NEU PRESS

SBF Dergisi

Volume: 7 Issue: 1 Year: 2025 | Research Article | ISSN: 2667-8063

High Technology Rivalry: Techno-Politics in China and India

Umut YAVUZ*

Selcuk University, Faculty of Economics and Administrative Sciences, Department of International Trade and Finance, Konya, Türkiye

Article Info

Received: 07.10.2024
Accepted: 23.06.2025
Published: 30.06.2025

Keywords:
China,
High technology,
India,
Techno-politics,
H-T rivalry.

Jel Codes: O32, O38, O53

ABSTRACT

In today's interconnected world, high technology stands as a ubiquitous force shaping global connectivity and societal dynamics, while techno-politics delves into the intricate interplay between politics and technology, elucidating the reciprocal influences between these domains and human society. Asia, as a populous continent, assumes paramount significance wherein high technology plays a pivotal role in shaping political discourse and power dynamics. China and India, the world's most populous nations, stand as pivotal actors in the global technological landscape and hold considerable sway in techno-political realms. The regional hegemonic aspirations of these states, underpinned by technological prowess, not only define their bilateral relations but also reverberate across regional and global arenas, reshaping geopolitical configurations. This study undertakes a comprehensive analysis of China's and India's policies in key technological domains such as aerospace, cyberspace, mechatronics (robotics), biotechnology, and nuclear technology. By scrutinizing their positions within the global technological competition, it seeks to elucidate the intricate techno-political rivalries between these two Asian giants and their broader implications for regional and global power dynamics.

Yüksek Teknoloji Rekabeti: Çin ve Hindistan'da Tekno-Politika

Makale Bilgisi

Geliş Tarihi: 07.10.2024
Kabul Tarihi: 23.06.2025
Yayın Tarihi: 30.06.2025

Anahtar Kelimeler:
Çin,
Yüksek teknoloji,
Hindistan,
Tekno-politika,
H-T rekabeti.

JEL Kodları: O32, O38, O53

ÖZET

Günümüzün her anlamda birbiriyle bağlantılı dünyasında, yüksek teknoloji küresel bağlantıları ve toplumsal dinamikleri şekillendiren evrensel bir güç olarak öne çıkarken, tekno-politika kavramı siyaset ve teknoloji arasındaki karmaşık etkileşimi irdeleyerek, bu alanlar ile insan toplumu arasındaki girift ilişkileri analiz etmeyi amaçlamaktadır. Yoğun nüfusa sahip bir kıta olarak Asya, yüksek teknolojinin siyasi söylemi ve güç dinamiklerini şekillendirmede belirleyici bir rol üstlenir. Dünya nüfusunun en kalabalık ülkeleri olan Çin ve Hindistan, küresel teknolojik peyzajda kilit oyuncular olarak yer alır ve tekno-politik alanlarda önemli bir etkiye sahiptir. Bu devletlerin bölgesel hegemonya hedefleri, sahip oldukları teknolojik güç aracılığıyla desteklenir ve sadece ikili ilişkilerini değil, aynı zamanda bölgesel ve küresel arenalarda yankılanarak jeopolitik konfigürasyonları da yeniden şekillendirir. Bu çalışma, Çin'in ve Hindistan'ın havacılık, siber uzay, mekatronik (robotik), biyoteknoloji ve nükleer teknoloji gibi anahtar teknoloji alanlarındaki politikalarını kapsamlı bir şekilde analiz etmekte ve küresel teknolojik rekabet içindeki konumlarını sorgulayarak, bu iki Asya devi arasındaki karmaşık tekno-politik rekabetleri ve bölgesel ve küresel güç dinamikleri üzerindeki geniş etkilerini açıklamaktadır.

To cite this article:

Yavuz, U. (2025). High technology rivalry: Techno-politics in China and India. *Necmettin Erbakan Üniversitesi Siyasal Bilgiler Fakültesi Dergisi, 7*(1), 1-16. DOI: 10.51124/jneusbf.2025.103

***Corresponding Author:** Umut YAVUZ, *uyavuz@selcuk.edu.tr*

INTRODUCTION

Technology is a tool helping humans reach their essential goals. Although for most of us, it is nothing more than mobile phone or the satellites. In fact, technology is also quite related to the politics since the latter is one of the most important aspect of human history. Man is a political animal in Aristotle’s words. The most important element of politics is essentially power. Thus, power today is directly related to technology. Thus, technology and politics have always been integrated to each other especially as one can easily detect in the history of wars.

The notion of techno-politics, relatively nascent when contrasted with the standalone realms of technology and politics, has swiftly emerged as a pivotal determinant in global politics amidst the rapid advancements in technology. Broadly construed, techno-politics encapsulates technology-driven policies or policies shaped by technological influence. This interplay underscores the direct correlation between technological progress and key facets of political landscapes, including International Relations (IR) and state policies.

This research investigates the intersection of technology and politics, known as techno-politics, within the context of Asia, the world's most populous continent, with a specific focus on China and India. The exploration of techno-politics extends beyond domestic affairs to encompass IR. The study places particular emphasis on the high-tech competition prevalent in Asia, examining China and India in terms of technology development and relevant policies. High-tech, in this context, encompasses aerospace, cyberspace, biotechnology, mechatronics, robotics, and nuclear technologies. Additionally, the research delves into the discussion of globalisation as a political and social process and its interconnected relations with technological advances.

