INTERNATIONAL JOURNAL OF ECONOMICS AND FINANCE STUDIES
Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221
Received: 11.01.2025 | **Accepted:** 15.03.2025 | **Published Online:** 30.05.2025

-RESEARCH ARTICLE-

THE IMPACT OF TURKISH MILITARY TECHNOLOGICAL ADVANCEMENT ON PRODUCTION AND PRODUCTIVITY GROWTH (2000–2024)

Ali Mahdi Abbas Al-Bairmani*

Economic Department, Faculty of Administration and Economics, Mustansiriya University, Baghdad, Iraq.
ORCID: https://orcid.org/0000-0002-4955-8297
Email: dr_amaal@uomustansiriyah.edu.iq

Ammar Majeed Kadhim

Economic Department, Faculty of Administration and Economics, Mustansiriya University, Baghdad, Iraq.
ORCID: https://orcid.org/0009-0006-5256-2306
Email: Amar_ad@uomustansiriyah.edu.iq

Ahmed Ayad Ibrahim

Economic Department, Faculty of Administration and Economics, Mustansiriya University, Baghdad, Iraq.
ORCID: https://orcid.org/0000-0002-3602-3031
Email: mahmadayad1980@uomustansiriuah.edu.iq

Corresponding Author email:
dr_amaal@uomustansiriyah.edu.iq

—Abstract—

Military and defence industries play a pivotal role in reducing dependency on foreign technologies, weaponry, and equipment, positioning them as key drivers in the development and modernisation of national armed forces. These industries serve as a foundational element for ensuring national stability. Consequently, numerous countries have initiated efforts to establish military sectors capable of supplying comprehensive military technologies across diverse domains, aiming to strengthen their forces while optimising defence expenditure and attaining self-sufficiency in

Citation (APA): Al-Bairmani, A. M. A., Kadhim, A. M., Ibrahim, A. A. (2025). The Impact of Turkish Military Technological Advancement on Production and Productivity Growth (2000–2024). *International Journal of Economics and Finance Studies*, 17(02), 434-458. doi: 10.34109/ijefs.2025170221

armament provision. In pursuit of national defence objectives, armed forces stimulate the growth of domestic military industries by establishing industrial institutions designed to foster sectoral development. These entities are responsible not only for supplying the armed forces but also for transferring military technologies to civilian sectors within the national economy. Furthermore, they engage in the production of military goods for export to regional neighbours and global markets, thereby enhancing competitiveness in the international arms industry. The expansion and production of military industries are also strategic measures to curtail import reliance. Research indicates that disembodied technological progress positively influences production growth and is associated with an increase in research and development expenditures relative to GDP. Similarly, embodied technological progress contributes to production growth, albeit with a capital-biased effect that enhances labour productivity. In addition, the growth in exports of commodities, defence products, and advanced technologies represents a significant source of revenue and resource mobilisation, thereby contributing substantially to GDP expansion and serving as an important indicator of economic and social advancement. Within the Turkish context, the defence sector emerges as a principal contributor to economic performance. Accordingly, it is recommended that Turkey maintain its policy of developing the military industry, utilising it as a deterrent, an investment asset, and a vehicle for the advancement of both embodied and disembodied technologies, ultimately supporting broader objectives of economic growth and development.

Keywords: Military Industry, Military Industry, Technological Advancement.

INTRODUCTION

Military and defence industries play an essential role in achieving national military autonomy, serving as primary drivers in the development of armed forces by minimising dependence on foreign sources for technology, weaponry, and equipment. They represent a fundamental component for sustaining national stability. Consequently, numerous countries have initiated the establishment of military industries capable of supplying a full spectrum of military technologies across diverse sectors, thereby enhancing military capabilities while optimising defence expenditures and fostering self-sufficiency in armament provision (Liu et al., 2023; Ortiz-Bobea et al., 2021). In line with this objective, national armed forces promote the development of domestic military industries through the creation of industrial institutions that support sectoral expansion and technological advancement. These institutions are responsible for meeting the operational needs of the armed forces, facilitating the transfer of military technologies to civilian sectors of the national economy, and producing military goods for export both regionally and internationally, enhancing their competitiveness within the global arms market. Furthermore, the establishment

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

and growth of military industries are regarded as strategic measures to decrease import dependency (Bove et al., 2018).

The present study focuses on analysing the military industry in the Republic of Turkey and its influence on the transfer of military technology to civilian economic sectors, as well as its overall contribution to national economic growth and development. Additionally, the research aims to assess the impact of technological advancements within the Turkish military sector on production and productivity growth over the period 2000–2024.

Research Problem

The study examines the debate surrounding the role of technology within the Turkish military industry, questioning whether it imposes a burden on national budgets and constrains economic growth, or whether it can be effectively transferred to other sectors, thereby fostering broader economic development and contributing to overall growth.

Research Hypothesis

The technology employed in the Turkish military industry has played a fundamental and leading role in steering other economic sectors and in driving growth, development, and progress. Since military commodities must continuously evolve to remain competitive in regional and global markets, this requires dedicating efforts to research and development. Such efforts not only enhance the competitiveness of military products but also contribute to the development of other civilian industries within the national economy through the transfer of the same technologies, in addition to reducing import costs.

THEORETICAL FRAMEWORK ON THE MILITARY INDUSTRY IN THE WORLD

The Military Industry and the Military-Industrial Complex

The term “Military-Industrial Complex” initially emerged among the ruling elites in the United States before gaining wider recognition in other Western nations, and it is regarded as one of the most influential lobbying entities shaping U.S. foreign policy (Flayyih & Khiari, 2023; Wang et al., 2019). The concept originates from the work of sociologist and political theorist C. Wright Mills, who argued that following the conclusion of World War II, the United States had been dominated by what he described as “the national coalition between industrialists and the military.” This notion subsequently played a crucial role in the advancement of strategic industries and in driving capitalist economic growth to a higher stage, accompanied by significant societal transformations. The expression “Military-Industrial Complex” was formally introduced in President Dwight Eisenhower's farewell address on 18 January 1961, wherein he highlighted, "The conjunction of an immense military establishment and a large arms industry is new in the American experience. The total influence, economic, political, even spiritual, is felt in every city, every Statehouse, every office of the Federal government. We must not fail to comprehend its grave implications. In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex" (Blut, 2021; Sveikauskas et al., 2018).

In general terms, the Military-Industrial Complex denotes an alliance between the state's military apparatus, political institutions including the executive and legislative branches, and industrial and commercial enterprises involved in sectors such as arms and oil production. Nevertheless, the existence of a capitalist economy is not a prerequisite for such a complex. This was exemplified in the former Soviet Union, where the complex was deeply institutionalised, given that commerce functioned effectively as a governmental branch. In contrast, the American model comprises a network linking the Department of Defence, selected congressional interest groups, arms manufacturing corporations, and academic institutions (Foster et al., 2019; Sveikauskas et al., 2018). One immediate consequence of World War II was the establishment of a precedent in which senior military officers assumed extensive political and administrative responsibilities.

For instance, General Douglas MacArthur exercised near-absolute authority while administering post-war Japan. Similarly, numerous officers served as ambassadors or occupied key positions within the State Department, their authority often exceeding the conventional capacities of civil administration and backed by substantial financial resources (Andersen et al., 2018; Niu et al., 2021). In this context, President Eisenhower cautioned against the emergence of the Military-Industrial Complex as a powerful entity capable of wielding moral, political, and operational influence over American governance. He noted that technological advancements had amplified their capacity to control administrative programmes and budgetary allocations, while their considerable financial resources enabled them to exert influence over academic and scientific institutions (Sveikauskas et al., 2018). Eisenhower further emphasised the potential threat to democratic governance posed by this nexus, observing that "There exists an industrial, military, financial, political, and intellectual complex that exercises an unprecedented influence in the American experience." His assessment occurred during the early development of the complex; however, contemporary analysis raises the question of its current magnitude, given the proliferation of American arms manufacturers, the expansion of their operations, the geographic dispersion of their headquarters, and their increased reliance on research and development centres to enhance capabilities and shape strategic decision-making within the U.S. state (Thijeel et al., 2024).

