's high-tech investments from their inception to the complex, diversified projects that are presently ongoing. It stresses high-tech sectors' transformational role in generating economic growth and strengthening competitive advantage in the global economy. The chapter opens by outlining the parameters that define high-technology investments, emphasizing distinguishing characteristics such as high R&D intensity, quick innovation cycles, and specialized workforce needs.

It contextualizes Turkey's economic trajectory by providing historical insights into the country's industrialization efforts, and it lays the groundwork for comprehending the country's transition to a knowledge-based economy. The Turkish government's aggressive posture has been critical in sparking high-tech growth through a range of incentive schemes such as R&D grants, tax incentives, and technology parks. The chapter extensively examines various policy tools, assessing their influence on the expansion of industries such as ICT, biotechnology, pharmaceuticals, aerospace, and defense. Case examples showcasing successful initiatives and outlining the synergistic effect of public-private partnerships enhance the story. Financing strategies for high-tech businesses are given special consideration, with the role of both domestic and international capital being evaluated. The examination delves into the difficulties of attracting investments as well as the strategic necessity of building an environment receptive to venture capital and foreign direct investment.

The interaction of funding and innovation is emphasized as an important aspect in the evolution of high-tech firms. The chapter presents a detailed overview of export growth in high-tech goods and dissects the techniques adopted to magnify Turkey's position in the global high-tech market, with the export-oriented component of Turkey's high-tech strategy being a prominent focus. It emphasizes the importance of branding, intellectual property rights, and international standards in improving Turkish high-tech export competitiveness. Human capital is highlighted as the cornerstone of technological growth, sparking a discussion about educational policy aiming at developing a professional workforce proficient in science, technology, engineering, and mathematics.

The chapter assesses measures to alleviate the 'brain drain' issue, focusing on activities aimed at attracting and retaining top-tier talent in the country's high-tech businesses. The regulatory and intellectual property landscapes are also evaluated, with a focus on the importance of a strong framework to preserve inventions and ensure compliance with international norms. The chapter recognizes the constraints and dangers inherent in Turkey's high-tech rise, such as geopolitical uncertainty, internal infrastructure, and policy-related roadblocks. Consequently, the chapter forecasts future directions, concentrating on emerging technologies and Turkey's prospective involvement in the emerging high-tech milieu. It articulates ideas for achieving long-term growth, arguing for long-term investment in innovation and the development of an entrepreneurial ecosystem.

2. The Importance of High-Tech Product Export

In the globalized world, one way for countries to enhance their competitiveness in international trade is the production and export of high-quality products containing advanced technology, which would be accepted in international markets. Currently, the export of high-tech products is considered a significant factor for increasing national income and fostering qualified economic growth.

The necessity of engaging in high-value exports and possessing high-tech sectors emerges as a requirement for the development of national economies and ensuring the sustainability of such development. Indeed, the "effective utilization of high technology" is acknowledged as one of the driving forces behind economic growth and development, particularly for countries adopting an export-driven growth strategy (Hobday et al., 2001).

With the increasing share of high-tech product exports in developing countries, the importance of high-tech products in international trade is growing steadily (Baesu et al., 2015). This situation is duly considered in plans and programs prepared by policymakers in countries, highlighting high-tech products as among the most crucial components of international trade. Furthermore, a country's ability to compete in high-tech markets contributes not only to its competitiveness but also to its overall competitiveness in the global economy. In addition to contributing to competitiveness, the export of high-tech products enhances export revenue, coupled with the high technology capacity of many countries. Nevertheless, sectoral production differences between countries help

facilitate the development of the global high-tech product export market (Giri et al., 2023).

In recent years, the widespread expansion of high-tech product exports has significantly accelerated global trade growth. With the assistance of technological advancements, new industrial products and markets have emerged. Simultaneously, improvements in international transportation efficiency through advanced communication technology and reduced trade barriers have facilitated the rapid increase in global trade (World Bank, 2000). On the other hand, in countries employing an export-driven growth model, the effectiveness of high technology is considered one of the driving forces behind development and economic growth. A country's ability to produce its own technology and export it signifies the level of its development (Konak, 2018).

