

**TRANSFORMATION AND ECONOMIC EFFECTS OF
THE TURKISH AEROSPACE AND DEFENSE
INDUSTRY**

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Abstract

The aerospace and defense industry are an industry with significant economic, technological, and political impacts. The defense industry is one of the most critical sectors that increase the global competitive power a country. A technological innovation developed by the aerospace and defense industry spreads to other sectors over time and contributes to overall development.

Ensuring national security is one of the most essential tasks of the states. In today's world, overcrowded armies have been replaced by high-tech defense vehicles. Therefore, it is a matter of national security for countries to have high-tech defense systems today. Spending on the defense industry for countries that cannot produce these systems takes place an important amount in both their imports and national expenditure. Defense industry, not only constitute of the economic burden because of imported defense vehicles but also create a dependency problem on other countries. The arms embargoes imposed on countries throughout history have shown that foreign dependence causes a severe security problem. For this reason, almost every country wants to invest as much in the defense industry as its resources would allow. In countries where high-tech defense systems are produced, share of the defense expenditure in import decreases and share of income from defense systems in export increases that is a contribution to the national income. A strong defense industry does not only affect foreign trade positively but also helps in building economic and political confidence by giving the country a strong image. Trust and stability are fundamental requirements of economic development. In economies where trust and stability do not exist, domestic and foreign investors avoid investing, negatively affecting economic growth.

The development of the aerospace and defense industry in a country contributes to the national security, provides employment in the value-added sector and accelerates innovation and technological development not only in defense sector but also in other sectors. The acceleration seen in the Turkish aerospace and defense industry in recent years provides important opportunities for developing the country's economy and expanding its geopolitical influence. This section aims to evaluate the developments in the aerospace and defense sector, which is a success story within the framework of the National Technology Initiative in terms of economy.

Keywords

Turkish Defense Industry, Defense Expenditures, Technological Development, Economic Growth, Balance of Trade

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1. Introduction

The individual's need for security is one of the basic needs in Maslow's hierarchy of needs. Although debates about the role of the state in the economic order have been going on for many years, there is a consensus that the state must provide national security. In this context, the state has a duty to defend its citizens against external threats. Defense literally means to defend the country against attacks. The activities that the state carries out to protect itself from internal and external threats to preserve its existence are defensive activities. In this context, all individuals in a society benefit from the services provided under the name of national defense, and national defense services are classified as public goods in terms of their qualifications (Ay, 2013, p. 75).

With the end of the cold war, a decrease in defense expenditures was observed worldwide. Although the general trend in the world is to reduce defense spending, Türkiye has not joined this trend. In addition, Türkiye's geographic location brings with it various geopolitical risks in addition to many advantages. Producing at least some of the critical defense products within the country not only guarantees the need of a strong military that is necessary for the country's national independence but also contributes to economic growth by producing the weapons and technologies necessary for the Turkish defense industry. Domestically produced modern defense equipment, on the one hand, decreases the spending for the imported military weaponry system and keeps the resources within the country and, on the other hand, the export of these products leads to an inflow of foreign resources into the economy. For this reason, investments in Türkiye's defense industry are expected to have multiple impacts on the social and economic contexts.

2. Effects of the Defense Industry

Since defense industry goods can not only be considered commercial goods, the production of these goods cannot be explained only by the comparative advantage model. Countries' investments in defense industries are affected by various political and strategic factors as well as economic factors (Braurer, 1991, p. 874). Similarly, developments in the defense industry affect society both politically and economically.

2.1. *Political effects of developments in the defense industry*

Most approaches that attempt to explain defense spending have focused on examining the action-response between two rivals that act rationally and have different regional or international strengths. In this context, the amount of resources allocated to defense in a country has been made to depend on the rival country's expenditures (reaction effect), the intensity of the country's grievances against the other (grievance effect), and the past cost of defense expenditures.

The motivation behind defense industry investments is largely to reduce the country's dependence on military resources in case of a potential security threat. Domestic production of defense systems is a matter of national security. The arms embargo faced by various countries throughout history has led the countries to prepare herself against the negative outcomes of possible arm embargos and invest in their defense industry.

How a government solves such problems depends on the country's political ambitions, culture, history, and worldview. There is no "one size fits all" approach, but certain factors must be considered concerning a nation's core defense business (O'keefe & Susman, 1998). The relationship between the government and the defense industry is critical to all citizens

and should not be ignored. The complex geopolitical system of the twenty-first century and the instability of the national security environment structures the defense industry. While the armed forces may not always be able to protect society from all types of malicious threats as demonstrated by the global terrorist attacks, counterterrorism efforts, agility and operation capacity are key elements of national security. These factors are primarily determined by what the defense industry provides (Heidenkamp, 2013, p. 139). For this reason, almost every country, regardless of its level of development, has made various attempts to develop its defense industry within its resources.

Analysis has shown that in more economically and politically stable countries, defense expenditures increase investments and lead to economic growth; in countries with high economic and political instability, defense expenditures have an adverse effect on investment and economic growth (Bloomberg, 1992; Looney and Winterford, 1995). Although the relationship between defense expenditures and economic growth has been extensively studied in the literature, the indispensable benefit of defense expenditures is that it helps to increase overall social welfare by ensuring national security and peace. For this reason, defense expenditures, with the confidence and stability it creates, provide the necessary precondition for economic growth (Değer & Sen, 1995, p. 285).

2.2. Economic effects of developments in the defense industry

The strength of a country's defense industry not only plays a deterrent role against external threats but also indirectly contributes to the political and economic stability of the country. According to Barro (1991), defense expenditures increase investment and serve economic growth by helping to protect property rights. Successful investment in the defense industry helps create an environment of confidence in the country. An atmosphere of confidence and stability is one of the most essential elements of economic development. Without these factors, it is not possible to make investments, so there is no question of economic development (Benoit, 1973).