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

The Military Industry as an Investment Commodity

The economic crisis that disrupted U.S. financial markets in 2007–2008 had widespread effects across various sectors of the American economy. Notably, the arms industry, as a key pillar of capitalist enterprise, emerged as a stabilising force during this period of turmoil. The military-industrial sector is recognised as one of the principal financiers of the U.S. economy, with its continued growth mitigating the risk of rapid economic collapse and providing opportunities to reorganise and rejuvenate other sectors, thereby facilitating recovery from the crisis. The United States has historically leveraged military expenditure to generate economic returns through the sale of arms, a trade that expands in response to rising global conflicts (Agatón Lombera et al., 2024; Kakran et al., 2023). In 2023, the United States and China remained the leading military spenders worldwide. U.S. defence expenditure reached approximately $916 billion, while China's military budget, despite continuous growth for 29 consecutive years—the longest uninterrupted increase recorded by any country—remained around $296 billion, less than one-third of U.S. spending, according to the Stockholm International Peace Research Institute (SIPRI) database. Despite China's sustained increase, the United States maintained its dominance in the global arms export market, controlling 42% of worldwide arms exports in 2023, compared with China's 5.8%, the majority of which (61%) were directed to Pakistan (Robertson, 2024).

The U.S. arms sector has undergone substantial expansion, extending beyond conventional warfare equipment to encompass advanced weaponry, military services, emerging technologies, and communications and information systems. Currently, arms manufacturing and military production account for approximately 40% of total U.S. industrial output. Historically, since 1950, the United States and the Soviet Union (prior to 1992) have been the principal global arms suppliers. In the period 2018–2022, the United States consolidated its position as the leading arms exporter, further widening the gap with Russia. During this interval, U.S. arms exports increased by 14%, raising its share of the global market from 33% to 40%, whereas Russia's exports declined by 31%, with its market share falling from 22% to 16% (Fravel et al., 2024).

A Review of Major Military Companies Worldwide

According to a report published by the SIPRI, total revenues from arms sales and military services generated by the world's top 100 companies reached $597 billion in 2022, as detailed in the institute's annual assessment of the military industries. As presented in Table (1), the list of the largest arms-producing companies by sales in 2021 was predominantly composed of U.S. firms, with Lockheed Martin, Raytheon Technologies, and Boeing occupying the leading positions. Among the ten largest arms manufacturers globally in 2021, five were American companies, followed by one

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

British firm and four Chinese enterprises (Inal et al., 2024). Lockheed Martin, an American corporation, maintained the top rank among global arms producers, despite experiencing a marginal 0.6% decline in sales compared with 2020, amounting to $60.34 billion in revenue. Overall, U.S. companies continue to dominate the ranking of the world's top 100 arms-producing firms. Nevertheless, the aggregate sales of the 40 U.S.-based companies included in the list decreased to $299 billion.

Table 1: The World's Largest Arms-Producing Companies by Sales in 2021

No	Company	Country	Sales ($)
1	Lockheed Martin	US	60.34
2	Raytheon Technologies	US	41.85
3	Boeing Defence, Space & Security	US	33.42
4	Northrop Grumman	US	29.88
5	General Dynamics	US	26.39
6	BAE Systems	US	26.02
7	NORINCO (China North Industries Corporation)	China	21.57
8	AVIC (Aviation Industry Corporation of China)	China	20.11
9	CASC (China Aerospace Science and Technology Corporation)	China	19.10
10	CATC (China Aerospace Times Electronics Corporation(	China	14.99

Source: Largest Arms-Producing Companies in the World.

An Overview of the Development of the Turkish Economy and Military Industry

The era of former Turkish Prime Minister Turgut Özal witnessed considerable transformation in Turkey's defence industry. The establishment of the Undersecretariat for Defence Industries (SAGEB) enabled civilian authorities to participate in defence production decisions for the first time in several decades. During this period, Turkish investors founded new defence companies, and existing firms expanded into the defence sector. Foreign investment and partnerships were actively promoted, with licensed production becoming particularly significant due to Turkey's strong ties with NATO countries and their investments in the nation (Akbaş & Canikli, 2018; Besenyo & Málnássy, 2022). Notable projects of this period included the assembly of F-16 fighter jets within Turkey (Málnássy, 2022), alongside a gradual increase in the proportion of locally manufactured components. Other major undertakings involved the production of armoured combat vehicles, light transport aircraft, basic trainer aircraft, and Cougar helicopters, manufactured domestically with foreign assistance under licensing agreements. By the late 1990s, defence projects in Turkey had become increasingly complex and diverse, establishing the foundation for a modern environment for domestic defence companies.

From the mid-2000s, the Turkish defence industry began delegating large and complex projects to private enterprises, although many of these initiatives experienced delays or cancellations. During this period, the defence sector launched major projects aimed at shaping the future and demonstrating its capacity to supply and equip the

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

Turkish Armed Forces, including Milgem, Atak, TCG Anadolu, Altay, and Anka. Among these, the Atak, Altay, and TCG Anadolu projects were developed based on foreign designs under licence, while Anka was inspired by Israeli UAV designs in operation within Turkey at the time. In contrast, the Milgem project was designed entirely by Turkish naval officers (Egeli, 2019). These projects represented highly complex "integrated system networks," with contractor companies assuming increasingly prominent roles. The expanding defence industry also encouraged numerous small- and medium-sized enterprises (SMEs) to invest, with OSTIM emerging as a key hub. During these years, the hierarchical structure of the contemporary Turkish defence industry began to take shape, with ASELSAN at the top, followed by state-owned and private institutions such as TAI, Baykar, Otokar, BMC, Roketsan, and the Undersecretariat for Defence Industries (SSM) (Demir, 2020).

On 15 July 2016, a failed coup attempt precipitated profound changes in Turkey's politics, economy, foreign relations, and defence sector. Following this turning point, the Turkish defence industry successfully completed complex and ambitious projects, many of which were central to the nation's military strategy (Orhangazi & Yeldan, 2021). For instance, the Milgem project progressed into its second phase with the construction of first-class frigates. The Altay main battle tank entered serial production, with its latest variants employing engines designed and manufactured by Turkish engineers. Similarly, TCG Anadolu began sea trials in 2021 and entered service in 2022, while Anka became regularly deployed in foreign operations and internal security missions. Among these developments, UAVs proved to be the most significant. The Bayraktar drone has emerged as one of Turkey's most distinctive defence assets, and the defence industry increasingly focused on producing subsystems. Turkish-made equipment, including munitions and support systems, is now used extensively, and the export of Bayraktar drones entails the simultaneous export of hundreds of MAM-L bombs. Armoured vehicles produced by BMC, FNSS, Otokar, or Katmerciler similarly incorporate locally developed subsystems, particularly from ASELSAN (Altınörs & Akçay, 2022).

In 2002, Turkey had only 56 defence companies, while over 1,500 firms were involved in the sector, employing 75,000 personnel, according to the Presidency of Defence Industries (Seren, 2021). By 2022, the number of defence companies had grown to nearly 3,000, employing more than 80,000 individuals. The scale of coordinated projects exceeded 800, with a total value approaching $90 billion, while sectoral sales surpassed $21 billion. Over the past decades, the Turkish defence and technology sector has advanced considerably, transitioning from reliance solely on consumer and domestic goods exports to military and defence products (Newman et al., 2015). President Recep Tayyip Erdoğan highlighted that Turkey's dependence on imported military equipment decreased from 80% in 2002 to 54% in 2022. In 2018, exports of defence industry products reached $258.916 million, and according to

Vol: 17 No: 02 Year: 2025 ISSN: 1309-8055 (Online) (pp. 434-458) Doi: 10.34109/ijefs.2025170221

former Prime Minister Binali Yıldırım, investments in the defence sector over the preceding 15 years exceeded $35 billion, with exports surpassing $2 billion and 65% of Turkey's military needs produced domestically (Seren, 2021; Yılmaz & Yorulmaz, 2023). In 2023, Turkey publicly announced more than 140 military deals, including sales contracts, partnerships, and cooperation agreements in defence production, imports, and exports. Key characteristics of the Turkish military industry in 2023 can be summarised as follows (Baysal, 2025; Erdinçler, 2019; Kurç et al., 2025):

I. Meeting the requirements of the Turkish Armed Forces: The Turkish military continues to be the primary beneficiary of domestic defence production.
II. Developing the Unmanned Aerial Vehicle (UAV) System: In 2023, Turkey's defence industry became increasingly focused on UAVs, which now represent the primary type of weapon in international defence deals.
III. Increasing Turkish Arms Sales: The global arms market remains strategically significant economically, politically, and in terms of security. In 2023, Turkey achieved approximately $5.5 billion in arms sales, up from $4.4 billion in 2022.
IV. Encouraging Civilian Industrial Institutions to Enter the Defence Industry: In 2023, Turkey actively integrated private sector participation in military production, fostering collaboration between technology-oriented institutions and defence manufacturers.