However, it can be asserted that the country's competitiveness is directly proportional to the export of high-tech products (Ünal & Seçilmiş, 2013). Countries require a certain level of technological development to produce high-tech products. To achieve this technological advancement, countries invest in research and development activities, the formation of qualified human capital, and innovation activities. It is observed that these activities contribute to technological improvements and product development in various fields such as communication, transportation networks, computers, pharmaceuticals, defense industry, and aviation. Additionally, the innovations derived from technological advancements and expenditures on research and development positively impact industrial development and economic progress, fostering heterogeneity in production (Erkişi & Boğa, 2019). The benefits of high-tech products are not limited to these aspects; strategically, the production/export of these products can provide various advantages to the producing/exporting country. The production/export of these products shapes and defines the country's national status worldwide, playing a strategic role in the country's political and defense power. In this respect, the contribution of high-tech products to determining the long-term competitiveness of the national economy is significant (Kabaklarlı et al., 2018).

On the other hand, as much attention has been drawn to the export of high-tech products, the import of high-tech products has also become a noteworthy topic due to the benefits it provides to the host country, particularly in terms of its contribution to accessing technology. Although it may not fall within the scope of this study, the utilization of imported high-tech products in the production process can lead to positive effects on economic indicators. Indeed, developing countries benefit from international technology diffusion, leveraging technology transfer from imported goods, integrating the acquired technology with local resources to access new products and production methods. Additionally, technology transfers realized through imports can serve as a source of inspiration for the research and development activities of developing countries (Millman et al., 2012).

3. High-Tech Product Exports in Turkey

In the Turkish economy, exports emerge as one of the most crucial elements for economic development and growth. Following the acceleration of the process of globalization in Turkey after 1980, technology transfer has intensified over the years, export product diversification has increased, and as a result of venturing into new markets, there has been an increase in export volume (Canbay, 2020). Despite the adverse effects of financial crises experienced in Turkey in the 2000s on foreign trade, there has been a continuous increase in export volume over the years. The total exports of Turkey for the period covered in this study, from 2007 to 2023, on an annual basis, are illustrated in Figure 1.

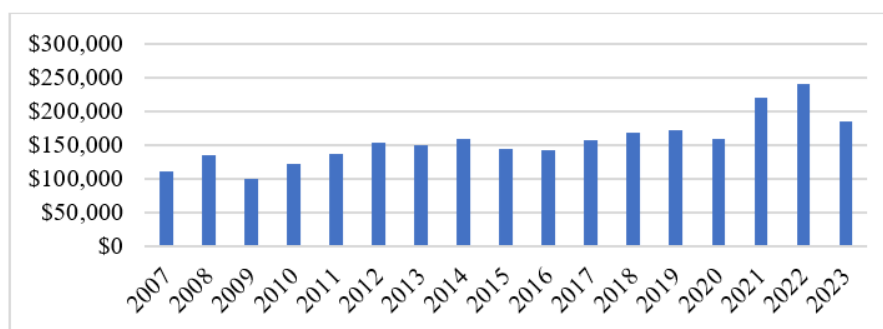


Figure 1. Total exports of Turkey during the period 2007–2023 (million US dollars)

Note: TSI (According to the Customized Trade System)

As observed from Figure 1, the global crisis that emerged at the end of 2008 adversely affected the export performance of many countries worldwide, including Turkey. In this context, there was a decline in exports due to the impact of the global economic crisis. However, with the recovery starting in 2010, there was an increase in foreign trade volume, and exports continued to rise over the years. Another global crisis during the period 2007–2021 was the COVID-19 pandemic in 2020. The pandemic had constrictive effects on Turkey's exports, and a contraction, particularly noticeable in April and May, peaked with the effects felt in the early months of 2020.