Techno-politics holds the potential to shape the future landscape of both politics in general and IR, not only within Asia but on a global scale. The trajectory of High Technology or Hi-Tech (H-T) competition in Asia becomes a crucial inquiry, resonating with implications worldwide. Questions about whether China or India will assert global dominance – if they could overcome Western hegemony- and to what extent technology will further globalization are pivotal. This study seeks to address such inquiries employing a qualitative methodology examining technological advancements to offer insights into the present landscape of techno-politics in Asia.

In the realm of technology, possibilities for advancements and innovations are boundless. Consequently, the study puts forth the following hypotheses: Techno-politics emerges as a key battleground in global politics, poised to continue shaping international relations by evolving them into a form of global governance. The competition between China and India in the realm of H-T takes cenzter stage, transcending Asia’s regional boundaries to impact global dynamics significantly. H-T not only serves as a global force but also plays a fundamental role in driving globalization. This research endeavors to enrich current scholarship by exploring the influence of techno-politics on IR. Through a thorough analysis of the H-T competition between China and India, the study benefits literature review and gathers data on technological progress and innovations within these competing nations.

In recent decades, both China and India have emerged as pivotal players in global high-tech production and foreign trade, challenging the long-standing technological and economic dominance of Western powers. China, for instance, accounted for more than 30% of global high-tech exports in 2022, positioning itself as a leading manufacturer in sectors such as electronics, semiconductors, and telecommunications (World Bank, 2023). India, on the other hand, has leveraged its extensive human capital in information technology and software engineering, with IT service exports exceeding $200 billion in 2023 (UNCTAD, 2023). These developments not only highlight the growing competitiveness of these economies but also underscore their potential to redefine global technological leadership, thereby justifying the study's specific focus on China and India in the context of shifting techno-economic paradigms.

Moreover, techno-politics has increasingly become a central axis around which international relations are reorganized, transforming traditional geopolitical rivalries into complex networks of global governance. Contemporary scholarship emphasizes how technological capabilities are not merely tools of economic development but also instruments of political influence and normative power (Medeiros, 2019; Rüland & Manea, 2021). As countries seek strategic autonomy and digital sovereignty, control over emerging technologies—ranging from artificial intelligence to green energy systems—becomes an essential determinant of national power. This dynamic reinforces the significance of examining techno-politics through the lens of global governance and legitimizes the investigation into how rising powers such as China and India are reshaping this order.

Understanding power dynamics extends beyond mere assessments of capabilities and influence; it necessitates an exploration of the socio-political contexts conducive to technological advancements like the internet, nuclear weaponry, or firearms. Technological determinism overlooking the human agency in technological innovation, has historically hindered such inquiries, particularly within the realm of IR. Therefore, a nuanced examination of the socio-political environments fostering technological developments is imperative. Hence, it becomes imperative to scrutinize each technological domain individually and assess its sociological and political ramifications within the context of its emergence and utilization. Accordingly, we will delve into five domains deemed most influential in both sociological and political spheres within the realm of H-T. Subsequently, the following section will scrutinize the techno-politic decisions enacted by India and China, analyze their regional and global political implications, and evaluate their activities in these H-T sectors. However, prior to this analysis, it is essential to address two fundamental inquiries: 1. What motivates countries to pursue dominance in H-T realms? 2. How do various factors influence countries in their decision to export or transfer their technologies to other nations? The H-T's importance extends across various dimensions, bolstering economic, strategic, and political prowess for nations. Notably, mastery of H-T translates into a fortified defense industry, military capability, and economic strength, providing states with a psychological edge over their counterparts.

Concerning the second inquiry, the following four responses are available:

Pursuit of economic interests: H-T is characterized by its high cost and substantial added value, thus serving as a lucrative source of income for exporting countries.

Strategic considerations: Macro-political motives may drive a country to bolster its regional power dynamics. For instance, the United States' provision of military technology to Saudi Arabia vis-à-vis Iran illustrates such strategic concerns.

Formation of alliances: Governments may export technology to cultivate alliances, leveraging either technology transfer or financial assistance. The Marshall Plan during the period of Cold War extended monetary support to fortify nations against influence of Soviet forces. Similarly, the USA's backing of India's nuclear sector and China's support for Pakistan's nuclear endeavors serve similar geopolitical objectives.

Cultivation of technological dependence: H-T exports can render recipient countries reliant on the exporting nation due to the high costs associated with maintenance and the perpetual emergence of newer technologies. Consequently, technology-importing nations develop a sense of allegiance to their exporting counterpart.

LOGIC AND DOMAINS OF HIGH TECHNOLOGY RIVALRY

High technology competition in the 21st century is not only an economic phenomenon but also a geopolitical struggle that defines the new architecture of international order. As advanced technologies such as semiconductors, artificial intelligence (AI), quantum computing, and space innovation increasingly dictate national security, economic independence, and global influence, states are recalibrating their strategies accordingly. The techno-strategic logic lies in the control of foundational and general-purpose technologies (GPTs), which act as force multipliers across civilian and military domains (Medeiros, 2019; Rüland & Manea, 2021). These technologies are no longer seen as neutral tools of productivity but as instruments of state power and soft dominance in global governance.

The competition is primarily taking shape through three interrelated domains: (1) innovation ecosystems, (2) technology supply chains, and (3) digital regulatory regimes. Innovation ecosystems refer to national capacities to generate, commercialize, and scale up high-tech innovations — an area where China's rise is most pronounced. For example, China surpassed the United States in the number of AI-related scientific publications and patent filings by 2022 (World Intellectual Property Organization, 2023). India, on the other hand, has positioned itself as a global hub for software engineering and digital services, backed by massive state-led digitalization programs like Digital India.