There is no consensus in the literature on the relationship between defense spending and economic growth. The efficiency of defense investment, especially for developing countries, is highly controversial. Some studies provide evidence that allocating scarce resources to defense expenditures instead of areas with higher efficiency has a negative impact on employment and economic growth in developing countries. Defense investments can divert resources from productive sectors and may generate negative externalities. Moreover, like all public investments, they can crowd out private sector investment. Although the defense industry benefits from transferring technology to the private sector, the use of civilian technology in weapon systems has increased in recent years (Dunne, 1996).

The defense industry, a sector that uses advanced technologies and conducts high-level research and development activities, is the locomotive of industrial development in developed countries. Considering the industrialization process of developed countries, it is seen that the defense industry has a positive impact on industrialization (Dabağır, 2005).

Since it requires large R&D budgets, defense industry investments are initially made by the state. Over time, new technologies created in the defense industry are also offered for the use of other industries. For example, internet technology, which is now used worldwide, was first used for military purposes in the United States and then offered for civilian use (Marson, 1997, p. 35). Defense industry investments of the private sector are realized with the incentives provided by the government at the beginning. These incentives are designed to enable the private sector to gain the competence, capabilities, and competitive advantage in the international arena to support the military by providing goods, services, materials,

and technical information. Through the incentives offered by the government to the defense industry, these companies are more willing to raise funds and invest.

In recent years, governments in the UK, USA, and Germany seem to receive higher support rates from the private sector for the supply of defense goods and services. This trend has fundamentally changed the relationship between the public and private sectors in the defense industry. The functions performed by the private sector go far beyond simply procuring military equipment and supplies. The private sector provides all lifetime services, including equipment maintenance, repair, and replacement. In addition, the private sector offers various types of support functions to the armed forces, including construction, laundry, and catering (Heidenkamp et al., 2013, p. 16).

Defense expenditures do not have a special role in economic theory. These expenditures are only one type of public expenditure. One of the pioneers of liberal economic thought, Adam Smith, reserved a separate chapter for defense in his book *The Wealth of Nations*. According to Smith, defense is much more important than wealth. The primary purpose of a state's policy is self-preservation, not the welfare of its citizens. Welfare goals are important because they serve security. For this reason, he considered defense among the fundamental functions of the state, although he was opposed to state intervention in the economy, and he retained defense as an exception in his free-trade theory (Boulding, 1951, p. 211). The view of the followers of the classical school (neoclassicals, monetarists, New Classics) was also similar. According to the Keynesian view, which replaced the Classical view, which emerged with the 1929 Depression, the state can have a positive effect on demand if necessary. If the main problem is insufficient demand, the government can overcome this problem by increasing public spending. Although he was in favor of state intervention, Keynes classified defense expenditures as the most inefficient public expenditure and did not find it right to use protectionism for the development of the defense industry (Bellais & Coulomb, 2008). On the other hand, Underconsumption theorists argue that military spending has a positive role in the economy, although it is not supported empirically (Dunne & Haines, 2002, p. 9).

Those who argue that the establishment of the domestic defense industry is a necessity; claim that the marginal benefits of the industry, such as promoting industrial development, creating jobs, and providing export opportunities, are greater than the marginal costs. The creation of such an industry would also encourage the development of civil industries by creating forward and backward linkages in the economy. The coefficient that indicates how much of the output of other sectors should be used to increase output in a sector by one unit is called the linkage coefficient that is very high in the defense industry with sectors such as iron and steel, machinery, metal products, electronics, and information technology. For this reason, strategic investments in the defense sector will contribute to the development of other sectors and thus the country's economy (Ziylan et al., 1998).

Moreover, joint venture, and licensing agreements with foreign investors will encourage technology transfer. Similarly, the development of the defense industry under the import substitution model and the fact that it exports over time will lead to an improvement in the balance of payments as foreign exchange is saved (Amara, 2008, p. 133).

3. Developments in the World Defense Industry

Two world wars and the Great Depression in the first half of the 20th century left behind a tired world. Both the losers and the winners of the two world wars recognized the need to build peace on a global scale and took essential initiatives in this direction. The foundation

dates of most of the institutions promoting international cooperation in today's world coincide with the years after the Second World War.

To get rid of the devastating effects of the war, the countries that were damaged by the war, most of which were European countries, gave priority to the effort to rebuild their countries in a peaceful environment. Gaining power in the international economic and political arena is only possible in an environment where peace and stability prevail. There was no significant decrease in military expenditures until the end of the Cold War

With the end of the cold war, a decline in defense expenditures has begun worldwide. The overall and regional distribution of worldwide military expenditures in the post-cold war period, which started with the dissolution of the USSR in 1989, is shown in Table 1.

Table 1. Total Military Expenditures (Billion USD\$, 2019 Prices) and Share of Regions (%)