Despite the economic recovery starting in June 2020, the encounter with new waves of the pandemic led to the reactivation of restrictive measures (Ay, 2021). In 2021, with the reduction of the pandemic's impact, the availability of various vaccines, the easing of restrictive measures, and the global trade beginning to recover, Turkey's exports also showed an increase, reaching the level of 213 billion US dollars.

When structurally examining Turkey's exports, it is observed that the manufacturing industry sector has consistently held the largest share in exports over the years based on economic activities. Figure 2 illustrates the trend of the share of the manufacturing industry sector in Turkey's exports during the period 2007–2023.

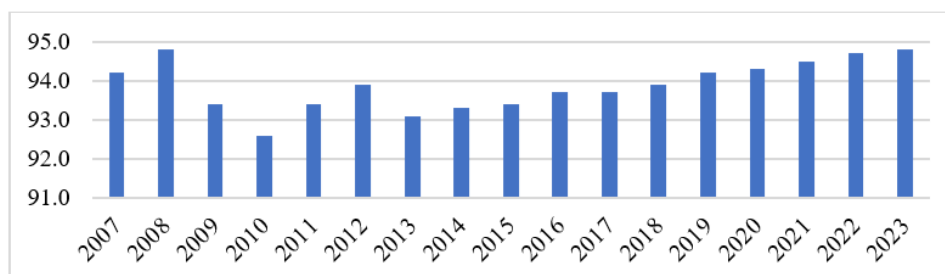


Figure 2. The share of the manufacturing industry sector in Turkey's exports (%)

Note: Turkish Statistical Institute (TSI)

As depicted in Figure 2, the manufacturing industry sector has constituted a significant portion of Turkey's exports over the years. Other sectors with limited impact on Turkey's exports based on economic activities include agriculture and forestry, mining and quarrying, and fishing. In Turkey's exports for the year 2021, the share of the manufacturing industry was 94.5%, agriculture, forestry, and fishing sector had a share of 3.2%, and the mining and quarrying sector accounted for 1.8% (TSI, 2022).

Data related to the technological level of Turkish manufacturing industry exports for the period 2007–2023 are shared in Table 1.

Table 1. Turkey's manufacturing industry exports by technology groups (million USD)

Years	Low Technology Product Exports	Medium-Low Technology Product Exports	Medium-High Technology Product Exports	High Technology Product Exports	Total
2007	33,040	30,669	32,875	4,498	101,082
2008	35,419	47,145	38,704	3,920	125,188
2009	30,285	32,850	28,976	3,339	95,449
2010	34,397	33,537	33,933	3,600	105,467
2011	40,747	40,970	40,314	3,931	125,962
2012	43,465	54,207	40,726	4,795	143,193
2013	48,700	43,333	44,535	4,789	141,357
2014	52,607	42,938	46,500	5,015	147,059
2015	47,070	39,699	42,722	4,899	134,390
2016	46,832	37,865	44,218	4,681	133,596
2017	49,034	41,593	50,805	5,706	147,138
2018	51,421	43,459	57,305	5,521	157,705
2019	53,070	44,446	58,159	5,884	161,558
2020	50,672	41,112	53,190	5,642	150,616
2021	65,505	62,591	65,988	6,574	200,632
2022	79,222	71,987	61,703	6,355	219,267
2023	56,909	60,163	59,924	5,739	182,735

Note: TSI (According to the Customized Trade System)

As seen from Table 1, in the year 2021, exports of medium-high technology products amounted to USD 65.988 million, low technology products were USD 65.505 million, exports of medium-low technology products reached USD 62.591 million, and high technology products constituted USD 6.574 million. When the manufacturing industry exports of Turkey are examined proportionally based on technology groups over the years 2007–2021, it is observed that 32.9% consisted of low technology products, 32.5% medium-high technology products, 30.7% medium-low technology products, and 3.5% high technology products.

