THE IMPACT OF DIGITAL FINANCE AND ARTIFICIAL INTELLIGENCE ADOPTION ON CORPORATE GROWTH: EVIDENCE FROM JAPANESE LISTED COMPANIES*

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Abstract. The subject of this research is the impact of digital finance and artificial intelligence (AI) on the growth and profitability of Japanese listed companies. Specifically, it focuses on companies listed on the Tokyo Stock Exchange's Prime section. Analyzing financial and operational data from FY2020 to FY2024, we employ a mixed-methods approach integrating quantitative analysis of sectoral performance metrics, earnings reports, and macroeconomic indicators with qualitative insights from consulting firms and policy stakeholders. Findings reveal a record 6.7% year-on-year (YoY) increase in combined net profits for Prime Market firms in FY2024, driven by synergistic advancements in AI integration and digital financial innovations. The research aims to understand how digital finance and AI are reshaping Japanese corporate profitability within the context of the global economy.

Sectoral analysis of the impact of AI and Digital Finance on the economy and corporate profits reveals significant transformations across industries. These technologies enhance efficiency, reduce costs, and create new revenue streams, but their effects vary by sector and by countries.

Macroeconomic effects of AI on global GDP growth demonstrate the potential of a trillion-dollar contribution. Artificial intelligence is now considered one of the main inputs to increase total factor productivity (TFP). Japan’s AI adoption lags behind the US and China but remains advanced, with fintech reshaping financial services and banks adapting

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to new technologies. The Electronics and Technology sector led this growth, with a profit surge of +12% YoY, driven by global AI-related semiconductor demand. Semiconductor manufacturers, through public-private collaborations, demonstrated robust growth. Sectoral analysis highlights significant contributions from automotive +9% YoY, trading houses +15% YoY, and manufacturing/machinery +7% YoY, attributed to yen depreciation, commodity prices, and factory automation demand. Tech and finance sectors adopting AI see 5-10% margin expansion, according to the McKinsey reports. Fintech disruption forces traditional banks to adapt. Japan's banks and megabanks invest in AI but lag in fintech innovation. Japan's financial sector also saw a profit increase of +5% YoY due to positive interest rates and digital finance adoption.

AI and digital finance are boosting productivity and profits across sectors, but their benefits are uneven. Tech-savvy firms gain the most, while laggards risk disruption. Policymakers must ensure inclusive growth through reskilling and fair regulations. Japan's government initiative aims to integrate AI and fintech into infrastructure.

The total revenue of Japanese listed companies on the Tokyo Stock Exchange's Prime section reached a 4.3% YoY increase, with export-oriented sectors outperforming domestic ones by 8%. Macroeconomic drivers include a strong correlation between yen depreciation and exporter profitability and fluctuating commodity prices. Despite these gains, persistent challenges such as AI talent shortages and geopolitical trade instability underscore the necessity for adaptive strategies.

However, uncertainties surrounding U.S. tariff policies pose significant risks. This paper underscores the transformative role of digital finance and AI in driving corporate profitability while emphasizing the imperative for strategic adaptability in a volatile global economic environment.

While AI and digital finance are reshaping Japan's corporate landscape, their full potential remains untapped. Strategic investments, policy support, and cross-sector collaboration will determine whether Japan can transition from an advanced adopter to a global leader in these transformative technologies. Our results suggest that firms prioritizing AI adoption and digital finance integration achieve superior resilience and profitability.

The study concludes with policy recommendations for sustaining Japan's leadership in advanced technologies, emphasizing workforce upskilling, supply chain diversification, and strategic tariff mitigation.

Introduction

In recent years, digital finance, bolstered by advancements in artificial intelligence (AI) and big data analytics, has emerged as a critical driver of financial performance and economic growth, particularly in technologically advanced economies like Japan. For Japanese companies, especially those in the semiconductor industry and other innovative sectors listed in the Prime Section of the Tokyo Stock Exchange (TSE), digital finance and AI have become indispensable tools for navigating a complex economic landscape characterized by tariff pressures, geopolitical uncertainty, and fluctuating inflation-deflation dynamics. Between 2020 and 2024, these technologies have played a pivotal role in enhancing profitability, driving research and development (R&D) investment, and fostering economic resilience.

The remarkable surge in profitability among Japanese listed companies in recent years offers a compelling lens through which to examine the transformative role of digital finance and artificial intelligence (AI) in a rapidly globalizing economy. This study investigates this phenomenon, with a specific focus on firms listed in the Tokyo Stock Exchange's Prime section, to explain the complex relationship between technological innovation and corporate financial performance. The urgency of this research lies in the need to identify the key drivers of this growth, particularly in an era marked by rapid technological advancements and shifting macroeconomic conditions.

The impetus for this study arises from the observable correlation between the accelerated adoption of digital finance and AI technologies and the substantial rise in corporate earnings across Japan. Understanding this relationship is critical for assessing how these technologies are redefining traditional business models and fostering sustained economic expansion. While prior studies have explored the influence of digital finance and AI in various sectors [1; 2; 3], this research provides a novel contribution by analyzing their impact within the unique context of Japan's recent macroeconomic and policy shifts.

Preliminary analysis reveals two primary drivers contributing to the observed profitability surge. Firstly, technological innovation, specifically the integration of AI and advanced semiconductor technologies, has enabled the automotive, manufacturing, and machinery sectors to enhance operational efficiency and advance next-generation automation. Secondly, the Bank of Japan's (BOJ) transition to positive interest rates has strategically

reinforced the financial sector, promoting the adoption of digital finance solutions and improving corporate liquidity.

Despite these advancements, the study identifies critical challenges that could impede sustained growth: global trade uncertainties (potential U.S. tariff policies pose risks to Japan's export-oriented industries, highlighting vulnerabilities in an interconnected global economy); supply chain and talent gaps; organizational culture and conservative corporate management.

This research extends prior work by scholars such as:

– Frey & Osborne (2017) [1], who studied automation's labor market implications by analyzing how AI adoption enhances profitability in capital-intensive industries;

– Brynjolfsson & McAfee (2014) [2], who examined AI's macroeconomic effects, by providing sector-specific insights within Japan's corporate landscape;

– McKinsey Global Institute (2016) [3], which explored digital finance's global impact.

This study examines the factors driving recent growth in Japanese listed companies, focusing on: the financial sector's recovery, the impact of the AI boom on semiconductor-related industries, and the challenges posed by geopolitical uncertainties, particularly U.S. tariff policies. Furthermore, we analyze the transformative role of digital finance in reshaping Japan's financial system, highlighting its contribution to efficiency, inclusivity, and resilience. We also seek to identify and examine the external factors that significantly influence both internal firm decisions – regarding investments, development strategies, and technology adoption – and the broader configuration of the external business environment.

By combining empirical financial analysis with qualitative executive insights, this study offers a nuanced understanding of how technological advancements and policy reforms are reshaping Japan's corporate sector amid global economic volatility. The findings not only contribute to academic discourse but also provide actionable insights for policymakers and business leaders navigating the digital transformation era.

Methodology

This study employs a **mixed-methods approach**, combining **quantitative financial analysis** with **qualitative insights** to assess the impact of digital

finance and AI adoption on corporate growth among Japanese Prime Market-listed companies (FY2020–FY2024). Analyzing financial and operational data from FY2020 to FY2024, we employ analysis of earnings reports, sectoral performance metrics, and macroeconomic indicators with qualitative insights from corporate executives and policy stakeholders.