Year	World Total	Annual Change (%)	Africa*	America*	Asia ve Oceania*	Europe*	Middle East* (Excluding Irak)
1992	1138.99		1.27	55.51	14.00	29.22	7.32
1993	1093.73	-3.97	1.49	55.28	14.89	28.34	7.27
1994	1061.81	-2.92	1.46	54.48	15.44	28.61	7.27
1995	1009.74	-4.90	1.41	54.01	16.72	27.86	7.26
1996	983.67	-2.58	1.40	52.61	17.58	28.40	7.52
1997	986.62	0.30	1.49	51.89	18.15	28.46	8.23
1998	969.54	-1.73	1.60	51.99	18.50	27.91	8.91
1999	992.52	2.37	2.11	50.99	19.11	27.80	8.52
2000	1021.82	2.95	1.85	51.30	18.98	27.88	9.14
2001	1043.71	2.14	1.89	50.95	19.63	27.54	9.25
2002	1122.96	7.59	2.08	52.58	19.10	26.24	8.39
2003	1207.72	7.55	1.75	54.81	18.51	24.94	7.98
2004	1389.11	15.02	1.67	51.74	17.05	21.97	7.43
2005	1442.67	3.86	1.66	52.16	17.23	20.99	7.76
2006	1489.59	3.25	1.67	51.34	17.64	21.05	8.16
2007	1549.20	4.00	1.68	50.91	17.98	20.80	8.44
2008	1639.08	5.80	1.86	51.63	18.02	20.21	8.03
2009	1753.89	7.00	1.82	52.00	18.95	19.19	7.81
2010	1789.51	2.03	1.92	52.38	18.99	18.45	8.02
2011	1793.25	0.21	2.15	51.72	19.65	18.11	8.11
2012	1779.04	-0.79	2.23	49.50	20.69	18.45	8.88
2013	1747.66	-1.76	2.53	46.90	21.98	18.50	9.64
2014	1739.67	-0.46	2.62	44.54	23.24	18.80	10.40
2015	1767.24	1.58	2.49	43.04	24.23	19.01	
2016	1774.07	0.39	2.40	42.68	25.29	19.63	
2017	1796.22	1.25	2.31	42.11	26.15	18.89	
2018	1842.14	2.56	2.20	42.26	26.28	18.76	
2019	1909.42	3.65	2.14	42.81	26.51	19.03	
2020	1959.77	2.64	2.19	43.34	26.48	19.28	

Source: <https://sipri.org/databases/milex>

Note: * Represents the Shares of the Regions in the Total of World Military Expenditures.

The end of the bipolar world with the dissolution of the USSR in 1989 manifests itself in military expenditures. Beginning in 1992, military spending declined, and this trend continued until the late 1990s. Starting in 1999, defense spending began to rise again, doubling within 20 years.

In the years following the collapse of the USSR, defense expenditures' share of total expenditures in the American region continued to rise, however, declining each year over the previous year. The only exception period for this region is 2002-2003, following the terrorist attack of September 11, 2001.

Military expenditures in the European region as a share of total military expenditures in the world declined until 2008. After that, the share of European countries remained at the level of 19%. It is assumed that the increase in the share of European countries in total military expenditures in 2015-2017 is due to terrorist attacks in various European countries.

Military expenditures in the Asian region as a share of total spending gradually declined through the post-2002 period. The exceptional period for this region began in 2011. After 2011, Asian countries' share of military expenditures has continued to increase until today. The increase in defense expenditures of China and North Korea in this region increases the region's share of total spending. The share of Middle Eastern and African countries has not changed significantly over the years.

From a historical perspective, although there have only been two major world wars in the last century, regional wars or political tensions have continued from the past to the present, and terrorist acts are increasingly globalized. As a result of such events, even countries or groups of countries that have established peace in their own countries or regions are forced to engage in some level of military expenditure. In addition, large-scale terrorist attacks, which were rare in the past, were the nightmare of the pre-pandemic era and caused unrest even in the countries of the European Union, which were based on the idea of peace in Europe.

4. Development of the Turkish Defense Industry and Applied Policies

The Republic of Türkiye was established in 1923 after the War of Independence after the First World War. Although there were important developments in the Turkish defense industry after World War I, Türkiye, which became a member of NATO member in 1949 after World War II, abandoned its strategy to develop its domestic defense industry and relied on U.S. for defense assistance. After the Peace Operation in Cyprus in 1974, the U.S. imposed military sanctions on Türkiye. After these sanctions, it was recognized that Türkiye needed a domestic defense industry, and important steps were taken to develop the domestic defense industry.

After Türkiye became a member, it integrated all its national security and defense mechanisms into NATO. Since the Soviet Union and the Warsaw Pact were seen as the primary threat, its military posture, doctrine, planning, training, procurement, and maintenance procedures were predominantly oriented toward NATO and the United States in particular (Mevlütöğlü, 2017).

Türkiye has preferred the import substitution model in the economy since the 1950s. This model did not contribute to the development of the defense industry due to insufficient investment. With the transition to the transformation and export-based growth model by the January 24, 1980, private sector companies were encouraged to invest in the defense

industry. Although the government's weight in the sector continued until 1985, the private sector's share in the sector increased steadily thereafter.

Law No. 3238 of 1985 introduced a new concept for the defense industry aimed at producing all types of equipment needed by the Turkish Armed Forces (TAF) domestically as much as possible. With this law, the Defense Industry Development and Support Administration (SAGEB) was established to develop the defense industry and modernize the TAF. The SAGEB was restructured as the Defense Industry Agency in 1989. The principles of the defense industry policy adopted by Law No. 3238 can be listed as follows (DIA):

- Utilizing domestic industrial infrastructure at the highest level.
- To encourage new investments that will produce advanced technology.
- To increase the share of foreign capital in the sector and technological cooperation with foreigners.
- Ensuring that tools related to the defense industry are produced domestically as much as possible by encouraging R&D activities.

With the transition to the export-based growth model in the 1980s, it was aimed to increase the production and export of defense industry products, and the export of Turkish Defense Industry products has increased continuously over the years.

In the 1990s, it was decided that Türkiye needed to establish various policies and strategies related to the defense industry. In June 1998, "Turkish Defense Industry Policy and Strategy Principles" (TSSPSE) were accepted with the Council of Ministers Decision No. 98/11173. The most distinctive feature of the document is that it provides an institutionalized approach that does not change from project to project to produce the necessary technologies for the country.