The second domain—technology supply chains—has become a geopolitical battlefield, particularly in the semiconductor sector. The U.S. and its allies are enforcing export control regimes to restrict China's access to cutting-edge fabrication equipment, while China is accelerating its domestic production through massive subsidies (Lee & Liu, 2023). Meanwhile, India is emerging as a reliable partner in the so-called ***"China+1"*** strategy, attracting foreign investment in electronics and green technology manufacturing.

Finally, regulatory power in digital governance has emerged as the third domain. The European Union, China, and the U.S. are competing to set global norms for AI ethics, data privacy, and platform regulation. This contest over regulatory narratives not only shapes international rule-making but also reinforces the geopolitical stakes of technological rivalry (Floridi, 2021).

Taken together, the logic of high-tech rivalry is rooted in a systemic transformation in which technological capabilities increasingly determine national sovereignty, economic resilience, and influence in international institutions. Understanding this dynamic is essential to assessing why countries like China and India are central actors in the shift from a Western-dominated techno-order to a more multipolar, contested technological future.

Techno-politics

H-T or referred to as frontier technology, signifies the pinnacle of technological advancements achieved by humanity (Cortright & Mayer, 2001:15). Conversely, there exists a counterpart known as unadvanced or low technology, representing traditional technologies of the earlier ages. Old or low technology is typically associated with designing products to be in the simplest way, it may also include primitive technologies. The conceptual content of H-T is continually evolving so its dynamism is not only within its content but also lies in the nature of its products.

H-T is a category of technology that all states strive to possess since its influences encompass both economic and political aspects. In this research, we categorize the primary H-T domains as Aerospace, Cyberspace, Mechatronics (Robotics), Bio-Technology, and Nuclear Technology since they cover technological realms significantly impacting human life and inter-state relations on a comprehensive scale.

Aerospace

The term "aerospace" emerges from the fusion of aeronautical and spaceflight principles. It encompasses the combined scientific, engineering, and commercial efforts aimed at exploration within and beyond Earth's atmosphere and space. "Aeronautics" pertains to studies concentrated on the atmosphere, whereas "astronautics" pertains to those aimed at space exploration.

Aerospace entities engage in the planning, design, production, operation, and upkeep of aircraft or spacecraft for various purposes. Aerospace operations encompass a wide range of activities, spanning commercial, industrial, and military applications. It is important to note that there is a technical distinction between aerospace and airspace. Airspace encompasses the airspace above the Earth's surface, whereas aerospace extends beyond it. The demarcation indicating the beginning of space is defined at 100 kilometers above the Earth's surface (FAI, 2021).

The aerospace industry encompasses various products, including civil and military aircraft, helicopters, unmanned aerial vehicles, missiles, space launchers, spacecraft, airships, and associated systems. As of 2018, global export sales of aerospace products reached $331.8 billion, reflecting a 2.1 percent increase since 2014. North America led in exports with 45.3 percent, followed by Europe with 42.8 percent, and with % 9.6 Asia (Workman, 2019).

USA dominates the aerospace industry, holding a 41.9 percent export share in 2018. Notable growth in aerospace exports since 2014 was observed in Malaysia, Ireland, China, and South Korea. Conversely, Italy, France, Japan, Germany and Canada experienced declines in exported aerospace product sales among the top exporters (Flight Global, 2019).

Cyberspace

Cyberspace is a term commonly employed to characterize the interconnected realm of digital technology. Although initially introduced through science fiction art as a popular cultural element, it has since evolved into a tangible reality. In today’s context, the concept serves as a vital tool for technology strategists, security experts, governments, military institutions, industry leaders, and investors to grasp the intricacies of the global technological sphere. As per the *Oxford Dictionary* (2020), cyberspace is defined simply as a network of communication where computer networks are interconnected. This term gained traction in the early 1990s with the widespread adoption of the internet, web networks, and digital communication systems, representing innovative ideas and phenomena (Strate, 1999, p. 382-383). Our collective experience illustrates that individuals utilize this interconnected global network for a myriad of purposes, including social interaction, idea sharing, information exchange, providing support, business transactions, activism, creative endeavors, gaming, entertainment, and participation in political discourse, among others. In fact, for some individuals who predominantly reside in cyberspace, popular culture has coined the term *cybernauts*, signifying a step beyond the reality experienced by others.

Cyberspace is defined as the capacity to utilize the digital domain to secure an advantage and influence events across diverse operational realms (Kuehl, 2009, p. 12). This notion allows for a comparison of countries’ cyber power within the context of IR. The Cyber Power Index, developed for G20 nations, assesses government commitment, cybersecurity policies, censorship, political efficacy, and intellectual property protection. The UK and the USA with Germany, Japan and France rank highest, while India ranks 14th and China 18th (Economist Intelligence Unit, 2013).

The importance of cyberspace lies in its link to cybersecurity, with cyberwarfare becoming increasingly prominent on the global stage. Cyberwarfare presents a means to disrupt states and their economies without traditional weaponry. A robust security network is essential to withstand cyber threats effectively.

In Asia, China boasts the most advanced cyber army, reportedly consisting of around 100,000 cyber soldiers. Moreover, China collaborates with experts of the field from non-governmental sector for conducting cyber attacks and has been implicated in organized attacks targeting Canada, France, India, Russia, and the USA (Mason, 2019).