This article is structured as follows: Introduction and Methodology; TSE Prime Market: General Overview, Key Drivers of Profitability; Digital Transformation: How Digital Finance and AI Adoption Drive Economic Outcomes in Japan's Corporate Sector; Future Projections, Government Initiatives, Startup Ecosystem, Industry Challenges; Conclusions.

TSE Prime Market: General Overview, Key Drivers of Profitability

The convergence of digital finance and artificial intelligence (AI) has become a key driver of corporate growth in the 21st century. Digital finance has significantly reduced the cost of acquiring and processing private information by replacing traditional intermediaries with AI-driven analytics. This technological shift enables more informed strategic decisions while enhancing market transparency [4; 5]. Contemporary systems now outperform traditional methods that relied on exclusive information channels, as demonstrated by measurable improvements in corporate decision quality [6; 7].

Unlike traditional methods that rely on exclusive channels such as insider information, digital finance leverages AI-driven analytics to enhance data accessibility, transparency, and processing efficiency [8; 9]. For Japanese semiconductor firms, this has translated into improved supply chain management, optimized production processes, and better risk assessment, all of which contribute to higher profit margins. For example, companies like Tokyo Electron and Renesas Electronics have reported increased profitability due to AI-powered demand forecasting and inventory management systems, which have minimized waste and maximized resource utilization [10; 11].

Moreover, the integration of AI into financial operations has allowed firms to identify new revenue streams and optimize pricing strategies. In an era of geopolitical uncertainty and tariff pressures, such as the U.S.-China trade tensions and Japan's own export restrictions, these capabilities have been crucial for maintaining competitiveness. By leveraging digital finance

tools, Japanese companies have been able to adapt to shifting trade policies and mitigate the impact of tariffs on their bottom line.

Japanese listed companies are projected to achieve record profits in recent years, especially in fiscal 2024, a testament to the synergistic power of financial innovation and AI-driven technological advancements. This success is mirrored in the Nikkei Stock Average's remarkable performance, reaching new highs daily since the start of 2024 and attracting significant attention to the Japanese market. The JPX Prime 150 Index, launched by JPX Market Innovation & Research in collaboration with Tokyo Stock Exchange (TSE) and Nikkei Inc. in July 2023 and with linked products introduced in early 2024, tracks 150 top-performing companies focused on value creation. As a barometer of the overall health and success of the Japanese corporate sector, the JPX Prime 150's performance is closely linked to the record profits being reported by listed companies [12].

The JPX Prime 150 Index serves as a valuable benchmark for identifying Japanese companies that are estimated to create sustainable value, making it highly relevant for research on corporate performance, market efficiency, and investor behavior. The index selects constituents based on two key dimensions of value creation [13]:

1. Return on Capital (Equity Spread: ROE – Cost of Equity)

– A positive equity spread (where ROE exceeds the cost of equity) indicates that a company is generating returns above investor expectations, signaling efficient capital allocation and value creation. This metric helps distinguish firms that are truly enhancing shareholder value from those that may be profitable but fail to meet required returns.

2. Market Valuation (PBR: Price-to-Book Ratio)

– A PBR above 1x suggests that the market prices the company’s stock above its book value, reflecting investor confidence in future growth, intangible assets, or superior management. This forward-looking measure captures market sentiment and non-financial factors that traditional accounting metrics may overlook.

By focusing on companies excelling in both financial performance (ROE vs. cost of equity) and market expectations (PBR > 1x), the JPX Prime 150 Index offers a robust framework for analyzing:

– Corporate Governance & Value-Creating Management: how firms align profitability with investor expectations;

– Market Efficiency: whether stock prices reflect fundamental and non-financial value drivers;

Investment Strategies: the long-term viability of targeting high-spread, high-valuation firms.

Incorporating JPX Prime 150's performance into our research can provide empirical insights into Japan's efforts to promote value-based management and enhance stock market appeal, while offering comparative perspectives for global investors.

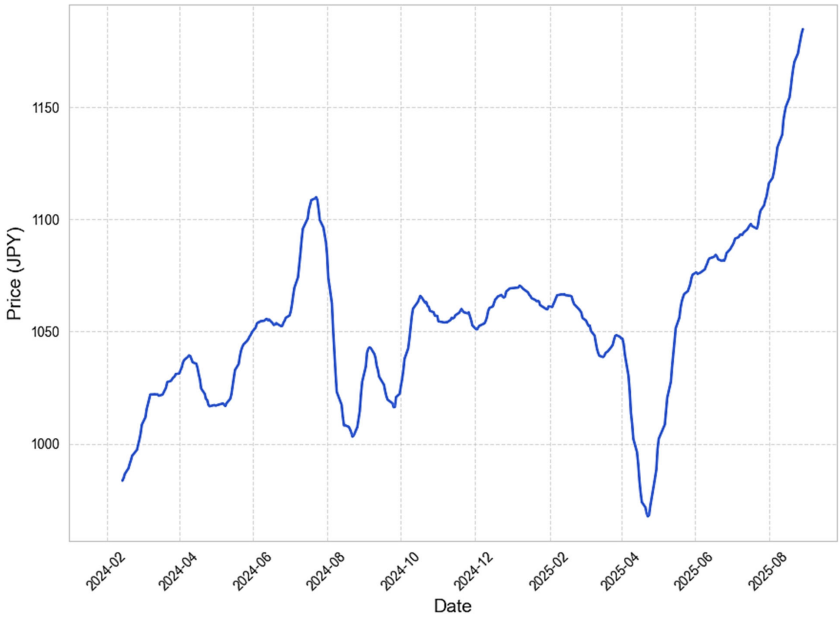


Figure 1. Stock price index - historical (JPX Prime 150 Index)

Source: [13]

The TSE Prime Market hosts a significant number of companies in the information and communication sector, which is the primary driver of AI adoption in Japan. These industry leaders are driving advancements in AI, automation, semiconductors, and digital transformation. Many of these firms, such as Toyota, Sony, and SoftBank, are defining the future through

disruptive innovations in intelligent systems, industrial automation, and next-gen digital infrastructure and are fundamentally reshaping global business paradigms. They have a significant global presence and influence. Also, they heavily invest in research and development, ensuring they remain competitive and innovative in a rapidly evolving technological landscape (Table 1).

Table 1

Global Corporate R&D Investors from Japan

Rank	Firm	Industry	R&D (€, millions)	R&D Growth	R&D Intensity
16	Toyota Motor	Automobiles & Parts	€8,776 millions	10%	3%
33	Honda Motor	Automobiles & Parts	€6,221 millions	7%	5%
36	NTT	Mobile Telecommunication	€5,721 millions	9%	6%
40	SONY	Leisure Goods	€5,340 millions	19%	7%

Source: [14; 15]

Effective April 4, 2022, Japan's new market segments have distinct listing criteria. The Prime Market targets companies with sufficient market capitalization and liquidity to attract institutional investors. These companies must demonstrate high-quality corporate governance and a commitment to sustainable growth and long-term value enhancement, prioritizing constructive investor dialogue. Both quantitative and qualitative criteria exist for liquidity, corporate governance, and other relevant factors. The initial and continued listing criteria are generally integrated, meaning listed companies must continuously meet the initial requirements. Each market segment operates independently. Therefore, companies wishing to transfer to a different segment must undergo an examination based on the initial listing criteria for that target segment [16].