The Human Development Index (HDI) for Turkey in 2023 was 0.853, categorising the country as having very high human development and ranking 51st out of 193 countries and regions. Between 1990 and 2023, Turkey's HDI increased from 0.598 to 0.853, representing a 42.6% improvement. The HDI is a composite measure evaluating long-term progress across three dimensions: life expectancy, access to knowledge, and a decent standard of living (UNDP).

Unaccounted Technological Progress and Turkish Production Growth (2000–2024)

Cobb-Douglas Function

The Cobb–Douglas production function represents one of the most frequently employed production functions in empirical research. It derives its name from the economists Charles W. Cobb and Paul H. Douglas, who initially applied this functional form in 1928 to examine the performance of the American manufacturing sector. The functional relationship is expressed as:

$$Y = A\ L\alpha\ K\beta$$

Where:

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

- (A): A Constant Related to Units of Measurement, Representing the Technical Efficiency Coefficient.
- α: Output Elasticity with Respect to Labour
- β: Output Elasticity with Respect to Capital

Measuring Technological Progress Using Tinbergen's Approach

A notable advancement in the development of the Cobb–Douglas production function was introduced by the Dutch economist Jan Tinbergen, who incorporated a third variable, time (t), alongside labour and capital. This extension aimed to account for disembodied technological progress, which does not possess a physical form but represents knowledge concerning the application, enhancement, and development of embodied technology. Disembodied technological progress also includes the translation of innovative scientific research into practical and beneficial applications within economic and social activities. Consequently, this form of technological advancement is closely linked to investments in education, research, and development (R&D), with a functional relationship existing between the rate of technological progress and total R&D expenditure. By contrast, embodied technological progress is realised through the direct application of production factors, such as more skilled and educated labour or technologically advanced capital, which contribute directly to increased output. To capture the effects of previously unaccounted technological progress, Tinbergen expanded the Cobb–Douglas production function by including time as a third variable. The resulting Tinbergen production function is expressed as:

$$Y = A L\alpha K\beta ert$$

Where:

- Y : Gross Domestic Product (GDP) in Current U.S. Dollars
- L : Total Labour Force
- K : Total Gross Fixed Capital Formation (In Current U.S. Dollars)
- e : Natural Logarithm Base
- rt : Time Coefficient Representing the General Trend Over Time, or the Effect of Unaccounted Technological Progress

This modification represents a notable advancement in the Cobb-Douglas production function, as introduced by the Dutch economist Jan Tinbergen, by incorporating the time variable (t) alongside labour and capital to capture disembodied technological progress. For the purpose of estimating the function, it is transformed into a linearised form suitable for statistical analysis. This transformation is achieved by applying the natural logarithm to the function, using the base 'e' (approximately 2.71828). The regression results of this model, estimated for the period 2000–2024, are presented in Table (2).

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

Tinbergen Function (Log-Linear Form):

$$\text{Ln } Y = \text{Ln } A + \alpha \text{ Ln } L + \beta \text{ Ln } K + rt \text{ Ln } e + U$$

Table 2: Regression Results of the R&D Expenditure–GDP Model (2000–2024)

D.W	F	$\bar{R}^2$	R^2	Rt	B	A	Period
1.060	704.064	0.989	0.990	0.059 (1.474)	0.731 (17.642)	-0.094 (-0.729)	(2000-2024) t

Source: SPSS program outputs.

Following the estimation of the function for the period 2000–2024, standard statistical tests confirm the robustness of the model. The F-test indicates that the model is statistically significant, while the R^2 and adjusted R^2 values demonstrate strong explanatory power. Furthermore, the Durbin-Watson (D.W.) test confirms that the model is free from autocorrelation issues. The labour coefficient (α), which reflects output elasticity with respect to labour, was estimated at -0.094. According to the t-test, this coefficient is not statistically significant, and its negative value suggests that labour exerts a minor negative impact on output, though this effect is negligible due to the lack of statistical significance. In contrast, the capital coefficient (β), representing output elasticity with respect to capital, was calculated at 0.731 and is statistically significant at the 5% level. The positive sign indicates that a 1% increase in capital, holding other variables constant, results in a 73.1% increase in output, implying that technological progress has been capital-biased, indirectly supporting the contribution of labour. The technological coefficient (rt), which captures unaccounted technological progress, was estimated at 0.059 and is statistically significant at the 10% level. Its positive sign indicates that disembodied technological progress exerts a beneficial effect on output growth; specifically, a 1% increase in technology, holding other variables constant, translates into a 5.9% increase in output.

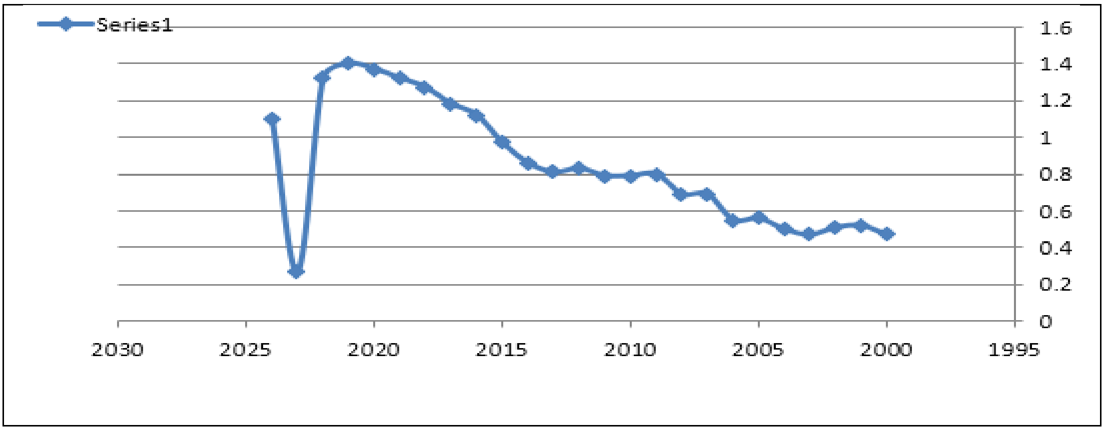

Figure 1: Evolution of Research and Development Expenditure as a Percentage of GDP (%)

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

Source: Prepared by the researcher based on Table (4); estimations were performed using Excel statistical software.

These results are consistent with the trends presented in Figure (1), which illustrate a rise in the proportion of R&D expenditure relative to GDP—from 0.47% in 2000 to 1.1% in 2024—peaking at 1.4% in 2021, thereby providing an indicator of disembodied technological advancement.

EMBODIED TECHNOLOGY AND PRODUCTIVITY GROWTH IN TURKEY

The capital-to-labour ratio (K/L), defined as the proportion of total fixed assets per worker at current prices, is employed as an indicator of embodied technological progress. This ratio reflects the amount of fixed capital available to each worker and can serve as a proxy for technological advancement. An increase in the K/L ratio indicates that more capital is allocated per worker, which may signify the adoption of more advanced technologies or the utilisation of more productive machinery.

To Clarify:

- Capital (K): Denotes the Total Fixed Assets at Current Prices, Including Machinery, Equipment, and Buildings.
- Labour (L): Refers to the Number of Workers or Employees in the Enterprise.
- K/L: Represents the Quantity of Capital Available Per Worker.

Consequently, the capital-to-labour ratio functions as an indicator of technological progress. A rise in K/L implies that each worker has access to a greater amount of machinery and equipment, potentially enhancing productivity and operational efficiency. An increase in this ratio suggests that the enterprise is investing in newer, more sophisticated technologies, thereby improving productivity and conferring a competitive advantage. It may also reflect higher degrees of automation, wherein machinery substitutes for labour in certain tasks. For example, if a company employs 100 workers and possesses fixed assets valued at 1,000,000 units, then:

$$K/L = 10{,}000$$

If the company subsequently invests in additional machinery, raising fixed assets to 1,500,000 units, then:

$$K/L = 15{,}000$$

This increment indicates greater capital available per worker, signalling potential technological advancement. Nevertheless, while K/L is a useful indicator, it is neither precise nor exhaustive, as other factors such as labour quality and managerial efficiency also influence productivity. In certain cases, a higher K/L may be

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

inefficient if, for instance, expensive machinery is procured but does not lead to productivity gains. Hence, the K/L ratio should be evaluated in conjunction with other determinants to obtain a comprehensive assessment of technological progress. Economists Harrod and Domar, in their growth theory, addressed the challenge of sustaining economic growth without recurrent recessions. They posited that economic expansion fundamentally relies on increasing capital proportionally with labour growth and technological improvements that enhance labour productivity, while assuming no substitution between production factors.