During the reference period, more than half of Turkey's exports comprised low and medium-low technology products. While medium-high technology product exports hold a significant share in Turkey's overall exports, and a certain level has been reached in the export of these products, it is noteworthy that high technology product exports have remained at quite low levels. In other words, it is observed that Turkey has not achieved a significant

increase in the value and share of high technology product exports in total manufacturing industry exports over the years. The ratio of Turkey's high technology product exports to total manufacturing industry exports over the years is depicted in Figure 3.

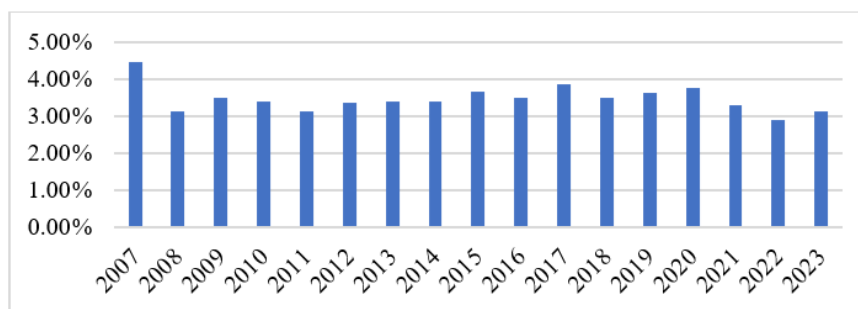


Figure 3. The percentage of Turkey's high-technology product exports in total manufacturing industry exports between 2007–2023 (%)

Note: Turkish Statistical Institute (TSI) (Based on the Customized Trade System)

As evident from Figure 3, the percentage of high-technology product exports in total manufacturing industry exports in Turkey has remained within a narrow range over the years, with no significant increase or decrease observed. In 2007, Turkey's high-technology product exports accounted for 4.45% of total exports, in 2012 it constituted 3.35% of total exports, and in 2021, it represented 3.30% of total exports.

4. Global High-Technology Product Exports

The disparity in the level of technological development among countries simultaneously influences their levels of economic growth, international trade, and competitiveness in the global economy (Şeker & Özcan, 2019). The export and import of high-technology products can provide crucial information about the levels of science and technology in countries. Countries heavily importing high-technology products are often observed to be unable to generate technology sufficiently and resort to technology transfer. Conversely, countries with high levels of science and technology tend to have a high proportion of high-technology product exports within their total manufacturing industry exports (Avdar & Avdar, 2021). High-technology products have recently emerged as one of the most dynamic components in international trade, and a country's competitiveness in high-technology markets is crucial for its overall competitiveness in the global economy (Oğuz & Sökmen, 2020).

Countries engaging in the export of high-technology products are prominently those with high incomes. In a study conducted by the World Bank, countries were classified into four categories based on their per capita income in the year 2019. According to this classification:

- Economies with a per capita annual income of USD 1,035 or less were categorized as 'Low-Income Economies'.
- Economies with a per capita annual income ranging from USD 1,036 to USD 4,045 were categorized as 'Lower-Middle-Income Economies'.
- Economies with a per capita annual income ranging from USD 4,046 to USD 12,535 were categorized as 'Upper-Middle-Income Economies'.
- Economies with a per capita annual income of USD 12,536 or more were categorized as 'High-Income Economies'.

5. Key Strategies and Policies Implemented in Turkey Regarding High-Technology Product Exports

Since the 1980s, there has been a shift in Turkey's economic growth and industrialization strategy from import-substitution industrialization to growth-oriented export, aiming to integrate with the global economy (Pabuşçu, 2021). Following this period, Turkey's integration into the global economy has shown a significant increase, leading to substantial growth in foreign trade volume. On the other hand, significant economic setbacks, such as the 1994 crisis, the 1999 earthquake, and the 1999, 2001, and 2008 crises, have resulted in declines in Turkey's export values (Özdemir et al., 2016). Another crisis, the COVID-19 pandemic that began in 2019 and continued its economic effects beyond 2021, led to a decrease in foreign trade for Turkey and many countries and sectors, while employment and trade opportunities increased in agriculture, healthcare services, and digitally transformed areas with remote work (Gürbüz et al., 2023). The economic policy changes implemented over the years and the crises mentioned above have undoubtedly significantly influenced the strategies and policies to be determined for export in the Turkish economy. Adapting to the requirements of the era, Turkey has defined its vision for the

economy as completing its digital transformation, possessing the latest production technology, and reinforcing its position as a highly competitive, logistically and legally robust production and trade hub.