Table 2 lists ten companies from the Tokyo Stock Exchange's Prime section, selected based on their demonstrated leadership in technological innovation. These companies exhibit substantial research and development activities and are characterized by their contributions to technological development and economic expansion in their respective industries.

Table 2

JPX Prime 150 Index – Market Caps (FY2024 Actual Data)

Rank	Company Name	Ticker Symbol	Industry	Market Cap (¥, Mar 2025)	Innovation Focus
1	Toyota Motor Corporation	7203	Automotive	¥43.1 trillion	Leader in hybrid and electric vehicle technology, autonomous driving, and hydrogen fuel cells. **Expanded** leadership in EVs, solid-state batteries, and autonomous mobility. **Solid-state battery commercialization**, autonomous driving partnerships (such as Isuzu, Mazda).
2	Sony Group Corporation	6758	Technology/ Entertainment	¥23.2 trillion	Innovator in gaming (PlayStation), imaging sensors, and AI-driven entertainment solutions (generative AI tools), advanced imaging for AR/VR. **AI-generated content tools**, dominance in CMOS sensors (60% global market share).
3	Keyence Corporation	6861	Industrial Automation	¥14.5 trillion	**Pioneer** in sensors, machine vision, and factory **automation technologies**. **AI-powered QC systems** and high-speed 3D vision for EV/electronics manufacturing.
4	SoftBank Group Corp.	9984	Technology/ Investment	¥20.8 trillion	Major investor in AI, **robotics,** and next-generation technologies through Vision Fund. **AI data center expansion** (with Arm's Neoverse chips) and robotics IP monetization.
5	Tokyo Electron Limited	8035	Semiconductor Manufacturing	¥10.1 trillion	Leading supplier of advanced **semiconductor** production equipment. **Next-gen lithography** tools for 2nm chips and beyond.

Rank	Company Name	Ticker Symbol	Industry	Market Cap (¥, Mar 2025)	Innovation Focus
6	Hitachi, Ltd.	6501	Conglomerate (Technology, Infrastructure)	¥16.1 trillion	Innovator in IoT, AI, and smart infrastructure solutions. **Green energy tech** (for example, grid optimization) and industrial AI.
7	Recruit Holdings Co., Ltd.	6098	Human Resources/ Technology	¥12.4 trillion	Leader in **AI-driven** HR tech platforms and workforce management solutions (predictive workforce analytics).
8	NTT Corporation	9432	Tele-commu-nications	¥14.2 trillion	Driving **5G**, quantum computing, and **digital transformation initiatives**. **6G research**, quantum encryption, and smart city infrastructure. Open RAN 5G/6G trials.
9	Shin-Etsu Chemical Co., Ltd.	4063	Chemicals	¥8.5 trillion	World's largest producer of silicon wafers, critical for **semiconductor** manufacturing. **Semiconductor materials** for advanced packaging (chiplets). **Photoresist/advanced materials** for GAA (gate-all-around) transistors.
10	Canon Inc.	7751	Technology/ Imaging	¥5.8 trillion	Innovator in imaging technology, healthcare equipment, and industrial optics. **Nanoprinting** for semiconductors and AI-enhanced medical diagnostics. **Nanoimprint lithography (NIL)** challenge to ASML in chip manufacturing.

Note: Closing prices as of March 31, 2025.

Source: [17]

Companies within the Tokyo Stock Exchange Prime section are demonstrating a significant global impact on technological advancement and economic growth. Toyota's and Sony's substantial market capitalization increases (+32.8% and +52.8% respectively, from beginning of FY2023 to the end of FY2024) signal Japan's resurgence in the global technology and electric vehicle markets [27; 146]. The semiconductor boom, driven by AI demand, has propelled Tokyo Electron and Shin-Etsu, highlighting their critical global supply chain roles. Notably, the widespread adoption of AI, illustrated by Japanese companies, positions these TSE Prime companies as leaders in AI-driven innovation.

Japan maintains a prominent position within the Global Innovation Index (GII), indicating a well-developed ecosystem conducive to technological advancement and innovation. The 2024 GII report identifies Japan as a leading innovator within the South East Asia, East Asia, and Oceania (SEAO) region, placing it within the top 25 economies globally. Specifically, Japan secured a global ranking within the top 13, a position consistently held since 2021, achieving a score of 54.1 in 2024. Within the SEAO region, Japan ranks fourth, following Singapore (4th), South Korea (6th), and China (11th). This performance is primarily attributed to its exceptional metrics in crucial indicators, including research and development (R&D) expenditure, patent applications, and high-technology exports [14]. According to the report Japanese Tokyo–Yokohama is the biggest Science and Technology (S&T) cluster globally and continues to lead. Japan has 3 clusters in the top 100 S&T clusters of the GII (Table 3).

Table 3

The Top Science and Technology Clusters in Japan

Rank*	Cluster name	Top patent field	Top academic subject
1	Tokyo-Yokohama	Computer technology	Physics
7	Osaka-Kobe-Kyoto	Automobiles & Parts	Chemistry
15	Nagoya	Mobile Telecommunication	Chemistry

* Rank in the top 100 S&T clusters of the Global Innovation Index

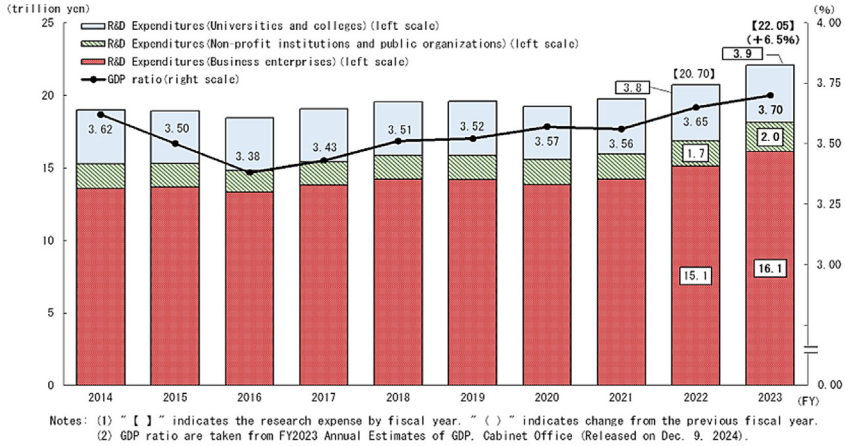
Source: [14]

These results highlight Japan's sustained commitment to promoting innovation, particularly in strategic sectors such as semiconductors,

robotics, and artificial intelligence, where it has established a recognized global leadership role [19; 20].

Japan's innovation prowess is further evidenced by its high R&D intensity, with R&D spending accounting for approximately 3.7% of its GDP in 2023, one of the highest ratios among OECD countries [22]. Japan's total expenditure on R&D during fiscal year (FY) 2023 stood at 22.05 trillion yen, a 6.5 percent increase from the previous fiscal year. This figure is the highest ever [21].

Japan's overall R&D expenditure increased across all research sectors in the latest fiscal year. Business enterprises led with 16.12 trillion yen (6.5% increase), followed by universities/colleges at 3.94 trillion yen (2.5% increase), and non-profit/public organizations at 1.99 trillion yen (15.1% increase). Within the business sector, transportation equipment (4.44 trillion yen, 10.6% increase), pharmaceuticals (1.54 trillion yen, 7.6% increase), and electronic components (1.37 trillion yen, 11.3% increase) represented the largest R&D spending industries (Figure 2).