Solow later critiqued this assumption, employing a Cobb–Douglas production function in his economic growth model, which allows for substitution between capital and labour. Solow demonstrated that with technological progress, conceptualised as a steady, exogenous enhancement of labour productivity, the marginal productivity of capital does not necessarily diminish as K/L rises. Instead, improvements in labour productivity contribute to the accumulation of skilled workers. Even in the presence of a constant population, the capital stock grows proportionally with the skilled labour force over the long term. Solow's framework thus highlights the feasibility of substituting capital for labour due to rapid industrial advancement and the deployment of computers and robotics, enabling sophisticated machinery to replace human labour efficiently. An increase or maintenance of capital concurrent with a reduction in labour indicates technological innovations and improvements that allow production to be sustained with fewer workers. The effect of this embodied technological progress on average productivity growth is measured using output per worker (Y/L), representing GDP per worker at current prices. Based on the Cobb–Douglas function (1), this function is linearised for statistical estimation by applying the natural logarithm. The regression results for the period 2000–2024 are presented in Table (3).

$$\text{Function (4):}\quad Ln\frac{Y}{L} = Ln\ a + B\ Ln\ \frac{K}{L} + \text{U}$$

Table 3: Statistical Results of R&D Expenditure Share in GDP (2000–2024)

D.W	F	$\bar{R}^2$	R^2	B	A	Period
1.27	1003.610	0.977	0.978	0.740 (31.680)	3.591 (17.591)	(2000-2024) t

Source: SPSS program outputs.

Following the estimation of the function for the period 2000–2024, standard statistical tests confirm the robustness of the model. The F-test demonstrates that the model is statistically significant, while the R^2 and adjusted R^2 values indicate strong explanatory capacity. In addition, the Durbin-Watson (D.W.) test verifies that the model is free from autocorrelation concerns. The detailed statistical results are reported in Table (6) and summarised in Table (3). The coefficient representing embodied technological progress, captured by the logarithm of the capital-to-labour ratio (β), was estimated at 0.740. This coefficient is statistically significant according to the t-test, and its positive value indicates a substantial positive impact on the logarithm of average labour productivity. In practical terms, this implies that embodied technological progress contributes positively to output growth: a 1% increase in embodied technological advancement, holding other factors constant, is associated with a 74% increase in average labour productivity. This finding suggests that technological progress has been capital-biased, effectively supporting and enhancing labour productivity.

EXPORTS AND GDP GROWTH IN TURKEY (2000–2024)

Evolution of the Value of Turkish Commodity Exports (2000–2024)

Table (4), along with Figure (2) and Figure (3), presents the trajectory of Turkish commodity export values over the observed period.

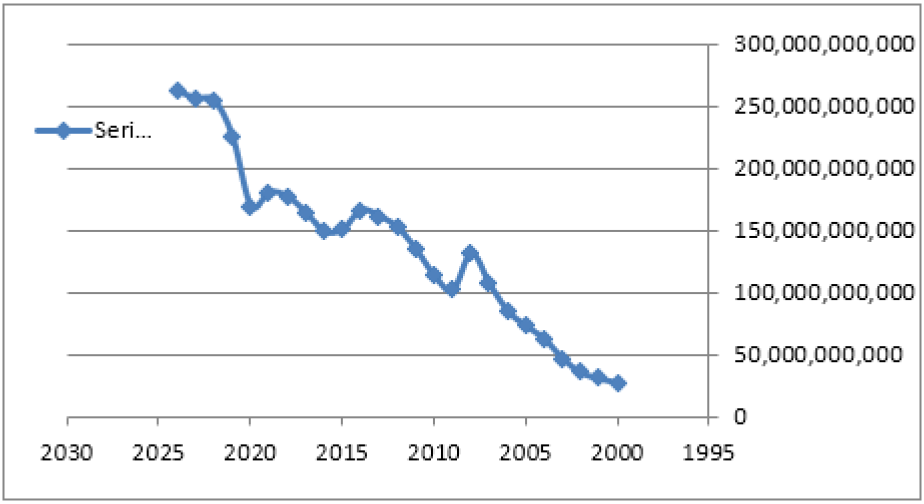

Figure 2: Evolution of Commodity Exports at Current US Dollar Prices
Source: Prepared by the researcher.

In 2008, exports reached USD 132,027,000,000, followed by a decline in 2009 to USD 102,027,000,000, corresponding to a negative growth rate of -0.23%. Thereafter, exports experienced a sustained increase, attaining USD 150,982,000,000 in 2015, before registering a minor decrease in 2016 to USD 149,247,000,000, reflecting a negative growth rate of -0.01%. Following this period, exports resumed their upward trajectory, ultimately reaching USD 261,855,000,000 by 2024, as shown in Table (7).

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

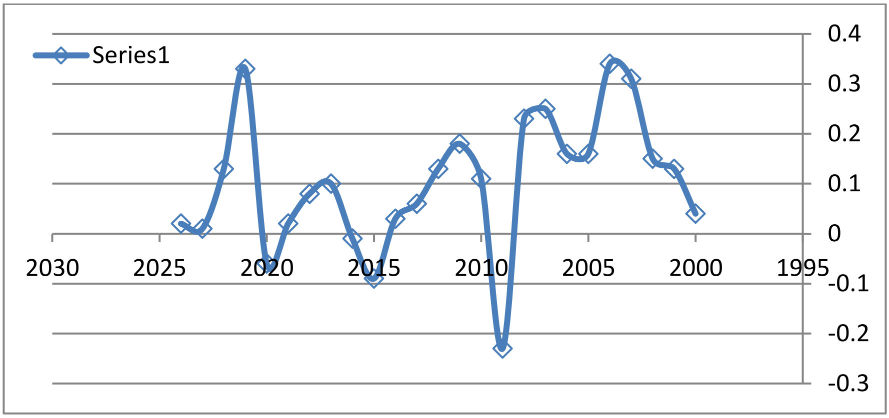

Figure 3: Annual Growth Rates of Commodity Exports (%)
Source: Prepared by the researcher.

Evolution of the Value of Turkish Advanced Technology Exports (2007–2024)

Table (4), along with Figures (4) and (5), depicts the progression of Turkish advanced technology export values over the period under consideration. In 2014, exports reached USD 4,293,034,117, before declining in 2015 to USD 3,872,189,201, corresponding to a negative growth rate of -10.87%. A further reduction was observed in 2016, with exports falling to USD 3,421,690,692, reflecting a negative growth rate of -13.17%. Thereafter, export values began to recover, increasing to USD 4,069,123,083 in 2017 and continuing their upward trajectory to reach USD 9,903,398,645 by 2024.

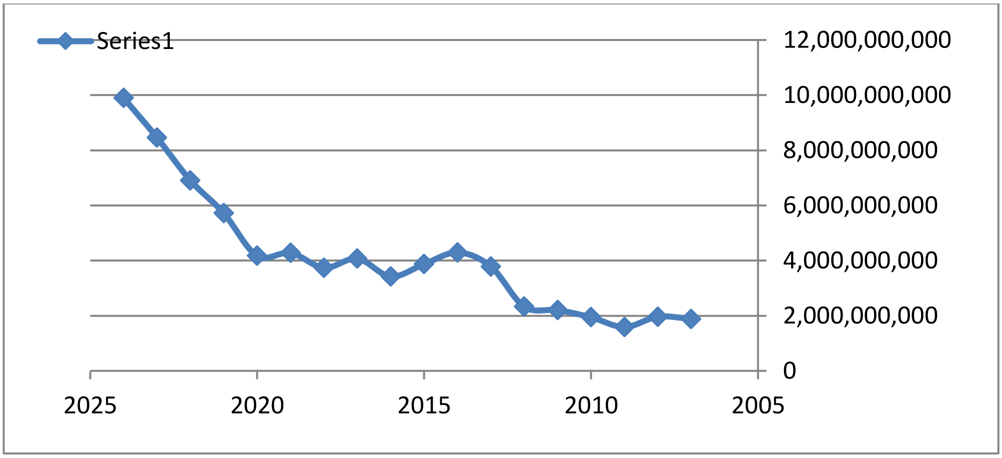

Figure 4: Evolution of Advanced Technology Exports (at Current US Dollar Prices)
Source: Prepared by the researcher.