In the International Cooperation and Export Strategic Plan prepared by the Defense Industry Agency (DIA) for the period of 2017-2021, the defense industry strategic objectives are described below (DIA, 2017):

"To lead the creation of financing models to increase the competitiveness of our companies in international markets; To create a strategic perspective with an integrated approach in international cooperation; To carry out studies that will ensure maximum utilization of incentives in the financing of marketing; To carry out projects that will support the foreign promotion, business development and cooperation activities of the Defense Industry; Increasing the Contribution of NATO-CNAD Activities to International Cooperation and Industrialization Activities".

Institutions within the Turkish Defense Industry consist of Military Factories affiliated with the Turkish Armed Forces (TSK), the Machinery and Chemical Industry Institution of the Ministry of National Defense, Turkish Armed Forces Foundation companies, and private companies. Defense industry companies are generally divided into public and private companies. At the lower level, military factories, state-owned enterprises/Turkish Armed Forces foundation companies, private companies, and foreign partners operate (Sezgin, 2017).

Although the Turkish Defense Industry was included in the 5th Development Plan (1985-1989) for the first time, similar targets regarding the defense industry were included in all development plans until the 11th Development Plan (2019-2023). To summarize, these objectives can be argued as follows:

- Promoting the domestic production of defense industry products,
- Observing national security requirements in investments in the communications sector,
- Supporting R&D activities in investment areas related to advanced technology.

In the 11th Development Plan, the Defense Industry was discussed under a separate heading from other development goals. The primary purpose of the 11th Development Plan was determined as follows (Ministry of Development, 2019):

“The main objective is to strengthen the defense industry ecosystem and to spread the skills acquired in the defense industry to the civilian sector to meet the needs of our Armed Forces and security forces with the understanding of continuous development, with national technologies and domestic opportunities to the maximum extent, and to increase defense exports.”

Policies and Measures determined to achieve this aim are listed as follows (Ministry of Development, 2019):

I. Projects that will serve the development of national technologies and reduce foreign dependency will be implemented with domestic resources.

- a) Advanced versions of existing products will be produced using domestic resources, and an approach to having a product group that can serve in different mission areas will be adopted.
- b) While producing defense vehicles, efforts will be made to reduce foreign dependency at all stages of production.
- c) A capability inventory will be drawn up to determine the current capabilities of the defense industry.
- d) By making the necessary plans for localization, the ratio of domestic products and sub-components in the defense industry will be increased.
- e) During the plan period, the Altay tank and the air and sea defense systems worked on will be added to the inventory; the number of Unmanned Aerial Vehicles (UAVs) currently in the inventory will be increased; existing studies on UAV and land vehicle engine will be completed.

II. Educational infrastructure will be strengthened to train the qualified workforce necessary to ensure sustainability in the defense industry; Support will be provided to companies operating in the sector; Measures will be taken to increase exports and cooperation in the sector.

- a) Training that will increase the interest in technology will be given through the Defense Industry Academy.
- b) With the Visionary Youth Project, internship and job opportunities will be provided to young people.

- c) Vocational and technical schools will be standardized by making needs analyses for sectors related to the defense industry. These schools will be opened in different provinces in case of need.
- d) Companies operating in the sector will be provided with training and financial support through the Industrial Competency Evaluation and Support Program (ICESP).
- e) Within the scope of the Defense Industry Investment and Development Activities Support Program, financial support will be provided to companies operating in the sector.
- f) Project and country-oriented export strategies will be determined to increase the exports of the Defense Industry.
- g) Various activities will be organized every year to strengthen cooperation, coordination, and sharing among all stakeholders in the sector.

III. To accelerate the National Technology Initiative, multi-use will be expanded in sectors that can feed each other with the defense industry in terms of technology.

- a) In line with the vision of creating a 100% national defense industry in critical technologies for the defense industry and shaping future war strategies, projects and investments based on basic and advanced technologies will be made and supported.
- b) Intersectoral multi-use opportunities will be examined, and these opportunities will be transformed into concrete projects.

With the attempts to nationalize the Turkish defense industry, many new products and subcomponents were added to TAF's inventory. Studies on the development of various types of defense equipment continue.

While reducing foreign dependency is a strategic issue for the defense industry, import substitution goods, and new technology products serve to improve the current account balance by reducing Türkiye's imports and increasing its exports. Defense industry investment is a type of public expenditure. From a Keynesian perspective, an increase in these expenditures leads rise in national income through the multiplier mechanism. In addition to this direct effect, all kinds of incentives for firms engaged in defense industries lead to private sector investment and thus to an increase in national income. Support for the defense industry is not limited to direct investment expenditures. As is clear from the goals of the 11th Development Plan targets, the state contributes to the country's human capital by organizing training programs that raise the workforce's quality and create new employment areas.

Due to the political and economic instabilities experienced during the 1980s and 1990s, Türkiye could not implement its Indigenization move, which it started after the Cyprus Peace Operation, at the desired level. Thus, targets related to the defense industry were not met. However, especially after the global economic crisis, the challenges in international politics, the rising war expectation worldwide, the tension that started in the Middle East with the Arab Spring, and the ongoing civil war in Syria have directly affected Türkiye due to its geographical location. The ongoing tensions in Iraq and the civil war in Syria have developed into processes that threaten Türkiye's border security and encourage terrorism.

Currently, Türkiye's operations to protect border security have been launched in different ways in the international arena, creating the impression that Türkiye is intervening in the above-mentioned countries. Due to these and similar perceptions, countries that are suppliers of defense vehicles or some of their subcomponents have decided to stop the sale of these vehicles to Türkiye from time to time. All these events have once again shown the importance of developing the national defense industry. In this context, initiatives on the development of national technologies with domestic facilities in Türkiye have gained momentum.