Notes: (1) " [ ] " indicates the research expense by fiscal year. " ( ) " indicates change from the previous fiscal year.
(2) GDP ratio are taken from FY2023 Annual Estimates of GDP. Cabinet Office (Released on Dec. 9. 2024).

Figure 2. R&D Expenditures Growth

Source: [21]

This investment has enabled Japanese firms to pioneer breakthroughs in advanced materials, quantum computing, and AI-driven technologies,

which are critical for maintaining competitiveness in an increasingly digital and interconnected global economy.

Japan's innovation ecosystem, characterized by strong collaboration between academia, industry, and government, demonstrates a high degree of efficiency in converting innovation inputs into outputs. This is evident in initiatives like the Society 5.0 framework, which strategically integrates AI, IoT, and big data into societal infrastructure to drive sustainable economic growth [23]. Consequently, Japan produces more innovation outputs relative to its level of innovation investments, as reflected in its strong performance in the GII. These efforts have not only strengthened Japan's GII position but also positioned it as a key player in addressing global challenges such as climate change, energy efficiency, and healthcare innovation (Table 4).

Table 4

Japan Global Innovation Index (GII) Ranking (2020-2024)

Year	GII Position	Innovation Inputs	Innovation Outputs
2020	16th	12th	18th
2021	13th	11th	14th
2022	13th	11th	12th
2023	13th	11th	14th
2024	13th	12th	14th

Source: [14]

Japan’s top-tier ranking in the *GII* is a testament to its sustained investment in R&D, its leadership in cutting-edge technologies, and its collaborative innovation ecosystem. These factors collectively contribute to Japan’s ability to drive economic growth and maintain its competitive edge on the global stage.

While global competitors are increasing their R&D investments to compete within the industry, Japanese firms spend more on R&D than any other country in the Asia region in the semiconductor industry. These high levels of reinvestment into R&D drive innovation in Japan's semiconductor industry and, in turn, help maintain global sales, market leadership and domestic employment.

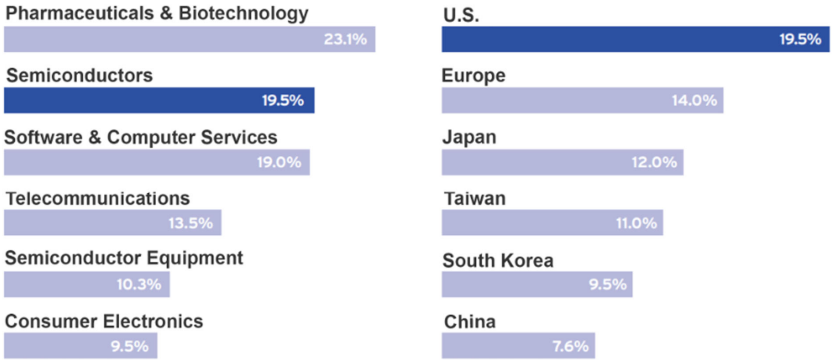


Figure 3. R&D Expenditures as a Percentage of Sales

Source: [24]

Furthermore, Japan remains a critical hub for global semiconductor innovation, housing companies that not only address industry-specific challenges but also drive technological advancements on a global scale. These firms are pivotal contributors to technological progress, R&D, and innovation, thereby promoting both technological advancement and economic growth within their industries.

The Table 5 represents the financial overview of major semiconductor companies, Tokyo Stock Exchange Prime Section.

Japanese semiconductor leaders have demonstrated notable growth, primarily attributed to the increased demand for AI and advanced technology semiconductors. These companies occupy critical positions within the global semiconductor supply chain, specializing in advanced manufacturing and materials. Post-pandemic, the industry experienced a growth phase, driven by heightened demand in consumer electronics, remote work technology, and data center infrastructure, resulting in improved net profits. Subsequent supply chain disruptions, component shortages, and geopolitical uncertainties introduced market volatility, with varied impacts across segments. However, demand remained robust for high-performance computing, AI chips, and automotive semiconductors. The current surge in AI applications is driving significant demand for advanced semiconductors, projecting positive net sales and profits for 2025, particularly for companies

specializing in advanced manufacturing equipment and materials. But global economic and geopolitical risks continue to be relevant factors.

Table 5

TSE Prime Semiconductor Innovation Leaders: Market Valuation

Company	Industry Specific	Market Cap
Tokyo Electron (8035)	A leading supplier of semiconductor production equipment.	~¥8.5-9 trillion (approximately $57-60 billion)
Advantest (6857)	A major player in semiconductor testing equipment.	~¥4.5-5 trillion (approximately $30-33 billion)
Renesas Electronics (6723)	A key provider of microcontrollers and system-on-a-chip (SoC) solutions.	~¥2.5-3 trillion (approximately $22-23 billion)
Lasertec (6920)	A key player in the manufacturing of equipment used in advanced chip production.	~¥2.3-2.5 trillion (approximately $15-17 billion)
Screen Holdings (7735)	Specializes in semiconductor manufacturing equipment and display production equipment.	~¥2-2.2 trillion (approximately $13-15 billion)
SUMCO (3436)	A major producer of silicon wafers, a crucial material for semiconductor manufacturing.	~¥1.2-1.4 trillion (approximately $8-9 billion)
Rohm (6963)	A provider of power semiconductors and other electronic components.	~¥1.1-1.3 trillion (approximately $3.3-4 billion)
Disco Corporation (6146)	A leading manufacturer of precision cutting and grinding tools used in semiconductor manufacturing.	~¥1-1.2 trillion (approximately $7-8 billion)
Taiyo Yuden (6976)	Specializes in capacitors and other electronic components.	~¥800-900 billion (approximately $5.3-6 billion)
Shinko Electric Industries (6967)	Focuses on lead frames and other semiconductor packaging solutions.	~¥500-600 billion (approximately $4.5-5 billion)

Sources: [25]

Financial results of leading Japanese semiconductor companies are finalized by March 31, 2025 and represented below in the Table 6 with complete FY2024 figures.

Table 6

Japanese Semiconductor Companies Financial Performance 2020-2024 FY (in billions of JPY)

Company (Ticker)	Metric	FY2020	FY2021	FY2022	FY2023	FY2024 (Final)
Tokyo Electron (8035)	Net Sales	1,130.7	1,399.1	1,866.2	2,237.3	**1,830.5**
	Net Profit	212.7	282.4	411.2	538.1	**363.9**
Advantest (6857)	Net Sales	312.8	416.9	560.4	614.2	**484.5**
	Net Profit	69.8	87.3	142.1	168.9	**62.3**
Renesas (6723)	Net Sales	715.7	994.1	1,417.7	1,565.2	**1,007.9**
	Net Profit	45.6	192.5	289.0	315.4	**214.3**
SUMCO (3436)	Net Sales	266.2	335.7	388.9	456.3	**339.4**
	Net Profit	19.0	42.1	65.9	85.4	**63.1**
Screen Holdings (7735)	Net Sales	320.3	364.2	441.8	526.9	**397.8**
	Net Profit	14.6	33.5	48.8	64.1	**52.2**
Lasertec* (6920)	Net Sales	54.3	88.9	145.1	187.3	**121.5**
	Net Profit	16.5	28.6	48.7	61.2	**40.2**
Disco (6146)	Net Sales	182.9	217.8	255.4	289.6	**218.9**
	Net Profit	44.8	57.7	69.3	78.5	**59.8**
Rohm (6963)	Net Sales	359.9	452.1	507.8	561.3	**467.8**
	Net Profit	37.0	66.8	85.2	93.7	**53.9**
Taiyo Yuden (6976)	Net Sales	300.9	363.4	379.2	395.8	**277.9**
	Net Profit	40.4	48.7	52.3	55.1	**32.1**
Shinko Electric (6967)	Net Sales	157.4	178.2	196.5	212.8	154.3
	Net Profit	15.8	20.3	25.7	29.4	20.7