The rapidly transforming elements of global competitiveness, changing roles between capital and labor in production, the diminishing emphasis on competition based on cheap labor, and the shift towards high-technology, faster, more flexible, and innovative production, along with the implementation of design and branding strategies, have also guided Turkey's Eleventh Development Plan published in 2019.

The Eleventh Development Plan, covering the period from 2019 to 2023, adopts a sectoral prioritization approach aimed at reducing Turkey's technological dependency and achieving structural transformation in the industry. With this approach, a comparative analysis of the trade, production, value-added, employment, and technology levels of manufacturing industry sectors, along with the analysis of inter-sectoral forward and backward linkages, resulted in the identification of the chemical, pharmaceutical-medical devices, machinery-electrical equipment, automotive, electronics, and rail system vehicles as priority sectors. These sectors aim to increase high-value-added production by ensuring technology, innovation, product quality, and efficiency. Since all these sectors fall within the categories of high and medium-high technology sectors, it is anticipated that progress in these sectors will contribute to reducing Turkey's technological dependency in manufacturing and achieving structural transformation in the industry (Presidency of the Republic of Turkey, 2022).

The 'Research and Development and Innovation' section of the Eleventh Development Plan also includes policies that will positively impact the export of high-technology products. In line with the goal of strengthening R&D and innovation capabilities towards enabling value-added production and enhancing the capacity for innovative product development in the manufacturing industry, the aim is to transform the R&D and innovation support system into a structure that differentiates and takes into account the needs and development potentials of medium-high and high-technology sectors. Special emphasis is given to priority sectors, and support for consortiums of firms engaged in the development and commercialization of high-technology products is addressed as one of the topics in the development plan. In the 2019-2023 period, the creation of the necessary ecosystem in Turkey is anticipated, particularly in areas requiring high technology, such as biotechnological drugs, concerning R&D, production, qualified human resources, and regulations.

The Ministry of Commerce of the Republic of Turkey, which is responsible for determining the goals and policies in domestic and foreign trade services, has also highlighted the importance of high-technology product exports in the policies and strategies prepared in line with the main policies determined in the Eleventh Development Plan. In this context, the Strategic Plan, published by the Ministry of Commerce for the period 2019–2023, has been prepared with the vision of ensuring sustainable economic growth by making trade more competitive, faster, and secure, while promoting high-technology and high-value-added exports. Turkey aims to achieve sustainable export growth by enhancing the value and competitiveness of exported goods and services, diversifying markets and products. Accordingly, the goal is to increase the share of high-value and high-competitiveness products in exports and strengthen Turkey's position in the global value chain (Ministry of Industry & Technology of the Republic of Turkey, 2019). In this context, the strategy and policies developed aim to enhance the exports of Turkish companies in high-technology, high-value-added, and innovative products by fostering the clustering of enterprises and their participation in the global supply chain. The objective is to support Turkey's more effective participation in global value chains. Certainly, to achieve this, it is necessary to incentivize companies to increase the share of high-value-added and high-technology exports in total exports. Additionally, the implementation of various policies, such as enhancing the appeal of free zones to attract investments in high-technology products to Turkey, is anticipated. Therefore, Turkey aims to contribute to competitive investments by developing investment potential on one hand, while also targeting an increase in technological and R&D-based activities for value-added production in free zones, thus contributing to the national economy (Ministry of Commerce, 2022).