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

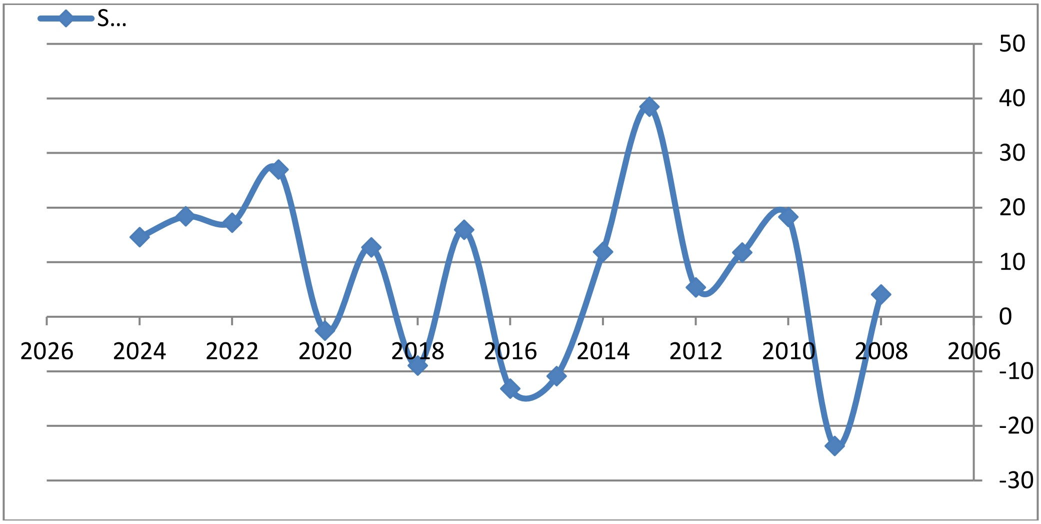

Figure 5: Annual Growth Rates of Advanced Technology Exports (%).
Source: Prepared by the researcher.

Evolution of the Value of Turkish Defence Industry Exports (2002–2024)

Table (4), together with Figures (6) and (7), illustrates the trajectory of Turkish advanced defence industry export values over the analysed period. In 2003, exports amounted to USD 331,000,000, before declining in 2004 to USD 196,000,000, corresponding to a negative growth rate of -68.88%. A further decrease was observed in 2017, with exports reaching USD 1,824,000,000, reflecting a negative growth rate of -7.07%. Exports subsequently increased in 2018 to USD 2,588,916,000, followed by another decline in 2020 to USD 2,265,000,000, with a negative growth rate of -35.45%. Thereafter, export values resumed an upward trend, culminating at USD 7,154,000,000 in 2024. The growth rates associated with these fluctuations are detailed in Table (7).

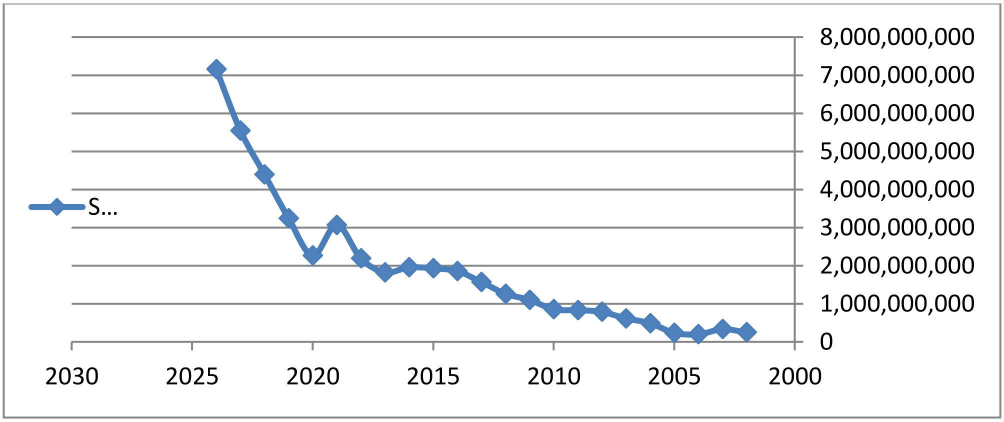

Figure 6: Evolution of Defence Industry Exports (At Current US Dollar Prices)
Source: Prepared by the researcher.

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

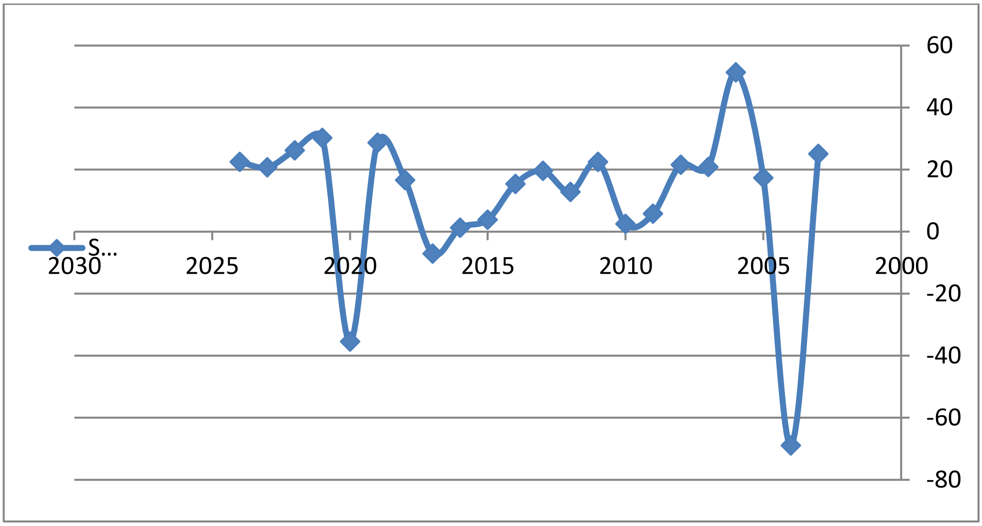

Figure 7: Evolution of Annual Growth Rates of Defence Industry Exports (%)
Source: Prepared by the researcher.

Evolution of Turkish Gross Domestic Product (GDP) for the Period 2002–2024

Table (4), together with Figure (8) and Figure (9), presents the evolution of Turkey's GDP over the examined period. In 2000, GDP stood at $270,293,000,000, before declining in 2001 to $196,753,000,000, corresponding to a negative growth rate of -27.21%. GDP subsequently increased over the following years, prior to experiencing a decline in 2009 to $641,634,000,000, reflecting a negative growth rate of -15.89%. The economy expanded during the subsequent four years, followed by reductions in 2014 and 2015, when GDP reached $930,730,000,000 and $854,631,000,000, with negative growth rates of -1.94% and -8.18%, respectively.