Note:

– All figures are rounded to one decimal place

– All monetary values are in billions of Japanese Yen (¥)

– For Japanese companies FY2024 (Fiscal Year 2024) starts April 1, 2024 – ends March 31, 2025. FY refers to fiscal year ending March 31 of the stated year

– Historical data from FY2020-2024 represents full fiscal year results

– Lasertec's fiscal year ends June 30

Sources: [28; 29; 30; 31; 32; 33; 34; 35; 36; 37; 38; 39]

The semiconductor industry experienced a significant downturn in FY2024 (April 2023–March 2024), primarily attributed to a post-pandemic demand correction characterized by inventory accumulation. Following the 2021–2022 chip shortage, companies engaged in over-ordering, resulting in excess inventory during 2023–2024. This was compounded by weakened

consumer demand, evidenced by declining sales in smartphones, PCs, and home electronics, exemplified by Taiyo Yuden's 30% sales decrease [38].

Geopolitical and macroeconomic factors further contributed to this decline. The slowdown in the Chinese economy and reduced demand from this key market negatively impacted Japanese suppliers, as demonstrated by Rohm's 42% profit reduction [36; 37]. Additionally, U.S. export controls and restrictions on advanced chip technologies to China affected certain Japanese suppliers.

An oversupply of DRAM and NAND memory chips led to a price crash, significantly impacting companies like Kioxia (not listed) and suppliers such as SUMCO, which reported a 26% sales decline [33].

Furthermore, capital expenditure reductions by major chipmakers, including TSMC and Samsung, resulted in delayed equipment orders, adversely affecting Tokyo Electron (18% sales decline) and Advantest (21% sales decline) [28; 29].

Despite this cyclical downturn, the semiconductor industry is projected to recover in 2025–2026, driven by structural factors including artificial intelligence (AI), electric vehicles (EVs), and industrial applications. The AI and data center sector is expected to significantly contribute to this recovery, with demand for high-performance computing (HPC) chips from companies like NVIDIA, AMD, and Intel necessitating advanced packaging technologies, thereby benefiting equipment suppliers such as Tokyo Electron and Lasertec [28; 34]. Specifically, Lasertec's extreme ultraviolet (EUV) mask inspection tools are critical for AI chip production.

The automotive and industrial sectors are also anticipated to recover, with the growth of EVs positively impacting Renesas, which forecasts a 20% sales increase in 2025 for its automotive chips [30; 31]. Companies like Rohm, which supply power chips for industrial robots, will benefit from increased factory automation [36; 37]. A rebound in the memory market, characterized by DRAM and NAND price recovery, is expected to aid suppliers such as SUMCO, and major manufacturers like Samsung and SK Hynix implement production cuts to stabilize prices [33].

Government support is a critical factor in this recovery, with Japan pledging over ¥2 trillion in chip subsidies to bolster domestic production, exemplified by investments in Rapidus and TSMC's Kumamoto fab. Inventory normalization is also expected to positively affect companies like

Taiyo Yuden, which anticipate a demand rebound as excess inventories are depleted.

This projected recovery is significantly influenced by the AI-driven growth in Semiconductor Industries. The surge in generative AI has spurred significant growth in semiconductor-related industries. Generative AI, with its complex algorithms and massive data processing needs, requires specialized chips. These include high-performance GPUs (Graphics Processing Units) and other advanced processors designed for AI workloads. This has created a surge in demand for the semiconductors that companies like Lasertec and Advantest produce. These companies have reported record profits, fueled by robust demand for AI-related products.

As for Lasertec, it specializes in the manufacturing of equipment used in semiconductor production, particularly those crucial for advanced chip manufacturing. The increased demand for these specialized AI chips directly translates to higher demand for Lasertec's equipment, boosting their profits. Advantest is a leading manufacturer of semiconductor testing equipment. As the demand for AI chips rises, so does the need for testing these chips to ensure quality and performance. This has led to a surge in orders for Advantest's testing equipment, contributing to their record profits. This sustained demand underscores the resilience and considerable growth potential of the generative AI sector.

In July 2024, Japan's Ministry of Economy, Trade and Industry (METI) unveiled its Semiconductor Revitalization Strategy. This comprehensive plan outlines a three-step approach: first, securing manufacturing infrastructure to meet current demand; second, establishing next-generation technologies; and third, conducting R&D on future semiconductor technologies, alongside human resources development, international collaboration, and the pursuit of higher-performance, greener semiconductors. The strategy leverages the Japan-U.S. Basic Principles on Semiconductor Cooperation to strengthen ties with the United States and fosters collaboration with the EU, Belgium, the Netherlands, the UK, South Korea, Taiwan, and other international partners. These collaborations will focus on developing use cases and advancing R&D for next-generation semiconductors, tailored to the specific needs of each partner country and region.

For the 2023 fiscal year, Japan allocated a substantial ¥1.85 trillion (US$13 billion) to its semiconductor initiative [40]. This funding, sourced

from various acts, was distributed across key areas: ¥632 billion (US$4.5 billion) under the 5G Promotion Act supported advanced logic semiconductor development; ¥575.4 billion (US$4.1 billion) through the Economic Security Act focused on power, analog, material, and electronic component technologies; and ¥645.6 billion (US$4.6 billion) via the Post 5G R&D Fund was dedicated to R&D efforts, including support for Rapidus, design advancements, and human resource development.

In 2024, Japan made significant investments in semiconductor technology through substantial subsidies. KIOXIA (JP) and Western Digital (US) received up to ¥150 billion (US$1 billion) on February 6th to advance 3D NAND flash memory technology. Later that month, on February 24th, a much larger subsidy of up to ¥732 billion (US$4.88 billion) was awarded to JASM, a joint venture between TSMC (TW), Sony (JP), Denso (JP), and Toyota (JP). This funding will support the construction of a second fabrication plant for advanced logic semiconductors.

The resulting boom in the semiconductor industry has a ripple effect throughout the Japanese economy. It stimulates further investment in research and development, creates high-skilled jobs, and strengthens Japan's position in the global technology landscape. The generative AI boom is not a short-term trend. It's expected to continue driving demand for advanced semiconductors for years to come, as AI technology becomes further integrated into various aspects of our lives. This suggests that the positive impact on semiconductor companies in Japan could be sustained in the long term.

However, potential risks remain that could impede the projected recovery. Geopolitical tensions between China and Taiwan pose a threat of supply chain disruptions, which could delay market stabilization. Additionally, elevated U.S. interest rates may constrain chip manufacturing investments due to increased borrowing costs.

As highlighted by the BofA Global Research 2024 Japan Conference [41], Japan possesses key strengths in navigating the evolving global economic landscape, characterized by rising inflation, national security concerns, and the transformative influence of AI. The conference emphasized that the pre-COVID-19 era of low inflation and interest rates is unlikely to return, with structural forces suggesting a trend towards higher averages.