Mechatronics: Robotics

Mechatronics (engineering) is a crossdisciplinary field that integrates electrical and mechanical systems. The development of mechatronics as a scientific discipline involves creating design solutions that integrate various sub-branches. Initially trademarked in Japan in 1969 by engineer Tetsuro Mori, the term "mechatronics" later gained universal recognition (Lennon & Mass, 2008:23). It encompasses elements from various domains such as robotics, electronics, computers, telecommunications, systems, control, and production engineering. The decision to address mechatronics and robotics collectively in this study stems from the comprehensive nature of mechatronics and the specific significance of robotics for future applications. Mechatronics constitutes a cross-disciplinary domain merging mechanical and electrical systems. Mechatronics is often viewed as a fusion of automation, robotics, and electromechanical engineering, representing a comprehensive collection of robotic technologies or an all-encompassing superset (Kamm, 1996, p. 11). This field investigates the interactions among mechanical systems, electrical systems, control systems, and their coordination. On the other hand, robotics emerged at the intersection of computer science and engineering, focusing on the design, construction, operation, and functioning of robotic systems. The objective of robotics science is to develop intelligent machines that assist individuals in daily activities and diverse production processes, including military applications and other distinct purposes. The advancements in robotics science are closely tied to progress in engineering disciplines such as information, computer, electronic and mechanical.

The term "robotics" originates from "robot," derived from the Slavic term "robota," meaning servant or worker or just simply work. It was first coined in 1920 by Czech writer Karel Capek in his play *Rossum's Universal Robots*. Science fiction writer Isaac Asimov introduced the concept of robotics in May 1941 in his short story *Liar!* and outlined the famous Three Laws of Robotics in his short story *Runaround*. These laws, stating that a robot cannot harm people, must obey human orders unless it conflicts with the first law, and must protect its existence unless it conflicts with the first law, have become foundational principles in contemporary science fiction. Despite originating in science fiction, Asimov's ideas have significantly influenced the field of robotics science (Asimov, 1950, p. 40).

The most advanced 10 countries in robotics worldwide are as follows: South Korea, Singapore, Germany, Japan, Sweden, Denmark, USA, Italy, Belgium, and Taiwan (IFR Press Release, 2018). The World Robotics 2018 report by the International Federation of Robotics (IFR) indicates a 6 percent increase in global robot installations, totaling approximately 425 thousand units valued at $ 17 billion. Asia leads in robot installations, with two-thirds of installations occurring in this region. Between 2013 and 2018, global robot installations grew by nearly 23 percent annually. Europe and the Americas follow, with installation rates of approximately 14 percent and 20 percent, respectively. Japan, the USA, China, Korea, and Germany are the top five markets for industrial robots, with China leading since 2013, installing about 155 thousand robots in 2018 alone. Despite a 1 percent decrease from 2017, China's installations still surpass those of Europe and America combined, totaling 130,772 units (World Robotics, 2019).

Biotechnology

Biotechnology combines biology with living systems to create products. It involves modifying organisms, historically through artificial selection and hybridization. Modern biotechnology includes genetic engineering and cell culture. The American Chemical Society defines it as using biological processes in industries (ACS, 2019). The European Federation of Biotechnology integrates natural sciences to produce goods and services (EFB, 2019). Modern biotechnology, propelled by genetic engineering, enables precise modifications to biological systems, accelerating research in medicine, agriculture, and industry. Today, biotechnology spans various subfields, including Animal Biotechnology, Medical Biotechnology, and Environmental Biotechnology, contributing to advancements such as new therapies and genetically modified crops (NTNU, 2020).

Biotechnology, drawing from molecular biology, biochemistry, and genetics, develops methods supporting fundamental research in biology. Bioengineering utilizes principles from the natural sciences to manipulate cells or molecules or just tissues, emphasizing the interdisciplinary character of biotechnological research (Abramovitz, 2015, p. 10).

The OECD (2010) report highlighted Singapore, Brazil, China, India, and South Africa as emerging leaders in biotechnology. Subsequently, a 2017 study reaffirmed this trend, citing significant advancements in China, Taiwan, Singapore, Japan, and South Korea, driven by a $2.5 billion investment (Ernst & Young, 2018).

Nuclear Technology

This technology encompasses study of atomic nucleus reactions, including applications such as nuclear energy, nuclear medicine, and nuclear weaponry. This technology operates on the principle of manipulating natural or artificial elements to release substantial energy through reactions, which, when harnessed as a weapon like atomic or hydrogen bombs, can yield catastrophic consequences. Conversely, when managed safely, nuclear technology, as exemplified by nuclear power plants, offers significant advantages.

As of 2019, there are a total of 450 nuclear reactors distributed across 30 countries globally. The United States hosts the largest number of reactors, with 97 units. France leads in Europe with 58 reactors, while in Asia, China, Japan, Korea, and India collectively account for 128 reactors. Additionally, plans were in place as of 2018 to construct approximately 150 new nuclear reactors worldwide, with 50 of them already in progress (Statista, 2019).

The primary focus of new reactor construction is predominantly observed in Asian nations like South Korea, India, and China. As of January 2019, China had 45 operational reactors, with an additional 13 reactors currently under construction. Moreover, China has plans to construct an additional 43 new reactors. Following these developments, China aims to generate a significant portion of its electrical energy from nuclear plants (The Economist, 2019).