5. The Place of the Defense Industry in the Turkish Economy

Due to its benefits for economic and national interests, the development of defense industry has always been on Türkiye's agenda. The defense industry, which has had a place in all development plans since the 5th Development Plan, is now one of the strategic industries. Table 2 shows Türkiye's overall military expenditures (in millions of USD) for 1980-2020 and the change from the previous year.

Table 2. *Military expenditure in Türkiye, the annual rate of change, and the share of military spending in GDP*

Year	Military Expenditure (Billion \$, 2019 Price)	Change from the previous year (%)	Percentage of GDP	Year	Military Expenditure (Billion \$, 2019 Price)	Change from the previous year (%)	Percentage of GDP
1980	5018.1	-	3.90	2001	11473.3	-8.3	3.60
1981	5661.7	12.8	3.82	2002	12207.5	6.4	3.80
1982	6189.4	9.3	4.30	2003	11352.5	-7.0	3.30
1983	5856.2	-5.4	3.94	2004	10549.9	-7.1	2.70
1984	5692.9	-2.8	3.60	2005	10168.2	-3.6	2.41
1985	6039.7	6.1	3.53	2006	10643.9	4.7	2.36
1986	6786.0	12.4	3.64	2007	10263.1	-3.6	2.22
1987	6480.9	-4.5	3.33	2008	10410.8	1.4	2.20
1988	5708.4	-11.9	2.93	2009	11139.7	7.0	2.49
1989	6604.9	15.7	3.15	2010	10942.6	-1.8	2.27
1990	7981.0	20.8	3.53	2011	11036.5	0.9	2.03
1991	8204.3	2.8	3.75	2012	11307.3	2.5	2.01
1992	8629.6	5.2	3.87	2013	11612.4	2.7	1.92
1993	9541.1	10.6	3.92	2014	11697.2	0.7	1.87
1994	9328.2	-2.2	4.05	2015	12036.4	2.9	1.81
1995	9583.0	2.7	3.90	2016	14111.9	17.2	2.05
1996	10725.1	11.9	4.14	2017	15146.6	7.3	2.05
1997	11177.8	4.2	4.10	2018	19225.2	26.9	2.52
1998	11712.4	4.8	3.18	2019	20603.4	7.2	2.71
1999	12932.3	10.4	3.89	2020	19567.2	-5.0	2.77
2000	12515.6	-3.2	3.66				

Source: SIPRI (2021)

Table 2 shows that Türkiye's military expenditure increased during the 1980s and 1990s. While military spending decreased during periods of economic crisis, it increased significantly the 1980s, during the years of the war on terrorism. When the Justice and Development Party came to power in 2002, the economic and political stability was achieved, and the successes in the fight against terrorism led to a decline in military spending. However, due to increasing geopolitical risks in the region and security problems on the borders and tensions in various parts of the world following the global crisis, military spending again increased after 2011. The decrease in 2020 is assumed to be due to the shift of public resources to the fight against the pandemic. Although it fluctuates from time to time, military spending share of GDP averages around 3%.

Table 3. *Share of Military Expenditures in Public Expenditures in Türkiye (2000-2020) (%)*

Year	Percentage of Public Expenditure	Year	Percentage of Public Expenditure
2000	9.2	2011	6.1
2001	8.1	2012	5.9
2002	9.2	2013	5.7
2003	8.5	2014	5.7
2004	7.7	2015	5.5
2005	7.4	2016	5.9
2006	6.9	2017	6.1
2007	6.6	2018	7.3
2008	6.4	2019	7.7
2009	6.5	2020	7.5
2010	6.3		

Source: SIPRI, 2021

Table 3 shows the share of military expenditures in total public spending. While this share was about 8.5% at the beginning of the period, a downward trend started in 2004 and continued until 2017, when it averaged about 6% over the period. Since 2017, however, the share of military expenditures in total public spending has increased again.

The total sales and sectoral distribution in the defense industry are shown in Table 4. The total turnover of the defense sector in Türkiye has increased continuously during the period under consideration. The subsector that produces land vehicles for defense accounts for the highest share of the industry, averaging 30%. On the other hand, the air defense industry, is the second-largest subsector with an average share of sales of around 20% in the period under review. It is followed by the naval defense industry. While the civil aviation subsector increased its share of total sales by 2018, it can be seen that this share tends to decrease in the following years, but this is likely due to the pandemic. It can be observed that the share of the other subsectors in total sales has decreased over the years.

Table 4. Sub-sector shares in the Turkish aerospace and defense industry (2013-2020) (%)

Year / Sub-Sector	2013	2014	2015	2016	2017	2018	2019	2020
Land	34	10,21	32,72	28,52	35,29	27,71	32,44	29,06
Naval	14	5,84	9,58	9,03	8,50	10,80	7,94	7,60
Air (military)	3	***23,60	19,23	14,88	16,91	20,1	22,14	22,38
Weapons-Ammunition, Missile				14,14	12,37	10,12	8,88	9,65
Others	***** 8	**** 27,62	** 23,55	* 10,89	*9,71			*5,47
MRO			2,34	3,38	2,55	6,12	5,53	7,18
Security				20,11	0,46	0,95	0,96	3,70
Civil Aviation	0.14		10,17	9,80	9,86	20,66	16,87	14,95
KBRN-P				0,15	0,28	0	0,00	0,02
C5ISR		**** 28,43	0,57	0,70			0,19	0,62
Informatics		4,29	1,83	1,09	0,70	0,72	0,28	1,18
Logistic support				5,61	0,02	1,92	1,44	1,95
Space	0			0,17	0,09	0,25	0,31	0,59
Exchange Earning Services				1,42	1,26	0,65	3,00	1,11
Total Endorsement (Million \$)	5,076	5,101	4,908	5,968	6,693	8,761	10,884	8,856

Source: Defense and Aerospace Industry Manufacturers Association Annual Reports

Note: *Military Factories, **Weapon-Ammunition, Missile Systems, CBRNE, Currency Earning Service, Space, Security, Logistics Support, Military Factories, ***For the year 2014, the air, civil aviation, and space sectors were combined in the report. **** Other (logistics, machine mold, engineering, etc.) for 2014, *****Electronic-Electric (C4ISR) and *****Other: security and service (logistics) sector.