Japan's strategic position in the semiconductor supply chain, coupled with its increasing adoption of AI, particularly in addressing its labor shortage, presents significant opportunities. Japanese component manufacturers are poised to benefit from the integration of AI into devices, though the full-scale impact may be delayed. The emergence of AI-focused GPU architectures also drives demand for Japanese hardware components.

While Japanese companies are diversifying production to mitigate U.S. export restrictions, concerns remain regarding potential Chinese retaliatory measures. Exporting to China, Japan's largest neighbor, presents complex challenges that hinder growth. Despite these geopolitical complexities, Japan's robust semiconductor industry and its proactive engagement in AI development position it as a critical player in the global technology landscape. The confluence of government support, technological innovation, and strategic industry positioning suggests a potential renaissance for Japan's semiconductor sector, albeit within the context of prevailing global economic and geopolitical uncertainties [41].

According to the Boston Consulting Group (BCG) report "Japanese Semiconductor Renaissance" the semiconductor industry is critical to the global economy, representing a $600 billion global semiconductor market, which is widely predicted to be a trillion-dollar industry by 2030, that underpins both everyday technologies and industries crucial for national and economic security, where Japan's possess unique position [42]. Japan is a global leader in NAND and Discrete, Analog, and Other (DAO) wafer fabrication. It also excels in semiconductor equipment and materials, with significant market shares in sub-segments like photoresist processing equipment. Japan is making strategic investments to enhance its semiconductor industry, leveraging its original equipment manufacturers (OEMs) and partnerships. For example, the JASM joint venture between TSMC, Sony, and Denso is investing $7 billion in a logic wafer fab in Kumamoto. Future opportunities are related to next-generation DRAM, which will be crucial for supporting AI and generative AI advancements. Investing in DRAM aligns with Japan's strategic focus on energy, supply chain resilience, and workforce development. Establishing a leading-edge memory fab in Japan could create significant economic benefits, including over 10,000 jobs and substantial annual output and tax revenues [43].

Investments and potential economic benefits of expanding its semiconductor capabilities are represented in the Table 7 below:

Table 7

Japan's strategic position in the semiconductor industry

Category	Description	Key Figures
Semiconductor Market Size	Global semiconductor market size	$600 billion
Japan's Market Share	Japan's share in global photoresist processing equipment market by revenue (2022)	92%
Japan's Strategic Investments	Investment in JASM joint venture for logic wafer fab in Kumamoto	$7 billion
Economic Impact of Memory Fab	Estimated jobs created by a leading-edge memory fab in Japan	Over 10,300 jobs
Annual Output of Memory Fab	Estimated annual output from a leading-edge memory fab in Japan	Exceeding $5 billion
Local Materials Spend	Estimated annual local materials spend for a memory fab in Japan	$2 billion
Tax Revenues	Estimated annual corporate tax revenues from a memory fab	Up to $220 million

Source: [43]

Japan's semiconductor industry is one of the most R&D-intensive sectors globally, with companies investing heavily in innovation to maintain their competitive edge. From 2022 to 2023, R&D spending in Japan's tech sector grew by over 30% annually, driven by the need to develop cutting-edge technologies such as AI chips, quantum computing, and advanced materials [45]. Digital finance has played a critical role in facilitating these investments by providing companies with access to real-time market data, predictive analytics, and AI-driven insights into emerging trends. SoftBank's deployment of a 4,000+ NVIDIA GPU-powered generative AI platform from September 2023 to July 2025 enables the development of Japanese-specific Large Language Models (LLM) [26]. This initiative reduces reliance on foreign AI models and enhances national data sovereignty.

Artificial intelligence (AI) has become a cornerstone of corporate strategy in Japan, with substantial investments across industries. According to recent market analysis, Japanese government spending on AI and Semiconductor Industry reached ¥1.6 trillion [47], while Japanese companies' private AI investment totaled ¥140 billion in 2024 with Artificial Intelligence Market growth rate of 20.4% (CAGR from 2025 to 2033) [48].

Japan is actively establishing itself as a key hub for AI infrastructure, supported by substantial investments from both domestic corporations and multinational technology firms, including NVIDIA, Microsoft, and OpenAI [46]. This rapid expansion is driven by escalating demand for generative AI and machine learning (ML) capabilities, while simultaneously stimulating employment growth and facilitating international research and development (R&D) collaborations. Japan is witnessing significant investments in large-scale AI data centers, such as SoftBank Corp., GMO Internet Group, Highreso, KDDI, Rutilea, SAKURA Internet and KDDI's collaboration with NVIDIA, Sharp, and Supermicro [51]. These projects emphasize scalability, energy efficiency, and high-performance computing (HPC) capabilities, positioning Japan as a competitive hub for AI infrastructure. Partnerships between telecom giants (KDDI, SoftBank), tech firms (Microsoft, NVIDIA), and manufacturers (Sharp) illustrate a multi-stakeholder approach to AI ecosystem growth. Microsoft's $2.9 billion investment further underscores foreign tech leaders' confidence in Japan's AI market [46].

Beyond individual projects, Japan is clearly positioning itself as a future leader in AI. Artificial intelligence is now considered one of the main inputs to increase total factor productivity (TFP) and has been receiving mass amounts of funding in developed countries, including Japan. METI has formally recognized AI infrastructure as a critical enabler of digital transformation. The Japanese government has allocated ¥1.05 trillion ($7 billion) for next-generation chip and quantum computing research and ¥471.4 billion to support domestic advanced chip production, according to Bloomberg [49]. In a separate allocation from the previous fiscal year's supplementary budget, METI approved subsidies totaling ¥101.7 billion. These subsidies are designated for projects aimed at strengthening Japan's fragmented high-technology supply chain. Specifically, ¥70.5 billion of this allocation is directed towards a joint venture between Denso Corp. and Fuji Electric Co., which plans to invest a total of ¥212 billion to increase the production of silicon carbide wafers and power chips, essential components in electric vehicles. This initiative follows METI's prior approval of subsidies for a collaborative effort between Toshiba Corp. and Rohm Co., focused on the joint production of power semiconductors [49]. The sustained investment in AI infrastructure within Japan indicates a strategic national commitment to become a leading contributor to the global AI ecosystem.

IDC reported that the Japanese AI systems market reached approximately $ 4.5 billion, with a year-on year growth rate of 35.5%. The AI systems market growth is attributed to the fact that a broad range of companies have embarked on digital transformation (DX), and have started increasingly utilized AI, a part of the de facto technologies. Japan's Ministry of Internal Affairs and Communications (MIC) predicts that Japan's AI systems market will grow to approximately $ 7.3 billion by 2027 [50]. AI related investments in Japan increase constantly from 2020. These investments have been directed toward areas such as machine learning, natural language processing, and robotics, which are essential for driving innovation in the semiconductor industry. For instance, AI-powered design tools have enabled Japanese firms to accelerate the development of next-generation semiconductors, reducing time-to-market and enhancing product quality [52].

While AI investments are predictive of future growth trajectories and the configuration of the evolving AI ecosystem, AI spending quantifies existing AI capacity.

Table 8

Comparative Analysis of Japan's Public and Private AI Infrastructure Spending (FY2020-FY2024)

Fiscal Year	Corporate AI Spending	Government AI Allocation	Key Confirmed Commitments
FY2020	$1.5B	$0.6B	METI's Moonshot R&D ($500M).
FY2021	$2.7B	$0.8B	Digital Garden City Nation ($700M).
FY2022	$4.5B	$1.3B	METI's AI Chip Strategy ($1B).
FY2023	$6.8B	$1.4B	Microsoft's $2.9B (multi-year).
FY2024	**$9.2B** (est.)	**$1.6B** (est.)	SoftBank Sakai DC ($740M), METI's AI sovereignty fund.