HIGH TECHNOLOGY IN ASIA: REFLECTIONS AND THE STATE OF RIVALRY

In the contemporary era, technology has become pervasive, shaping nearly every aspect of human life and influencing the trajectory of societies. This intersection of technology and human affairs has compelled states to engage with technological advancements, recognizing its significance not only in bolstering economic and technical capabilities but also as a means of facilitating societal interaction and serving as a political instrument for the dissemination of ideas. However, existing theories within IR encounter challenges in adequately addressing this multifaceted nexus of technology and politics. While the relevance of this domain is undeniable, scholarly attention remains relatively limited.

Key themes within techno-politics encompass the domains of statecraft, power dynamics, international security paradigms, warfare strategies, and foreign policy formulations. The World War

II, marked by the existential threat of nuclear warfare, catalyzed scholarly inquiry into the intricate interplay between technology and political dynamics. Subsequently, during the Cold War era, the emergence of space technologies emerged as a focal point of geopolitical contention.

It is imperative to acknowledge that technology wields a dual nature, embodying both constructive and destructive potentials. While historical events such as the tragedies of Hiroshima and Nagasaki underscore technology's ominous capabilities, the Cold War era also witnessed the constructive utilization of space technologies for peaceful exploration and scientific advancement. Nevertheless, in the contemporary milieu, the integration of technology and politics is more imperative than ever, with technology serving as a linchpin for economic progress and the enhancement of human welfare. High-technology domains hold significant strategic value in contemporary geopolitics, shaping states' security, economic, and social policies, particularly evident in educational systems. The USA, with its dominant presence across these domains, wields considerable influence in global politics, with its superpower status intricately linked to its technopolitical strategies, notably in education.

In light of these considerations, it is pertinent to examine China and India's roles and engagements within the H-T domain within the region.

Asia has emerged as the epicenter of global high-technology development and competition in the 21st century. The continent—particularly through the rise of China, India, South Korea, Japan, and Southeast Asian economies—has become both a manufacturing powerhouse and a vibrant laboratory for innovation, digital transformation, and techno-geopolitical realignments. Understanding the multifaceted reflections of high technology in Asia requires a closer look at its intersections with economic growth, Industry 4.0/5.0 transformations, research and development ecosystems, digital economies, and geopolitical rivalries.

The ascent of Asia in global high-tech landscapes is closely tied to its industrial and export-oriented growth models. China, often dubbed the "world's factory," has moved from low-cost mass production to advanced manufacturing, driven by initiatives such as Made in China 2025 and Smart Manufacturing Development Plan (2021–2025) (Kennedy, 2020). These state-led programs aim to dominate key sectors like robotics, aerospace, and semiconductors. India, meanwhile, launched the Make in India and PLI (Production-Linked Incentive) schemes to boost domestic high-tech production and reduce dependence on imports (Singh, 2022).

Asian economies are rapidly adopting Industry 4.0 technologies—IoT, AI, big data analytics, and cyber-physical systems—particularly in South Korea, Japan, and Singapore. Simultaneously, the idea of Industry 5.0, which centers around human-machine collaboration, resilience, and sustainability, is gaining attention in Chinese and Indian policy circles (Lee et al., 2021). These transitions are reshaping traditional manufacturing and service sectors into intelligent, adaptable, and greener ecosystems.

Asia's R&D investments have surged dramatically. According to UNESCO (2023), China now ranks second globally in total R&D spending and leads the world in the number of scientific publications. India has built strong digital innovation hubs in cities like Bangalore and Hyderabad, driven by a mix of state-led initiatives and private-sector dynamism. Japan and South Korea remain global leaders in patents per capita, particularly in AI, materials science, and electronics (OECD, 2022). These ecosystems are not only national assets but also strategic components in global innovation value chains.

Asia's digital economy has expanded rapidly, with China and India as twin engines of growth. China's digital platforms (Alibaba, Tencent, ByteDance) have developed vertically integrated ecosystems, often outperforming Western competitors in mobile payments, super-apps, and AI applications (Cheng & Yi, 2021). India, with its Unified Payments Interface (UPI) and Digital India program, has revolutionized financial inclusion and digital public infrastructure. Southeast Asia is also witnessing an e-commerce boom, expected to surpass $200 billion by 2025, driven by mobile-first users and regional digital integration (Google et al., 2022).

High technology has become central to Asia's geopolitical positioning. The U.S.–China tech rivalry reflects a broader struggle over technological supremacy, with semiconductors, AI, and 5G at the core (Cheung, 2021). The U.S. has implemented export controls and forged technology alliances (e.g., the Chip 4 Alliance) to contain China's ascent, while China accelerates its self-reliance strategy through state capital and talent repatriation. India is increasingly seen as a pivotal actor in this rivalry, attracting Western investment and forming tech alliances under the Quad framework.

Table 1

High Technology Competition Between China and India

H-T Field	China	India
	Population: 1,416,171,007	Population: 1,463,563,559
Aerospace	In the top 10 but at the end of the list with $4.6 billion (%1.4) world export.	16th in the world in Aerospace Exporting (% 0.6).
Cyberspace	Commitment for cybersecurity (high) – 100,000 cyber soldiers – Ranked 27th in cybersecurity.	Commitment for cybersecurity (high) – Ranked 47th in cybersecurity.
Mechatronics-Robotics	140,000 industrial robots (annual installation) – Rank 1st. World's biggest robot market. 23rd in robot density (68 – Number of Installed Robots per 10,000 Employees).	4300 industrial robots (annual installation) – Rank 10th. 44th in robot density (only 3 – Number of Installed Robots per 10,000 Employees).
Biotechnology	Investments made in the biotechnology sector in China between 2014 and 2017 amounted to $45 billion dollars. (+ Sinovac)	By the end of 2025, the Indian Biotechnology industry is projected to reach $150 billion. Stronger commitment by the Indian government.
Nuclear Technology	45 operable nuclear reactors (+10 under construction) in 2019. 290 nuclear warheads.	22 operable nuclear reactors (7 under construction) in 2019. 130–140 nuclear warheads.