Another policy document related to high-technology product exports is the Export Master Plan, published in 2019, where it is emphasized that increasing the share of high-technology product exports in Turkey's manufacturing industry is crucial. In Turkey, to increase value-added production and exports, the Ministry of Industry and Technology is developing high-technology-focused policy practices in addition to the Ministry of Commerce. One of these initiatives is the 'Technology-Focused Industrial Initiative Program', aiming to provide significant state incentives to companies producing priority products in target sectors. This program focuses on concentrating support and incentives provided by the Ministry of Industry and Technology, KOSGEB, and TÜBİTAK on medium-high and high-technology level sectors (Ministry of Industry & Technology of the Republic of Turkey, 2019). Upon examining the comprehensive plans and programs encompassing the fundamental policies and strategies implemented in Turkey for high-technology product exports, it is evident that the primary goal is to increase Turkey's high-technology product exports, thereby entering the high-income group of countries and enhancing societal welfare. These plans and programs aim to achieve development in the high-technology sector, both through foreign direct investments and the provided supports, with the objective of increasing the share of high-competitive and high-value-added products in exports. It is explicitly understood from these plans and programs that there is a need to augment the export share of high-technology products, strengthening Turkey's

position in the global value chain. Additionally, the plans and programs emphasize the importance of adopting a sustainable export approach, acknowledging the risks associated with achieving these goals during periods characterized by increased protectionism in trade, slowed global growth, and the emergence of pandemics and conflicts negatively impacting the world economy and foreign trade.

6. Discussion

The rapid evolution of the global economy in the 21st century demands nations to strategically invest in high technology to remain competitive. Turkey, with its rich history and diverse economic landscape, has been actively pursuing high technology investments as a key driver for export development. This discussion section delves into the various facets of Turkey's high technology investments, their impact on export growth, and the challenges and opportunities that lie ahead.

6.1 Integration of High Technology in Turkey's Economic Landscape

Turkey's commitment to embracing high technology is evident in its efforts to integrate advanced technologies across sectors. The government's initiatives, such as the National Technology Move and Turkey's 2023 Vision, underline the importance of technological innovation in achieving sustainable economic growth. The establishment of Technoparks, research centers, and collaboration between academia and industry are critical components of Turkey's strategy to harness high technology for economic development.

6.2 High Technology Investments and Export Growth

One of the primary objectives of Turkey's high technology investments is to fuel export growth. The infusion of advanced technologies into manufacturing processes enhances productivity, quality, and innovation, making Turkey's products more competitive in the global market. The positive correlation between high technology investments and export development is evident in the increased share of high-tech exports in Turkey's total export basket. This shift toward high-tech exports not only contributes to economic diversification but also positions Turkey as a player in the global knowledge economy.

6.3 Key Sectors Driving High Technology Exports

Analyzing the specific sectors contributing to high technology exports is crucial for understanding Turkey's export dynamics. The automotive industry, aerospace and defense, information technology, and biotechnology have emerged as key drivers. Turkey's automotive sector, for instance, has leveraged high-tech manufacturing processes and innovation to become a major exporter of vehicles and components. The aerospace and defense industry, with its focus on research and development, has seen notable advancements in producing technologically sophisticated products for both domestic and international markets.

6.4 Global Competitiveness and Market Penetration

Turkey's success in high-tech exports is not only measured by the quantity but also by the quality and competitiveness of its products in the global market. Strengthening global competitiveness involves not only technological prowess but also effective marketing and branding strategies. Turkey must continue to invest in building a global reputation for reliability, innovation, and quality to penetrate new markets and increase its market share in existing ones. Collaborative efforts between the government and private sector can play a pivotal role in establishing Turkey as a trusted source of high-tech products.

6.5 Challenges in Turkey's High Technology Journey

While Turkey has made significant strides in high technology investments, several challenges persist. One major hurdle is the need for a robust ecosystem that supports research and development. Strengthening intellectual property rights, promoting a culture of innovation, and incentivizing private sector investments in R&D are critical steps. Additionally, addressing the skill gap and ensuring a well-trained workforce capable of handling advanced technologies is imperative for sustaining Turkey's high-tech growth.