It will be useful to compare the data in Table 5 with Table 6 that shows the expansion of the exported product range and the increase in the volume of exports, Türkiye's export revenues have increased over the years. The sectors that achieved the highest export revenues were land, air, and civil aviation. Although high export volumes were achieved in some years, most of Türkiye's export revenues came from trade with countries other than Europe and America.

Table 5. *Export Revenues of Türkiye for the Period 2014-2019 (Million \$)*

Year	Region	Land	Naval	Aerospace (Military)	Weapons- Ammunition, Missile	Others*	Civil Aviation	MRO	Exchange Earning Services
2014	USA	0	0	***465		***99			
2014	Europe	4	31	***275		***94			
2014	Others	270	91			***472			
2015	USA	18	1	213		**58	285	2	
2015	Europe	25	12	89		**26	169	7	
2015	Others	691	83	53		**176	7	2	
2016	USA	16	3	209	18	0	308	0	22
2016	Europe	46	25	124	6	37	200	6	21
2016	Others	426	75	46	171	120	11	2	42
2017	USA	7	4	262	35	0	313	0	15
2017	Europe	22	34	105	6	16	225	5	51
2017	Others	493	41	26	81	54	4	3	18
2018	USA	0.6	2	481	24	0	183	0	6
2018	Europe	12	38	102	7	11	306	6	40
2018	Others	528	165	110	80	59	9	8	1
2019	USA	174	113	75	13	7	287	8	28
2019	Europe	0.2	6	552	44	0	210	0	9
2019	Others	897	134	144	323	291	115	12	26
Total		3630	858	3331	808	1520	2632	61	279

Source: Defense and Aerospace Industry Manufacturers Association Annual Reports

Tables 6 and 7 show the quantities of defense industry products exported and imported by Türkiye from 1995 to 2021. Although Türkiye has been importing defense tools since its foundation, it started exporting them in the second half of the 1990s. The period shown in the table was chosen to observe the developments in both exports and imports.

The first exports of the Turkish defense industry were made in 1980/81 through the sale of ships abroad. It exported armored vehicles for the first time in 1995 after a long time and since then exports of armored vehicles continued to increase during the period under review. In the late 1990s, Türkiye exported aircraft, armored vehicles, and ships. In 2005, a new export item was added, and Türkiye started to export heavy weapons, and since 2013, missiles and rockets were added to the list. The export of air defense vehicles gained momentum since 2019.

Table 6. Defense Industry Products Exported by Türkiye and Amounts of Exports in the 1995-2021 Period

Year	Aircraft	Armored Vehicles	Heavy Weapons	Guided Missile and Rocket	Sensors	Ships	Others	Total
1995		3						3
1996		3						3
1997		0						0
1998						3		3
1999	20	20				3		43
2000		16				3		19
2001	2					3		5
2002		26						26
2003		42						42
2004		28						28
2005		16	7					23
2006		74	7					82
2007		35	12			19		66
2008		68	14			30		112
2009		43	10			11		65
2010		70	3					72
2011		38	24			24		86
2012		63	52			28		143
2013		58	27	20		51		156
2014		68	17	20		62		168
2015	24	71	9	40		107		252
2016		107	9	7		113	1	237
2017		93		4	8	62	2	169
2018		120		6	16	88	2	231
2019	30	202		6			2	239
2020	11	221	0				1	233
2021	25	113	16	40		186		380
Toplam	112	1599	207	142	24	831	7	2921

Source: <http://www.sipri.org/databases/armstransfers/sources-and-methods/>

The structure of exported products has also changed over the years. In the past, Türkiye sold modernized vehicles to the other countries by purchasing them mostly from abroad. Today, however, the Turkish defense industry has carried out successful projects and has managed to develop defense vehicles that are mostly produced with domestic resources. The use of the newly developed technologies in the counterterrorism operations carried out and the successes achieved by Türkiye have attracted attention at the international level, and interest in the products of the Turkish defense industry has increased.

Table 7. Defense Industry Products Imported by Türkiye and Amounts of Imports in the 1995-2021 Period

Year	Aircraft	Armored Vehicles	Heavy Weapons	Guided Missile and Rocket	Sensors	Ships	Engines	Warship weapons	Air Defense Systems	Satellites	Others	Total
1995	537	162	64	198	122	426	34	22			9	1574
1996	565	1	100	216	146	365	37	25	39			1494
1997	1013	84	100	153	46		24		50		53	1521
1998	982	60	106	258	49	922	37	35	158		29	2636
1999	765	100	6	161	27	411	4	5	158		100	1736
2000	145	58	6	77	52	538	18	35	158		95	1181
2001	117	23		100	46	84	5		135			509
2002	325	43		151	36	204	5		135			900
2003	30	57		83	36	120	5					330
2004	15	62	69	103			8					257
2005		3	104	111	116	544	10	10	198			1095
2006		83	104	42	58	229	10	5				531
2007	3	277	104	69	12	213	15					692
2008	26	269	104	93	25	102	18	5				640
2009	6	365	130	68	37	102	21	5				732
2010	42	59	173	64	25	102	15	5				485
2011	286	56	173	144	74		33	13				780
2012	881	31	173	71	164	160	17	8				1503
2013	276	3	164	85	182		29	53				793
2014	1125	51		94	157		47	50				1524
2015	353	25		22	20		17	3				438
2016	209	6		47			16			50		328
2017	235	6		109	13		38	28				428
2018	315	6		38	30		69	31				488
2019	345	6		168	29		79	3	130			760
2020	37	5		38	3		11					94
2021	201			32	8		30					271
Total	25884	6268	2425	4863	2429	10783	1258	446	2159	50	354	56920