Source: Worldometers, 2025; Workman, 2019; Aero India, 2020; Global Cybersecurity Index, 2018; World Robotics, 2019; Arranz, 2018; Department of Biotechnology, 2020; Sipri, 2020.

This evolving landscape suggests that Asia is not merely a consumer or producer of technology but a formative agent shaping the rules, norms, and architectures of global techno-politics. The region's ability to integrate innovation, governance, and strategic foresight will determine its long-term influence in a multipolar technological order.

In examining the competition in High-Technology (H-T) between China and India, it becomes evident that China maintains a significant lead across various H-T sectors.

Analysis from Table 1 reveals key data concerning the five primary H-T domains, illustrating China's dominance. For instance, in the Aerospace sector, China ranks 10th globally in terms of export rates, whereas India trails behind at 16th place. While both countries exhibit a high commitment to cybersecurity, China places greater emphasis on this aspect, securing the 27th position worldwide compared to India's 47th ranking. Moreover, China boasts an annual installation of 140,000 robots, far surpassing India's mere 4,300, making it the earth's largest market of robots.

The robot density per ten thousands employees is significantly higher in China at 68, compared to India's meager 3. Although India invests more in the biotechnology industry, China's successful development of the Sinovac vaccine during the Covid-19 pandemic underscores its advanced biotechnological capabilities. Additionally, China's nuclear prowess is notable, with 45 operable and 10 under construction reactors, along with 290 nuclear warheads. In contrast, India possesses 22 operable reactors and 7 under construction, along with approximately 130 to 140 nuclear warheads. Collectively, these findings underscore China's superiority over India across all H-T domains.

The latest data shown in Table 2 highlights a stark contrast between China and India in the domain of high-technology exports. In 2023, China recorded an impressive $825.05 billion in high-tech exports, maintaining its dominant global position, particularly in electronics, semiconductors, electric vehicles, and battery technologies. This figure accounts for a significant portion of its total merchandise exports of $2.89 trillion. In contrast, India's high-tech export performance, while improving, remains modest with electronic goods exports reaching $38.58 billion in FY 2024–25. Despite this gap, India demonstrated remarkable growth in this sector with a 32.47% increase, reflecting strategic policy shifts and increased government support. While China continues to lead the global high-tech race, India is steadily gaining momentum, especially in electronics manufacturing and IT-related services, suggesting a gradual transformation of its technological and industrial base.

Table 2

High-Tech Exports of China and India (2024–2025)

Indicator	China (2023)	India (FY 2024–25)
High-tech exports (current US$)	$825.05 billion	$38.58 billion (Electronic goods exports)
Total merchandise exports (current US$)	$2.89 trillion	$437.42 billion
Total services exports (current US$)	$1.0 trillion (estimated)	$383.51 billion
Total exports (goods & services)	$4.58 trillion (estimated)	$820.93 billion
Growth in high-tech exports	5.9% increase	32.47% increase in electronic goods exports
Key high-tech export sectors	Electronics, semiconductors, EVs, batteries	Electronics, IT services

Source: World Bank, 2023; Ministry of Commerce & Industry, Government of India, 2025; Business Standard, 2025.

CONCLUSION

Technology has played a pivotal role in shaping human civilization since ancient times, intertwining with political dynamics and societal development. The amalgamation of science and technology has propelled humanity forward, enhancing its capabilities and influencing global power dynamics. The relationship between science and technology is symbiotic, with science delving into fundamental principles and technology applying these discoveries in practical contexts. Politics serves as a crucial mediator in the interaction between society and technology, shaping policies and governing their utilization.

Technological advancements have historically been driven by political motives, particularly evident during times of conflict and competition among nations. The pursuit of technological superiority has been a recurring theme in IR, leading to a perpetual race for innovation and dominance. The concept of techno-politics sheds light on the intricate relationship between technology and politics, exploring how policymakers interact with technology and how technology, in turn, influences policy-making. As technology becomes increasingly globalized, its impact transcends national borders, shaping the geopolitical landscape and fostering international cooperation and competition.

H-T emerges as a key battleground for global supremacy, with nations vying for dominance in various technology sectors. China and India, as two major players in this arena, are engaged in a fierce competition for regional and global influence, leveraging their technological capabilities to bolster their geopolitical standing. While China has emerged as a frontrunner across various H-T fields, India has struggled to keep pace, particularly in sectors like aerospace, robotics, and nuclear technology. Despite India's strengths in information technology and biotechnology, it lags behind China in overall technological prowess.

Within the scope of the main purpose of this study—which is to assess the dynamics of high technology as a driver of strategic competition in Asia—it is crucial to deepen the comparative evaluation of China and India in the third part. The updated data on both countries' high-tech sectors point to a significant divergence not only in scale but also in structural orientation, competitiveness, and long-term strategic positioning.

China remains the undisputed leader in high-tech exports, with a total of $825.05 billion in 2024, driven by globally competitive sectors such as semiconductors, advanced electronics, electric vehicles, artificial intelligence, and renewable energy technologies. Its vast industrial base, advanced manufacturing ecosystem, and state-led investment in R&D and innovation infrastructure allow it to dominate global high-tech value chains. Additionally, with an estimated $4.58 trillion in total exports (goods and services), China is able to translate technological capacity into extensive market reach, reinforcing its economic and geopolitical influence.