Note:

– Fiscal Year (FY) is from April current year to March next year)

– Corporate spending includes direct capital expenditures on AI infrastructure (data centers, GPU clusters, and internal R&D facilities).

– Government allocation comprises national AI initiatives and public subsidies.

– Figures exclude venture capital, mergers/acquisitions, and operational AI software expenses.

Sources: [45; 50; 51; 53]

The Table's 8 data, showing a corporate AI spending CAGR of around 57% and a government allocation CAGR of approximately 28% from

FY2020 to FY2024, suggests a clear trend towards industry-centric AI development in Japan.

From FY2020 to FY2024, Japanese corporate AI spending has grown significantly, with total annual expenditures reaching an estimated $9.2 billion in FY2024 (April 2024–March 2025). Leading companies like Toyota, Sony, SoftBank, and Hitachi have driven this trend, focusing on AI infrastructure such as data centers (such as SoftBank's Sakai facility), GPU clusters, and industrial R&D. These investments support applications in autonomous driving, robotics, and healthcare, reflecting Japan's strategic emphasis on AI-driven efficiency and innovation. Alongside private-sector spending, the Japanese government has allocated $1.6 billion in FY2024 for national AI initiatives (for example, METI's sovereignty fund), ensuring Japan remains a competitive player in the global AI landscape [54; 55; 56; 57].

According to reports from IDC Japan, Statista, and METI, Japan's AI spending has grown at a compound annual growth rate (CAGR) of 20-25% during this period. An estimated breakdown is in the table below:

Table 9

Total AI Spending and Key Drivers

Year	Total AI Spending (USD)	Key Drivers
2020	~$2.5 billion	Initial adoption of AI in manufacturing, healthcare, and finance.
2021	~$3.1 billion	Increased investment in AI for automation and data analytics.
2022	~$3.8 billion	Growth in AI-powered IoT, robotics, and supply chain optimization.
2023	~$4.7 billion	Expansion of generative AI (for example, ChatGPT-like tools) and AI in R&D.
2024	~$5.8 billion (estimated)	Focus on AI for sustainability, autonomous systems, and advanced manufacturing.

Note:

– Aggregate spending across all AI segments (including non-hardware, software, services, non-infrastructure)

– Calendar year reporting (vs. fiscal year in Table 8)

– Estimates for 2024 are based on CAGR projections from 2020-2023 data

– 2024 estimate is 37% lower than Table 8's FY2024 projection due to exclusion of multi-year capex

Sources: [58; 60; 61]

Table 9 demonstrates steady growth of AI spending that reflects rapid AI adoption across industries. Initial pilot projects (2020) evolved into enterprise-wide deployments (2024), particularly in automotive (Toyota) and electronics (Sony). [54; 55] Generative AI's impact (2023–2024) aligns with global trends but emphasizes Japan's unique focus on robotics and sustainability.

The analysis of leading Japanese Prime Listed Companies is represented below in the Table 10 indicates that top 10 firms account for ~33% of Japan's total corporate AI spending (Table 8, FY2023). SoftBank (600M) and Toyota (600M) lead in absolute spending, reflecting their AI-first strategies [68].

Table 10

Total AI Spending by Leading Japanese Prime Listed Companies (2023-2024)

Company	AI Spending (2023-2024)
Toyota	~$500 million annually
Sony	~$400 million annually
SoftBank	~$600 million annually
Hitachi	~$300 million annually
NTT	~$350 million annually
Fujitsu	~$250 million annually
Renesas	~$200 million annually
Mitsubishi Electric	~$150 million annually
Rakuten	~$100 million annually
Panasonic	~$200 million annually
Total	**~$3.05 billion annually**

Estimated based on sources: [54; 55; 56; 57; 65; 68; 70; 71; 72; 73; 74; 75]

These companies in the **Prime Section** of the Tokyo Stock Exchange are collectively spending over **$3 billion annually** on AI technologies as of 2023-2024. Their investments are driving innovation across industries, from automotive and manufacturing to healthcare and fintech. As AI continues to evolve, these companies are well-positioned to maintain their leadership in the global market.

Japanese companies typically experience a delay between initial AI investments and measurable returns. Early adopters in financial services and manufacturing sectors often see 18-24 month lags before significant ROI

materializes. Manufacturing firms (particularly automotive and electronics) tend to show more direct ROI correlations from AI spending on production optimization and quality control. Service sectors like banking or retail see more variable returns that depend heavily on implementation quality. Scale advantage makes larger TSE Prime companies with over ¥1 trillion market cap generally demonstrate better AI spending-to-ROI conversion rates, likely due to complementary data assets and technical talent. Firms investing in AI integration capabilities alongside pure technology spending show significantly higher ROI metrics. Companies focusing on both technology and talent development outperform those focused solely on technology acquisition. Companies deploying AI for cost reduction show faster but smaller ROI improvements (typically 5-15% efficiency gains), while those using AI for market expansion or product innovation show delayed but potentially larger returns. TSE-listed companies with higher overall digital maturity scores demonstrate stronger AI-spending-to-ROI conversion rates, suggesting AI investments build on existing digital capabilities.

While a holistic ROI figure for AI investments across the TSE Prime Market during this period is not readily available in open sources, reports and market observations indicate a positive correlation between strategic AI investments and improved financial performance for specific companies. For instance, companies in the technology sector have leveraged AI to develop new products and services, optimize software development processes, and enhance cybersecurity measures, leading to increased revenue streams and improved operational efficiency. Similarly, infrastructure companies have utilized AI for predictive maintenance, smart grid management, and logistics optimization, resulting in cost savings and enhanced service reliability.

The absence of aggregated ROI figures for AI investments across the TSE Prime Market can be attributed to several factors:

– ***varied implementation strategies***: AI implementation varies significantly across companies and sectors, making it challenging to establish a standardized framework for measuring ROI;

– ***long-term investment horizon***: many AI investments are long-term strategic initiatives whose financial returns may not be fully realized within a short 4-year window;

– ***difficulty in isolating AI's impact***: it is often complex to isolate the direct financial impact of AI investments from other concurrent business activities and market factors;

focus on intangible benefits: AI investments often yield intangible benefits such as improved customer satisfaction, enhanced innovation capabilities, and better risk management, which are difficult to quantify in traditional ROI calculations.

Given the challenges in obtaining standardized ROI figures, investors and analysts evaluating AI-related stocks on the TSE Prime Market are increasingly focusing on alternative performance indicators, like Operating Profit Margins, Revenue Growth Rates, Research and Development (R&D) Expenditure, Qualitative Assessments (company's AI strategy, talent acquisition, and competitive positioning in the AI landscape, etc.)

The Return on Investment (ROI) of AI initiatives for Japanese companies from 2020 to 2024 varies significantly depending on the industry, the specific use case, and the scale of implementation. Below is an analysis of the Estimated ROI of AI investments for the top 10 Japanese companies listed in the Prime Section of the Tokyo Stock Exchange (TSE).