Table 4: Evolution of the Value of Selected Economic Variables in Turkey at Current Prices for the Period 2000–2024 (In US Dollars)

Years	GDP	Gross Fixed Capital Formation (GFCF)	Commodity Exports	Total Workforce	Exports of Advanced Technologies	Exports of Defense Industries
2000	270293000000	60924544200	27775000000	22804910		
2001	196753000000	36215311263	31334000000	23207086		
2002	235695000000	46787775821	36059000000	23537756		248000000
2003	309039000000	65052513151	47253000000	23365651		331000000
2004	403256000000	102945000000	63167000000	22775376		196000000
2005	500945000000	133720000000	73476000000	23212611		237000000
2006	551090000000	158604000000	85535000000	23497202		487000000
2007	675043000000	190004000000	107272000000	23635212	1883247744	615000000
2008	762846000000	205336000000	132027000000	24405474	1963946211	784000000
2009	641634000000	144333000000	102143000000	25413653	1587951755	832000000

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

2010	770447000000	191409000000	113883000000	26452690	1943401874	853000000
2011	831535000000	232713000000	134907000000	27575358	2202177883	1100000000
2012	873968000000	238264000000	152462000000	28126488	2327323000	1262000000
2013	949179000000	271502000000	161481000000	29149709	3782775017	1570000000
2014	930730000000	269904000000	166505000000	29521920	4293034117	1855000000
2015	854631000000	255444000000	150982000000	30550902	3872189201	1929000000
2016	860503000000	253149000000	149247000000	31514194	3421690692	1953000000
2017	848258000000	256469000000	164495000000	32535361	4069123083	1824000000
2018	767898000000	231876000000	177169000000	33302540	3735743019	2588916000
2019	749163000000	197691000000	180833000000	33686201	4280255330	3068000000
2020	711734000000	198253000000	169638000000	31770146	4172760165	2265000000
2021	809177000000	230976000000	225214000000	33490693	5715371245	3244000000
2022	898302000000	264542000000	254170000000	35081594	6906506415	4395000000
2023	1106830000000	356238000000	255627000000	35554975	8461609431	5545000000
2024	1307480000000	410189000000	261855000000	36080817	9903398645	7154000000

Source: World Bank Group, Data, Turkey

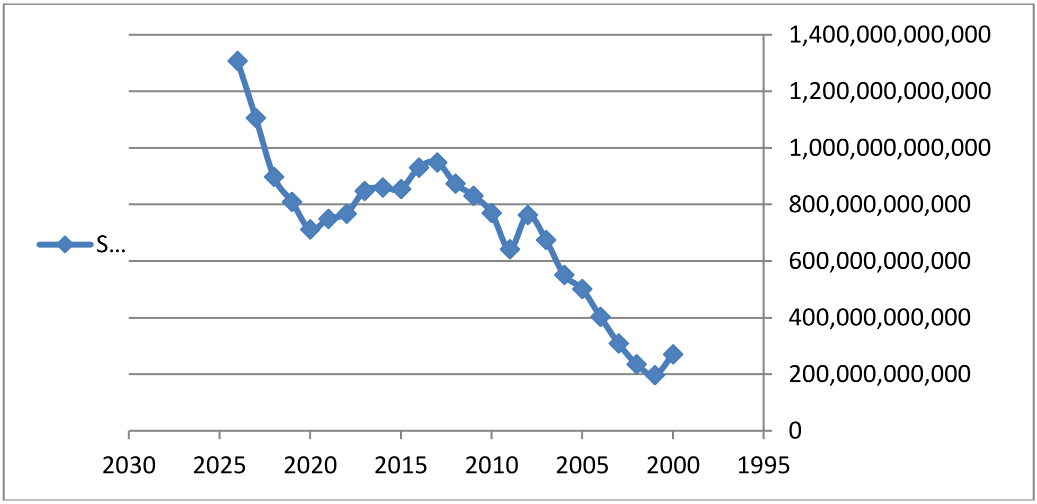

Figure 8: Evolution of Gross Domestic Product (GDP)
Source: Prepared by the researcher.

GDP rebounded in the following year but then experienced declines between 2017 and 2019, ultimately falling to $711,734,000,000 in 2020, representing a negative growth rate of -5%. Thereafter, GDP resumed its upward trajectory, reaching $1,307,480,000,000 by 2024, as indicated in Table (7).

INTERNATIONAL JOURNAL OF ECONOMICS AND FINANCE STUDIES
Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

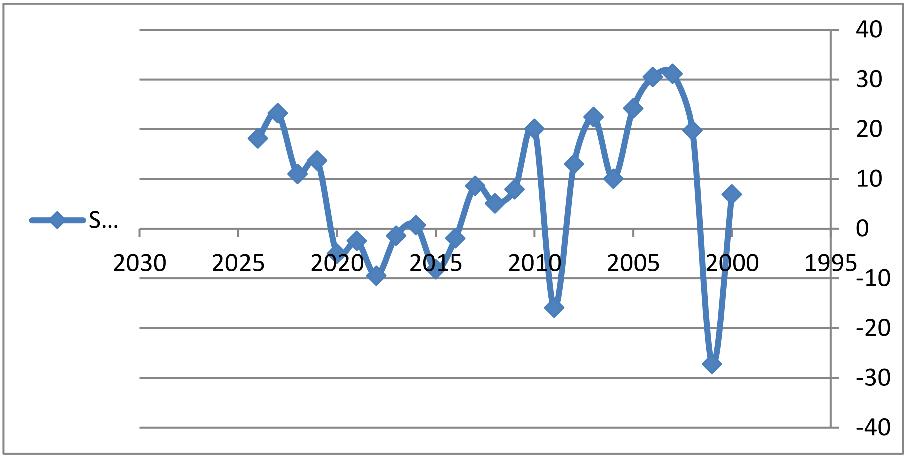

Figure 9: Evolution of Annual Growth Rates of Turkey's (GDP)
Source: Prepared by the researcher.

To provide a comparative overview of the country's economic and industrial performance, Figure (10) illustrates the joint development of Turkey's GDP, commodity exports, advanced technology exports, and defence industry exports over the period 2000–2024. This visual representation helps demonstrate the proportional relationships and overall trajectory of national output alongside sectoral export growth.

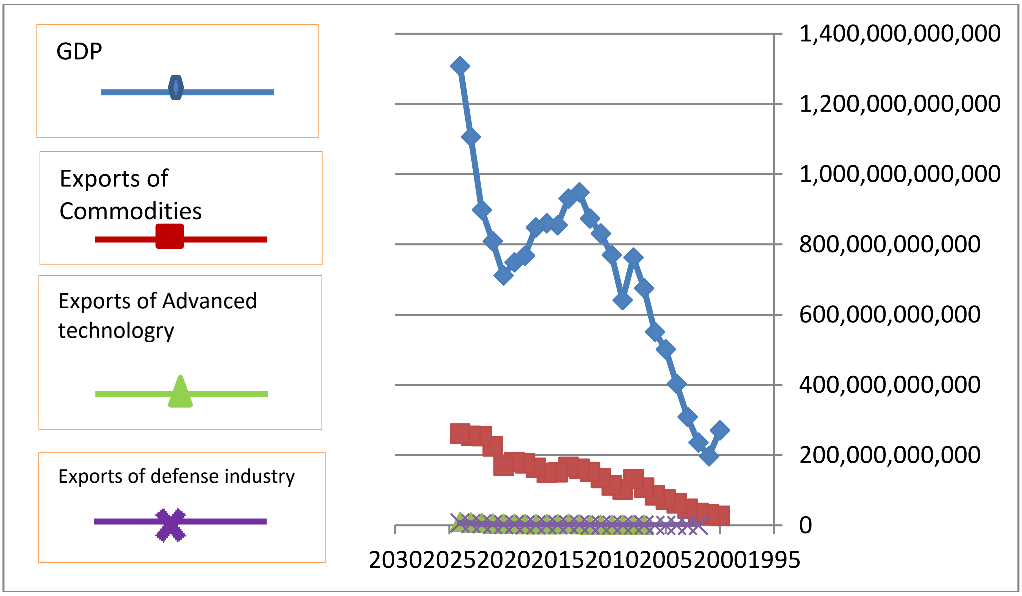

Figure 10: Development of Turkey's GDP, Commodities Exports, Advanced Technology Exports, and Defence (Military) Exports
Source: Prepared by the researcher.

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

Furthermore, Figure (11) presents the annual growth rates of the same four key variables GDP, commodity exports, advanced technology exports, and defense industry exports over the study period. The figure highlights the fluctuations and cyclical behavior of each sector, providing valuable insights into the dynamic interactions between technological advancement, export performance, and economic growth.