Source: <http://www.sipri.org/databases/armstransfers/sources-and-methods/>

Comparing Tables 6 and 7, it is noticeable that Turkish defense imports include more products than its exports. This is an indication that foreign dependence on the defense industry has not yet ended or declined sufficiently. The products with the highest total value in imports are aircraft, ships, and armored vehicles. In this context, the technologies and vehicles developed by Türkiye to produce armored vehicles and aircraft will reduce import spending for military spending.

Table 8. *Distribution of Türkiye's Defense Vehicles Imports by Region and Sector (million US \$)*

Year	Region	Land	Naval	Aerospace (Military)	Others*	Civil Aviation	MRO
2015	USA, Europe, and Others	422	129	255	22	236	3
2016	USA	103	15	138	48	210	3
2016	Europe	220	101	128	32	134	4
2016	Others	112	12	14	2	10	3
2017	USA	118	28	126	51	209	4
2017	Europe	365	94	110	73	129	5
2017	Others	105	6	58	34	18	11
2018	USA	180	64	348	42	384	5
2018	Europe	447	92	144	106	448	3
2018	Others	112	9	30	13	21	1
2019	USA	107	19	648	60	564	5
2019	Europe	403	161	132	175	564	7
2019	Others	110	23	31	49	25	5
2020	USA	90	16	424	20	370	63
2020	Europe	287	43	125	150	343	21
2020	Others	74	9	75	23	24	4

*Others: KBRN-P, Informatic (Military), C5ISR, Logistic Support, Space, Security, Exchange Earning Services

Türkiye imports defense industry products mainly from the U.S., followed by EU countries. While air defense vehicles are imported from the U.S. to a greater extent, most of the land and sea defense vehicles are imported from European countries.

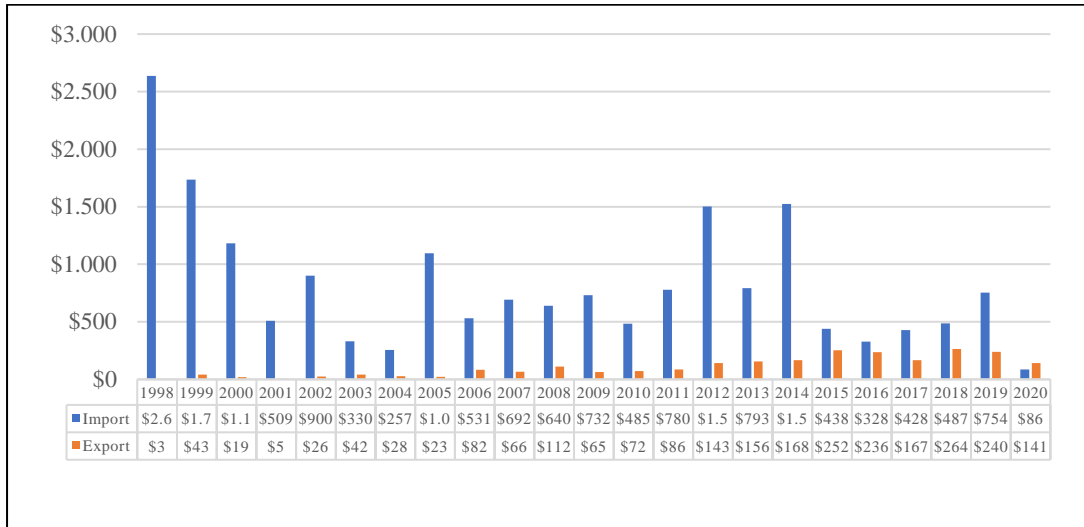


Figure 1. 1998-2020 Türkiye’s aerospace and defense industry export/import indicators (Million \$)

The graph shows the imports and exports of the Turkish defense industry during the period 1998-2020. While at the beginning of the period the imports of the Turkish defense industry were significantly higher than the exports, it can be seen that the imports decreased significantly over the years. In the period following 2014, the decline in defense industry imports was accompanied by an increase in exports. Thus, the sector’s export-import coverage ratio increased, and in 2020, exports exceeded imports creating a trade surplus.

Table 9. Employment Share and Total Employment of the Sector for the 2013-2020 Period

Year	Technician -Operator	Executive	Graduated from a University	Other (expert/ unskilled/ administrative)	Engineer	Total Number of Employed Persons
2013	33%		12%	19%	36%	32.368
2014	30%		23%	12%	35%	31.242
2015	40%	6%	11%	9%	34%	31.375
2016	30%	3%	11%	26%	30%	35.502
2017	37%	2%	11%	20%	31%	44.74
2018	48,3%	0,8%	9,4%	17,6%	23,9%	67.239
2019	48%	2%	10%	16%	25%	73.771
2020	49%	1%	12%	14%	24%	77.566

Looking at the distribution of employees in the defense industry by occupation, we find that the percentage of engineers among employees in the sector has declined. Over the past seven years, the total number of employees has more than doubled. While the number of managers among employees has declined over time, the proportion of university graduates has remained constant.