In contrast, India has positioned itself as a rapidly growing but still emerging high-tech actor. Its electronic goods exports grew by over 32% in FY 2024–25, reaching $38.58 billion, and it achieved a total exports figure of approximately $824.9 billion. While the absolute figures lag far behind China's, India's momentum is noteworthy. The Indian government's strategic emphasis on "Make in India," digital transformation, semiconductor manufacturing, and biotechnology has laid the groundwork for long-term gains. Furthermore, India's strengths in IT services, digital platforms, and e-commerce ecosystems offer it a different but increasingly relevant profile of techno-economic competitiveness.

The rivalry between the two countries is not just about figures but also about competing development models. China's centralized, top-down approach with strong industrial policy contrasts with India's more decentralized, service-led and entrepreneurial path. In the geopolitical arena, both countries view high-tech capabilities as crucial to securing influence in Asia and the Global South. China's Belt and Road-related digital infrastructure exports (Digital Silk Road) compete directly with India's growing role in the Indo-Pacific's digital and strategic architecture, especially in cooperation with the U.S., Japan, and Europe.

Therefore, a nuanced comparison in this section is essential. Rather than viewing the rivalry as a binary contest, it should be interpreted as a multi-layered competition in which China currently leads in scale and complexity, while India gains ground in adaptability, market depth, and innovation-driven growth. This evolution will shape not only their bilateral dynamics but also the broader architecture of Asian techno-politics.

The Covid-19 pandemic has underscored the critical role of biotechnology and technological infrastructure in responding to global crises, further emphasizing the significance of H-T in shaping human life and society.

Certain limitations must be acknowledged before delving into the study. Firstly, the focus is primarily on the Chinese and Indian political preferences influencing the production and utilization of technology. Additionally, there is a challenge in obtaining a clear picture of specific H-T issues, considering the potential existence of secret projects related to nuclear or cyber warfare technologies operated either by private enterprises under state oversight or autonomously.

Etik Beyan

Bu çalışma Prof. Dr. Murat Çemrek danışmanlığında 2021 yılında sunulan "Techno-politics in Asia: Hi-tech competition between China and India" başlıklı yüksek lisans tezinden üretilmiştir.

Etik Kurul Onayı

Araştırmanın niteliği gereği herhangi bir etik kurul onayı gerekmemektedir..

Yazar Katkıları

Araştırma Tasarımı (CRediT 1) Yazar 1 (%100)

Veri Toplama (CRediT 2) Yazar 1 (%100)

Araştırma - Veri Analizi - Doğrulama (CRediT 3-4-6-11) Yazar 1 (%100)

Makalenin Yazımı (CRediT 12-13) Yazar 1 (%100)

Metnin Tashihi ve Geliştirilmesi (CRediT 14) Yazar 1 (%100)

Finansman

Çalışmada herhangi bir finansal destekten faydalanılmamıştır.

Çıkar Çatışması

Herhangi bir çıkar çatışması yoktur.

REFERANSLAR

Abramovitz, Melissa (2015). *Biological engineering.* Gale Virtual Reference Library.

ACS, (2019). Biotechnology. *American Chemical Society.* www.acs.org.

Aero India (2020). Aerospace Industry in India. https://www.defense-aerospace.com/articles-view/feature/5/102287/quick-overview-of-india%E2%80%99s-aerospace-industry.html

Arranz, Adolfo (2018). *Betting big on biotech.* https://multimedia.scmp.com/news/china/article/2167415/china-2025-biotech/index.html

Asimov, Isaac (1950:40). *Runaround. I, Robot* (The Isaac Asimov Collection ed.). Doubleday.

Business Standard. (2025). *Total exports jump to $825 bn in FY25 as services shipments rise over 13%.* https://www.business-standard.com/economy/news/total-exports-jump-to-825-bn-in-fy25-as-services-shipments-rise-over-13-125050100743_1.html

Cheng, M., & Yi, Y. (2021). Digital Giants and the Rise of Platform Economies in China. *Journal of Contemporary China*, *30*(129), 217–234.

Cheung, F. (2021). Tech Wars: US–China Competition and the Future of Digital Order. *Asia Pacific Journal of International Affairs*, *3*(2), 44–63.

Cortright, J., Mayer, H. (2001). *High Tech Specialization: A Comparison of High Technology Centers*. Brookings Institution, Center on Urban & Metropolitan Policy.

Cyberspace. (2020) In the Oxford Dictionary. Retrieved April 26, 2020, from https://www.lexico.com/en/definition/cyberspace

Economic Times. (2025). *India's exports cross $820 bn in 2024-25: Commerce ministry.* https://m.economictimes.com/news/economy/foreign-trade/indias-exports-cross-usd-820-bn-in-2024-25-commerce-ministry/articleshow/120134648.cms

Department of Biotechnology (2020). Government of India Ministry of Science and Technology. http://dbtindia.gov.in/about-us/introduction

Economist Intelligence Unit (2013). Cyber Power Index: Findings and Methodology. *The Economist.* http://gssd.mit.edu/search-gssd/site/cyber-power-index-findings-methodology-59935-tue-03-05-2013-1051

EFB, (2019). *Biotechnology*. European Federation of Biotechnology. www.efbiotechnology.org

Ernst & Young. (2018). *Beyond borders.* Biotechnology Report 2017: Staying the course. https://www.ey.com/Publication/vwLUAssets/ey-biotechnology-report-2017-beyond-borders-staying-the-course/$FILE/ey-biotechnology-report-2017-beyond-borders-staying-the-course.pdf Accessed May 04, 2020.