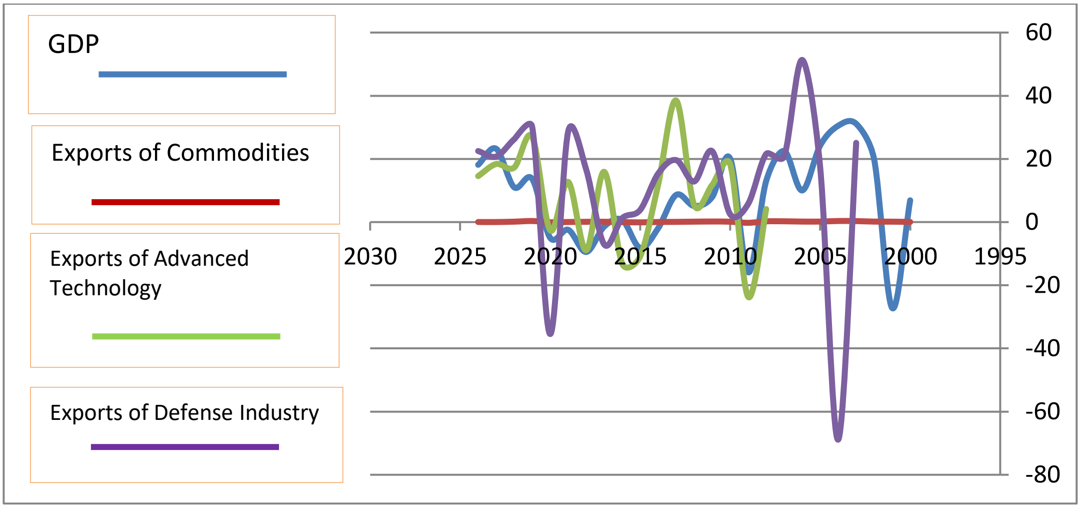

Figure 11: Annual Growth Rates of GDP, Commodities Exports, Advanced Technology Exports, and Defence (Military) Exports
Source: Prepared by the researcher.

To further examine the macroeconomic dynamics underlying Turkey's economic development and industrial performance, Table 5 and Table 6 present a detailed logarithmic transformation of the key production variables for the period 2000–2024. Table 5 outlines the natural logarithms of GDP, total workforce, and gross fixed capital formation, in addition to R&D expenditure as a share of GDP, allowing for a more robust econometric interpretation of long-term relationships among output, labour, and capital accumulation. The use of logarithmic values minimizes scale disparities and captures the proportional growth trends of each variable. Complementarily, Table 6 focuses on the capital-to-labour ratio and average labour productivity, together with their corresponding natural logarithms. These indicators provide empirical insight into Turkey's embodied technological progress and productivity growth patterns, serving as an essential basis for estimating the elasticity coefficients used in the subsequent regression analysis.

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

Table 5: Natural Logarithms of GDP, Labour Force, and Capital, along with R&D Expenditure as a Percentage of Turkey's GDP

Years	LNY Logarithm of (GDP (1)	LNL: Natural Logarithm of Total Workforce (2)	LNK: Natural Logarithm of Gross Fixed Capital Formation (3)	LNT: The Natural (Base-e) Logarithm of Numbers from 1 to 25 .(4)	Research and Development (R&D) Expenditure as a Percentage of Gross Domestic Product (GDP% (5)
2000	26.32	16.94	24.83	.00	0.47
2001	26.01	16.96	24.31	.69	0.52
2002	26.19	16.97	24.57	1.10	0.51
2003	26.46	16.97	24.90	1.39	0.47
2004	26.72	16.94	25.36	1.61	0.50
2005	26.94	16.96	25.62	1.79	0.56
2006	27.04	16.97	25.79	1.95	0.55
2007	27.24	16.98	25.97	2.08	0.69
2008	27.36	17.01	26.05	2.20	0.69
2009	27.19	17.05	25.70	2.30	0.80
2010	27.37	17.09	25.98	2.40	0.79
2011	27.45	17.13	26.17	2.48	0.79
2012	27.50	17.15	26.20	2.56	0.83
2013	27.58	17.19	26.33	2.64	0.81
2014	27.56	17.20	26.32	2.71	0.86
2015	27.47	17.23	26.27	2.77	0.97
2016	27.48	17.27	26.26	2.83	1.12
2017	27.47	17.30	26.27	2.89	1.18
2018	27.37	17.32	26.17	2.94	1.27
2019	27.34	17.33	26.01	3.00	1.32
2020	27.29	17.27	26.01	3.04	1.37
2021	27.42	17.33	26.17	3.09	1.40
2022	27.52	17.37	26.30	3.14	1.32
2023	27.73	17.39	26.60	3.18	0.27
2024	27.90	17.40	26.74	3.22	1.10

Source: Prepared by the researcher.

Table 6: Natural Logarithms of the Capital-to-Labour Ratios and Average Labour Productivity in Turkey

Years	Y/L Labour Productivity (1)	K/L Capital-to-Labour Ratio (2)	LNY/L Logarithm of Labour Productivity (3)	LNK/L Logarithm of Capital-to-Labour Ratio (4)
2000	11852.40	2671.55	9.38	16.94
2001	8478.14	1560.53	9.05	16.96
2002	10013.49	1987.78	9.21	16.97
2003	13226.21	2784.11	9.49	16.97
2004	17705.79	4520.01	9.78	16.94
2005	21580.73	5760.66	9.98	16.96

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

2006	23453.43	6749.91	10.06	16.97
2007	28560.90	8039.02	10.26	16.98
2008	31257.17	8413.52	10.35	17.01
2009	25247.61	5679.35	10.14	17.05
2010	29125.47	7235.90	10.28	17.09
2011	30155.00	8439.17	10.31	17.13
2012	31072.77	8471.16	10.34	17.15
2013	32562.21	9314.06	10.39	17.19
2014	31526.74	9142.49	10.36	17.20
2015	27974.00	8361.26	10.24	17.23
2016	27305.25	8032.86	10.21	17.27
2017	26071.88	7882.78	10.17	17.30
2018	23058.24	6962.71	10.05	17.32
2019	22239.46	5868.60	10.01	17.33
2020	22402.60	6240.23	10.02	17.27
2021	24161.25	6896.72	10.09	17.33
2022	25606.08	7540.76	10.15	17.37
2023	31130.10	10019.36	10.35	17.39
2024	36237.54	11368.62	10.50	17.40

Source: Prepared by the researcher.

Table 7: Annual Growth Rates of Selected Economic Variables in Turkey for the Period (2000–2024)

Years	GDP (%) (1)	Commodity Exports (%) (2)	Advanced Technology (3) %Exports (%)	Defence Industry Exports (%) (4)
2000	6.89	0.04		
2001	27.21-	0.13		
2002	19.79	0.15		
2003	31.12	0.31		25.08
2004	30.49	0.34		-68.88
2005	24.23	0.16		17.3
2006	10.01	0.16		51.33
2007	22.49	0.25		20.81
2008	13.01	0.23	4.11	21.56
2009	15.89-	-0.23	-23.68	5.77
2010	20.08	0.11	18.29	2.46
2011	7.93	0.18	11.75	22.45
2012	5.10	0.13	5.38	12.84
2013	8.61	0.06	38.48	19.62
2014	1.94-	0.03	11.89	15.36
2015	8.18-	-0.09	-10.87	3.84
2016	69.00	-0.01	-13.17	1.23
2017	1.42-	0.10	15.91	-7.07
2018	9.47-	0.08	-8.92	16.64
2019	2.44-	0.02	12.72	28.68
2020	5.00-	-0.06	-2.58	-35.45
2021	13.69	0.33	26.99	30.18

2022	11.01	0.13	17.25	26.19
2023	23.21	0.01	18.38	20.74
2024	18.13	0.02	14.56	22.49

Source: Prepared by the researcher.

CONCLUSIONS

The analysis demonstrates that disembodied technological progress exerts a positive influence on production growth. Specifically, a 1% increase in technological advancement, while holding other variables constant, results in a 5.9% rise in output. Moreover, the proportion of R&D expenditure relative to GDP increased from 0.47% in 2000 to 1.1% in 2024, with the peak value during the study period reaching 1.4% in 2021. Similarly, embodied technological progress significantly enhances labour productivity, with a 1% increase, ceteris paribus, yielding a 74% growth in average labour productivity, reflecting a bias of technological progress toward capital while simultaneously supporting the labour force. Furthermore, the expansion of exports in commodities, defence products, and advanced technologies constitutes a vital source of national income, substantially contributing to GDP growth. These sectors serve as key indicators of Turkey's economic and social advancement. Within this context, the defence industry emerges as a major contributor to the national economy, encompassing nearly 3,000 firms and employing over 80,000 personnel. The cumulative value of projects coordinated through the Presidency of Defence Industries, spanning more than 800 initiatives, exceeds $90 billion. Defence-related exports reached $7.154 billion in 2024, with approximately 300 distinct military products shipped to over 180 countries, primarily within Europe. Based on these findings, the study supports the hypothesis asserting that the technology employed in the Turkish military industry has played a pivotal and leading role in stimulating other economic sectors, thereby promoting growth, development, and national progress. The production of competitive military goods necessitates continual technological advancement and substantial investment in research and development. This, in turn, facilitates the transfer of technological capabilities to civilian industries, enhancing domestic economic capacity while simultaneously reducing dependence on imports. Consequently, the study recommends the continued implementation of Turkey's defence development strategy, recognising the sector not only as a tool of deterrence and an investment asset but also as a driver of both embodied and disembodied technological progress, thereby serving as a strategic pathway for sustained economic growth and national development.