6. Rewriting the Rules of War: Armed Unmanned Aerial Vehicles

The stagnation that began in the economies of developed countries after the 2008 global financial crisis turned into a global recession within a few years. The fact that the emerging Chinese economy in the East threatens the hegemonic power of the West has led to trade wars and ushered in a new era in international relations. Political tensions, regional

problems, and wars, in addition to the inability to overcome economic problems, have caused a great wave of migration, the emergence of new terrorist groups, and an increase in terrorist attacks.

In this unstable and volatile environment, countries have increased the share of defense expenditures. Due to its location, Türkiye found itself in the midst of chaos between the Middle East and Russia and had to increase its defense expenditures to ensure national security. Due to instability in the region and the increase in terrorist incidents, Türkiye needed to protect its national interests, and conflicts of interest with various countries caused problems in the supply of defense resources from time to time. In this context, initiatives have been launched to increase the production of the high-tech defense industry in Türkiye under the National Technology Program. The main objective of these initiatives is to reduce foreign dependence on the defense industry.

Türkiye's first armed unmanned aerial vehicle (UAV) flight and test firing was conducted on 17 December 2015 using the locally manufactured Bayraktar TB2 tactical UAV. Bayraktar TB2, which has a wingspan of 40 feet and a take-off weight of 1,400 kilograms, and has a range of 150 kilometers. In its test firing from an altitude of 16,000 feet, it accurately hit the target from 5 miles. Moreover, Roketsan modified the missiles, which work on the logic of "oblivion with fire", for the use of TB2 (Gürcan, 2019, p. 241). Later, Turkish armed drones began to be used in counter-terrorism operations and received widespread attention in the world press with their operational superiority and successful launches.

Baykar Tech, the local champion of industrial aviation in recent years, and Turkish Aerospace Industries (TUSAŞ) has developed several highly efficient UAV systems and exported them to many countries. Bayraktar TB-2 has been sold to Ukraine, Qatar, Azerbaijan, Poland, Morocco, Turkmenistan, Ethiopia, and Kyrgyzstan, and negotiations are underway to export to Niger and Albania. Turkish UAVs have been used in Nagorno-Karabakh and Libya and by Ukrainian forces against Russian occupation forces since February 24, 2022 (Nedos, 2022, 6). These drones play a game-changer role in high-risk operations because of their superiority (Kasapoğlu & Kırdemir, 2018, p. 20).

Due to the developments experienced and the increasing foreign demand for Turkish UAVs and UCAVs, the development of UAV and UCAV technologies has been more visible. The export of defense industry products has greatly reduced the foreign dependence on the Turkish defense industry. Early production advantages in unmanned aerial vehicle technologies is taken as a sign that the structure of Türkiye's comparative advantages will improve in the coming years. These developments in the defense industry are expected to have a positive impact on other sectors.

The success of operations with Turkish defense weapons strengthens Türkiye's position in the region and increases its political and military power. Some military experts claim that the successful usage of Turkish UCAVs played an important role in Azerbaijan's victory in Karabakh in 2020.

7. Challenges for the Aerospace and Defense Industry

In the international economic division of labor, economic, technological, and political difficulties can arise when seeking to produce cutting-edge technology. The aerospace and defense industries are knowledge-intensive and high-tech industry, and these technologies must be kept confidential and their transfer is impossible. The transfer of such critical technologies is usually subject to the control and approval of states.

Defense systems always use the most advanced cutting-edge technologies, and the secrecy of these technologies is essential, making their disclosure impossible. The transfer of critical technologies often depends on government control and approval. And even if the sharing of some relatively obsolete technologies were allowed, the use of these technologies would be inconvenient as it would not comply with data protection regulations. For this reason, at least the “necessary” and “critical” defense systems must use nationally produced technologies.

Those who first produce new technologies in defense industry had been reluctant to share the knowledge about the new product, want to become the first exporters of the commodities and dominate the world markets. In countries where national technology transfer started late, the industry that produces new products must be protected. Otherwise, it is difficult for them to compete with their rivals in the international arena (Ziylan, 2003, p. 1).

Countries with knowledge intensive defense technology ensure the security of the country, thanks to the deterrent effect of this technology. Success in the production of defense vehicles gives the country a new impetus not only in terms of security but also in terms of politics and economy. When the country becomes an exporter of these products by investing in the defense industry, the burden that the country’s defense expenditure places on the economy is transferred to importing countries, paving the way for the development of new technologies in the sector (Temiz, 2012, p. 2).

8. Conclusion

Türkiye’s geographical location brings many advantages, but also geopolitical risks. During the cold war period, Türkiye was a frontline country in the bipolar world. In addition, there is the uncertainty that comes from bordering middle eastern countries that have been far from stability and peace for many years. The issue of security has always been high on Türkiye’s agenda, both because of the growing geopolitical risks in the post-cold war era, and because of the terror that feeds them.

The Turkish aerospace and defense industry is one of the three sectors identified as strategic sectors in the 11th Development Plan. Initiatives in the Turkish defense industry led to developments in other sectors. The widespread use of new technologies in other industries serves economic development on the one hand and helps to close the foreign trade deficit on the other.

The contribution of new investments in the defense industry to the development of the country’s human capital is undeniable. It contributes to the formation of a better equipped human capital, especially with its training programs, internships, and employment opportunities for young people. New technologies can only be developed by well-trained human capital. Moreover, investment in this sector increases employment.

Due to the civil war and instability in the region, Türkiye has made intensive efforts to ensure its national security over the past 10 years. In this process, priority has been given to support investments in the aerospace and defense industry and related private sector initiatives under the National Technology Initiative for developing products needed especially for the defense industry. Looking at the developments in the aerospace and defense industry, it is observed that the defense industry is adding value, creating jobs, leading to innovation, and serving the country with the synergies it creates. The momentum gained in the aerospace and defense industry and the success story achieved serve as a source of inspiration for other industries as well.

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