6.6 The Role of International Collaboration

International collaboration is indispensable for Turkey's journey into high technology excellence. Partnerships with global research institutions, technology firms, and foreign governments can accelerate Turkey's access to cutting-edge technologies and foster knowledge exchange. Engaging in joint ventures and collaborative projects

can enhance Turkey's technological capabilities and promote the transfer of expertise, contributing to a more vibrant and globally connected high-tech ecosystem.

6.7 Sustainability and Ethical Considerations

As Turkey advances in high technology, it is crucial to consider the sustainability and ethical dimensions of these advancements. Sustainable practices in manufacturing, energy consumption, and waste management are essential to mitigate environmental impacts. Ethical considerations regarding data privacy, cybersecurity, and responsible use of emerging technologies should be integral to Turkey's high-tech strategy, ensuring that advancements align with ethical standards and global expectations.

6.8 Future Outlook and Recommendations

The future trajectory of Turkey's high technology investments and export development hinges on a multi-faceted approach. Strengthening the collaboration between academia, industry, and the government remains paramount. Prioritizing investments in education and skill development, fostering an environment that nurtures innovation, and incentivizing private sector participation are key recommendations. Additionally, Turkey should proactively engage in international collaborations to stay abreast of global technological advancements and contribute to shaping the future of high technology.

7. Conclusions

The production and export of high-tech products have become crucial for countries today due to their ability to stimulate economic growth and add significant value to their sectors and economies (Harlow et al., 2013). With the 21st century being characterized as the era of information, export, considered as the engine of development and holding a significant share within the manufacturing sector, highlights factors such as utilizing knowledge, creating innovation, and transforming innovation into commercial success (Avcı et al., 2016). Therefore, examining the technology intensity within the manufacturing sector can reveal the structural situation and guide policies in this field. In Turkey, the share of manufacturing industry in total exports was 94.5% in the year 2021. However, the ratio of high-tech product exports to total manufacturing industry exports in Turkey has fluctuated within a narrow band between 2007 and 2021, with no significant increase or decrease. Turkey's high-tech product exports accounted for 4.45% of total exports in 2007, 3.35% in 2012, and 3.30% in 2021 (TSI, 2022). Thus, while increasing exports is crucial for our country, a mere increase in exports may not provide sustainable contributions. Enhancing the share of exports in total exports by increasing the export of products containing high technology, defined as the superior renewal of knowledge compared to other technologies, will strengthen our country's position in international trade. In this context, the question of what factors may affect the export of high-tech products becomes important in this study.

The study results indicate the necessity for Turkey to establish policies that will facilitate the acquisition of technology and reduce external dependency in order to enhance its high-tech product exports. Policies aimed at attracting foreign direct investments to manufacturing industries that contribute to high technology should be developed. Various policies can be implemented to encourage foreign direct investments that facilitate technology transfer, such as applying tax advantages, reducing bureaucracy, and providing employment incentives. Strategic areas for high-tech products should be identified and supported. Additionally, considering the need for imported inputs in Turkey's high-tech product exports, structural changes to reduce the use of imported inputs and meet this need from the domestic market would be beneficial.

Moreover, based on the study results, it is crucial to consider the real exchange rate as a significant variable for high-tech product exports. Therefore, when determining exchange rate policies, it is important to take into account the impact of these policies on foreign trade dynamics, considering product groups based on technology levels. Turkey's journey into high technology investments and export development represents a dynamic interplay between policy initiatives, industrial strategies, and global market dynamics. While challenges persist, Turkey has demonstrated resilience and determination in harnessing the power of high technology for economic growth. Continued commitment to innovation, collaboration, and sustainability will be pivotal in ensuring Turkey's place in the global high-tech landscape, fostering economic prosperity and technological advancement for years to come.

Data Availability

The data used to support the research findings are available from the corresponding author upon request.

Conflicts of Interest

The author declares no conflict of interest.

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