REFERENCES

Agatón Lombera, D. I., Cardoso López, D. A., López Cabrera, J. A., & Nuñez Mora, J. A. (2024). Market reactions to US financial indices: A comparison of the

GFC versus the COVID-19 pandemic crisis. *Economies*, *12*(7), 165. https://doi.org/10.3390/economies12070165

Akbaş, H. E., & Canikli, S. (2018). Determinants of voluntary greenhouse gas emission disclosure: An empirical investigation on Turkish firms. *Sustainability*, *11*(1), 107. https://doi.org/10.3390/su11010107

Altınörs, G., & Akçay, Ü. (2022). Authoritarian neoliberalism, crisis, and consolidation: the political economy of regime change in Turkey. *Globalizations*, *19*(7), 1029-1053. https://doi.org/10.1080/14747731.2021.2025290

Andersen, M. A., Alston, J. M., Pardey, P. G., & Smith, A. (2018). A century of US farm productivity growth: A surge then a slowdown. *American Journal of Agricultural Economics*, *100*(4), 1072-1090. https://doi.org/10.1093/ajae/aay023

Baysal, B. (2025). Evaluating the advances and challenges in Turkey's defence industry: a comparative analysis. *Southeast European and Black Sea Studies*, *25*(1), 31-52. https://doi.org/10.1080/14683857.2025.24547220

Besenyo, J., & Málnássy, A. (2022). Future expansion and prospects of Turkish defense industry. *Insights into Regional Development*, *4*(2), 10-21. https://doi.org/10.9770/IRD.2022.4.2(1)

Blut, M. (2021). Meta-analysis in information systems research: method choices and recommendations for future research. *Industrial Management & Data Systems*, *121*(1), 12-29. https://doi.org/10.1108/IMDS-08-2020-0495

Bove, V., Deiana, C., & Nisticò, R. (2018). Global arms trade and oil dependence. *The Journal of Law, Economics, and Organization*, *34*(2), 272-299. https://doi.org/10.1093/jleo/ewy007

Demir, I. (2020). Transformation of the Turkish Defense Industry. *Insight Turkey*, *22*(3), 17-40. https://www.jstor.org/stable/26956174

Egeli, S. (2019). Making sense of Turkey's air and missile defense merry-go-round. *All Azimuth: A journal of foreign policy and peace*, *8*(1), 69-92. https://doi.org/10.20991/allazimuth.470640

Erdinçler, R. E. (2019). Current Security Policies In Turkey On The Perspective Of Defence Industry Technologies: A Reactivity-Proactivity Analysis. *Güvenlik Bilimleri Dergisi*, 1-19. https://doi.org/10.28956/gbd.551707

Flayyih, H., & Khiari, W. (2023). Empirically Measuring the Impact of Corporate Social Responsibility on Earnings Management in Listed Banks of the Iraqi Stock Exchange: The Mediating Role of Corporate Governance. *Industrial Engineering & Management Systems*, *22*(3), 273-286. https://doi.org/10.7232/iems.2023.22.3.273

Foster, L., Grim, C., Haltiwanger, J., & Wolf, Z. (2019). Innovation, productivity dispersion, and productivity growth. In *Measuring and Accounting for Innovation in the 21st Century*. University of Chicago Press. https://www.nber.org/system/files/chapters/c13889/c13889.pdf

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

Fravel, M. T., Gilboy, G. J., & Heginbotham, E. (2024). Estimating China's Defence Spending: How to Get It Wrong (and Right). *Texas National Security Review 7*(3), 40-54. https://doi.org/10.26153/tsw/54043

Inal, V., Gurdal, T., Degirmenci, T., & Aydin, M. (2024). The effects of military expenditures on labor productivity, innovation and economic growth for the most militarized countries: panel data analysis. *Kybernetes*, *53*(3), 821-840. https://doi.org/10.1108/K-06-2022-0852

Kakran, S., Sidhu, A., Bajaj, P. K., & Dagar, V. (2023). Novel evidence from APEC countries on stock market integration and volatility spillover: A Diebold and Yilmaz approach. *Cogent Economics & Finance*, *11*(2), 2254560. https://doi.org/10.1080/23322039.2023.2254560

Kurç, Ç., Güvenç, S., Mevlütoğlu, A., & Egeli, S. (2025). Balancing aspiration and reality: autarky in Turkish defence industrial policy. *Defence Studies*, *25*(2), 383-406. https://doi.org/10.1080/14702436.2025.2472705

Liu, D., Li, Y., You, J., Balezentis, T., & Shen, Z. (2023). Digital inclusive finance and green total factor productivity growth in rural areas. *Journal of Cleaner Production*, *418*, 138159. https://doi.org/10.1016/j.jclepro.2023.138159

Málnássy, A. (2022). Turkish military technology developments and military industry capabilities of force projection in the light of geopolitical goals. *Strategic Impact*, *2*(83), 60-71. https://www.ceeol.com/search/article-detail?id=1093630

Newman, C., Rand, J., Talbot, T., & Tarp, F. (2015). Technology transfers, foreign investment and productivity spillovers. *European economic review*, *76*, 168-187. https://doi.org/10.1016/j.euroecorev.2015.02.005

Niu, Z., Zhang, Y., Li, T., Baležentis, T., Štreimikienė, D., & Shen, Z. (2021). Total factor productivity growth in China's corn farming: An application of generalized productivity indicator. *Journal of Business Economics and Management*, *22*(5), 1189-1208. https://doi.org/10.3846/jbem.2021.15105

Orhangazi, Ö., & Yeldan, A. E. (2021). The re-making of the Turkish crisis. *Development and change*, *52*(3), 460-503. https://doi.org/10.1111/dech.12644

Ortiz-Bobea, A., Ault, T. R., Carrillo, C. M., Chambers, R. G., & Lobell, D. B. (2021). Anthropogenic climate change has slowed global agricultural productivity growth. *Nature Climate Change*, *11*(4), 306-312. https://www.nature.com/articles/s41558-021-01000-1

Robertson, P. E. (2024). The Military Rise of China: The Real Defence Budget Over Two Decades. *Defence and Peace Economics*, *35*(7), 809-825. https://doi.org/10.1080/10242694.2024.2342043

Seren, M. (2021). Politics, industry and academia: Examining dynamics of Turkish defense industry's great leap forward in the post-2002 Era. *Bilig*(96 (TBMM'NİN 100. YILI ÖZEL SAYISI)), 93-119. https://doi.org/10.12995/bilig.9604

Sveikauskas, L., Rowe, S., & Mildenberger, J. D. (2018). Measuring productivity growth in construction. *Monthly Lab. Rev.*, *141*, 1.

Vol: 17 **No:** 02 **Year:** 2025 **ISSN:** 1309-8055 (Online) (**pp.** 434-458) **Doi:** 10.34109/ijefs.2025170221

https://heinonline.org/HOL/LandingPage?handle=hein.journals/month141&div=3&id=&page=

Thijeel, A. M., Neffati, A., Khiari, W., & Al-Fandawi, H. H. F. (2024). Dividend Policy, Earnings Management and Corporate Governance: An Empirical Study of American Agribusiness Firms. *AgBioForum*, *26*(3), 156-165. https://agbioforum.org/menuscript/index.php/agb/article/view/427

Wang, Y., Sun, X., & Guo, X. (2019). Environmental regulation and green productivity growth: Empirical evidence on the Porter Hypothesis from OECD industrial sectors. *Energy Policy*, *132*, 611-619. https://doi.org/10.1016/j.enpol.2019.06.016

Yılmaz, S., & Yorulmaz, M. (2023). The effects of Turkish defense industry's transformation on Turkish foreign policy. *İnsan ve Toplum Bilimleri Araştırmaları Dergisi*, *12*(1), 1-21. https://doi.org/10.15869/itobiad.1186736