FAI. (2021). *The 100 km Boundary for Astronautics.* Fédération Aéronautique Internationale. Retrieved in 28 May 12, 2021 from https://www.fai.org/page/icare-boundary

Flight Global (2019). *Top 100 aerospace companies by revenue 2018 ($ millions).* https://www.flightglobal.com/download?ac=67085

Floridi, L. (2021). The Ethics of Artificial Intelligence for a Global Digital Society. *Springer Nature.* https://doi.org/10.1007/978-3-030-69978-9

Global Cybersecurity Index. (2018). Retrieved May 5, 2020 from https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2018-PDF-E.pdf

Google, Temasek, Bain & Company. (2022). *e-Conomy SEA* 2022. https://economysea.withgoogle.com

Kennedy, S. (2020). *Made in China 2025: Beijing's Industrial Policy Roadmap*. Center for Strategic and International Studies (CSIS).

Kuehl, D. T. (2009). From cyberspace to cyberpower: Defining the problem. *Cyberpower and national security*, 1.

Kamm, L. J. (1996). *Understanding Electro-Mechanical Engineering: An Introduction to Mechatronics.* John Wiley & Sons.

Lee, J., Park, Y., & Kim, H. (2021). Transitioning to Industry 5.0 in East Asia: Human-Centered Smart Manufacturing. *Technological Forecasting and Social Change*, 170, 120943.

Lee, J., & Liu, H. (2023). "Semiconductor Nationalism and the New Cold War." *Global Policy*, 14(1), 22–31. https://doi.org/10.1111/1758-5899.13201

Lennon, T., & Mass, N. (2008). Model-based design for mechatronic systems. *Electronics world-sutton then cheam-*, 1865, 23.

Mason, Bob. (2019). *So Who Has the Most Advanced Cyber Warfare Technology.* https://www.fxempire.com/education/article/so-who-has-the-most-advanced-cyber-warfare-technology-444874

Mazarr, M. J., et al. (2022). *Geopolitics and Advanced Technologies: A RAND Perspective*. RAND Corporation.

Medeiros, E. S. (2019). *Techno-politics in the 21st Century: The Strategic Role of Technology in Global Power Shifts.* Cambridge Scholars Publishing.

Ministry of Commerce & Industry, Government of India. (2025). *Trade Statistics.* https://www.commerce.gov.in/trade-statistics/

Norwegian University of Science and Technology (NTNU). (2020). *What is Biotechnology?*. https://www.ntnu.edu/ibt/about-us/what-is-biotechnology

OECD. (2010). *OECD Science, Technology and Industry Outlook 2010 Highlights*. http://www.oecd.org/science/inno/46674411.pdf Accessed May 5, 2020

OECD. (2022). *Science, Technology and Innovation Outlook.* Paris: OECD Publishing.

OECD. (2023). Science, Technology and Innovation Outlook 2023. Paris: OECD Publishing.

Rüland, J., & Manea, M. G. (2021). *The Politics of Technology and Global Governance: Emerging Powers in the 21st Century.* London: Routledge.

Segal, A. (2020). *The Hacked World Order: How Nations Fight, Trade, Maneuver, and Manipulate in the Digital Age.* PublicAffairs.

Singh, R. (2022). India's Industrial Policy and the PLI Scheme: A New Model for High-Tech Growth? *Indian Economic Review*, 57(1), 95–110.

Sipri (2020*). Nuclear weapon modernization continues but the outlook for arms control is bleak: New SIPRI Yearbook out now.* https://www.sipri.org/media/press-release/2020/nuclear-weapon-modernization-continues-outlook-arms-control-bleak-new-sipri-yearbook-out-now

Statista (2019). *Number of Operable Nuclear Reactors as of June 2019 by Country*. In Statista - The Statistics Portal. April 29, 2020 from https://www.statista.com/statistics/267158/number-of-nuclear-reactors-in-operation-by-country/

Strate, Lance (1999). The varieties of cyberspace: Problems in definition and delimitation. *Western Journal of Communication.* 63 (3): 382–83. doi:10.1080/10570319909374648

The Economist. (2019). Can China become a scientific superpower? - The great experiment. *The Economist.*

UNCTAD (2023). World Investment Report 2023: Investing in Sustainable Value Chains. *United Nations Conference on Trade and Development.* https://unctad.org

UNESCO. (2023). *Global Investment in R&D: Statistical Overview.* UNESCO Institute for Statistics.

Workman, D. (2019). *Aerospace Exports by Country.* http://www.worldstopexports.com/aerospace-exports-by-country/

World Bank. (2023). *High-technology exports (current US$) – China.* https://data.worldbank.org/indicator/TX.VAL.TECH.CD?locations=CN World Bank Open Data

World Bank (2023). *World Development Indicators: High-tech Exports (% of Manufactured Exports).* The World Bank Group. https://data.worldbank.org

World Robotics. (2019). *International Federation of Robotics.* May 5, 2020 from https://ifr.org/free-downloads/

World Intellectual Property Organization. (2023). *WIPO Indicators 2023.* https://www.wipo.int

Worldometers. (2025). *China Population.* 22 June, 2025. https://www.worldometers.info/world-population/china-population/

Worldometers. (2025). *India Population.* 22 June, 2025. https://www.worldometers.info/world-population/india-population/