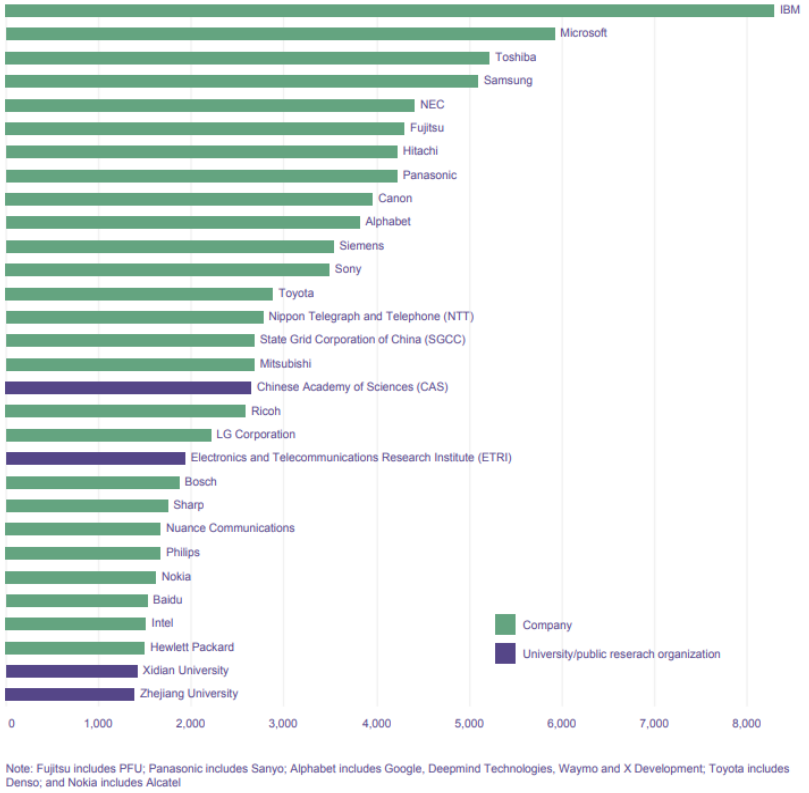
Table 11

Estimated ROI of AI investments (2020-2024)

Company	Average ROI (2020-2024)
Toyota	20-25%
Sony	25-30%
SoftBank	**30-40%**
Hitachi	20-25%
NTT	15-20%
Fujitsu	15-20%
Renesas	20-25%
Mitsubishi Electric	15-20%
Rakuten	20-25%
Panasonic	15-20%

Note: The Return on Investment (ROI) figures for AI investments presented in this study are approximate estimates. They are derived from a synthesis of the author's assessment, publicly available financial data, industry reports, company disclosures, and expert assessments. Due to the complexity of isolating AI's specific impact and the long-term nature of these investments, these figures should be interpreted as indicative ranges rather than precise accounting measurements. This approach is consistent with common scholarly practices for quantifying the impact of emerging technologies in corporate finance.

Sources: [54; 55; 56; 57; 63; 65; 68; 69; 70; 71; 72; 73; 74; 75; 76; 77; 78]



Note: Fujitsu includes PFU; Panasonic includes Sanyo; Alphabet includes Google, Deepmind Technologies, Waymo and X Development; Toyota includes Denso; and Nokia includes Alcatel

Figure 4. Top 30 Patent Applicants by Number of Patent Families
(Companies represent 26 of the top AI patent applicants worldwide)

Source: [81]

The ROI of AI investments by Japanese companies from **2020 to 2024** demonstrates the transformative potential of AI across industries. Companies like **SoftBank**, **Toyota**, and **Sony** have achieved significant returns by leveraging AI for innovation, efficiency, and market expansion. As AI technologies continue to evolve, these companies are well-positioned to maintain their competitive edge and drive further growth. AI initiatives are expected to deliver even higher ROI in the coming years as technologies mature and adoption increases.

Table 12

Estimated ROI of AI Investments of Japanese Prime Listed Companies (2020-2024)

Company/ Industry	AI Focus	Drivers of high ROI	Performance Indicators
Toyota Motor Corporation Automotive	Autonomous driving, robotics, and supply chain optimization.	**20-25% ROI** from AI-driven supply chain optimization, reducing inventory costs and improving production efficiency. **15-20% ROI** from investments in autonomous driving technologies, enhancing vehicle safety and reducing accidents.	Toyota's partnership with **Preferred Networks** has improved manufacturing **efficiency** by 10-15%.
Sony Group Corporation Electronics, Entertainment, Semiconductors	Image sensors, gaming, and content creation.	**25-30% ROI** from AI-powered image sensors, capturing a dominant share of the smartphone and automotive markets. **10-15% ROI** from AI-driven gaming innovations, enhancing user engagement and monetization.	Sony's AI-driven image sensors account for over **40% of the global market share**, generating significant revenue.
SoftBank Group Corporation Technology, Investment	Robotics, fintech, and AI startups.	**30-40% ROI** from investments in AI startups like **OpenAI** and **SenseTime** through the Vision Fund. **10-15% ROI** from AI-powered customer service solutions in its telecom and fintech businesses.	SoftBank's AI investments have contributed to a **20% increase in portfolio value** since 2020.
Hitachi, Ltd. Industrial Technology, IT Services	Predictive maintenance, smart factories, and healthcare.	**20-25% ROI** from AI-driven predictive maintenance, reducing downtime and maintenance costs. **15-20% ROI** from AI-powered healthcare solutions, improving diagnostic accuracy and patient outcomes.	Hitachi's **Lumada AI platform** has improved operational efficiency by 15-20% for industrial clients.
NTT Corporation Tele-communications	Network optimization, cybersecurity, and customer service automation.	**15-20% ROI** from AI-powered network optimization, reducing operational costs and improving service quality. **10-15% ROI** from AI-driven cybersecurity solutions, preventing data breaches and enhancing client trust.	NTT's AI chatbots have reduced customer service costs by **20%**.

Fujitsu Limited IT Services, Hardware	Quantum computing, healthcare, and sustainability.	15-20% ROI from AI-driven weather prediction systems, improving accuracy and reducing costs for clients. 10-15% ROI from AI-powered healthcare diagnostics, increasing efficiency and reducing errors.	Fujitsu's AI solutions have contributed to a **10% increase in revenue** from healthcare clients.
Renesas Electronics Corporation Semiconductors	Automotive semiconductors, IoT, and edge computing.	**20-25% ROI** from AI-powered microcontrollers for autonomous vehicles, capturing a larger market share. **15-20% ROI** from AI-driven IoT solutions, improving energy efficiency and performance.	Renesas' AI chips have contributed to a **15% increase in automotive semiconductor sales**.
Mitsubishi Electric Corporation Industrial Automation, Electronics	Factory automation, energy management, and robotics.	**15-20% ROI** from AI-driven predictive maintenance, reducing downtime and maintenance costs. **10-15% ROI** from AI-powered energy management solutions, improving efficiency and reducing costs.	Mitsubishi's AI systems have improved factory efficiency by **10-15%**.
Rakuten Group, Inc. E-commerce, Fintech	Personalized marketing, logistics optimization, and financial services.	**20-25% ROI** from AI-powered recommendation engines, increasing sales and customer engagement. **15-20% ROI** from AI-driven fraud detection systems, reducing losses and improving trust.	Rakuten's AI solutions have increased e-commerce revenue by **10-15%**.
Panasonic Holdings Corporation Electronics, Automotive	Smart home devices, automotive systems, and energy solutions.	**15-20% ROI** from AI-powered home appliances, increasing market share and customer satisfaction. **10-15% ROI** from AI-driven EV battery management systems, improving performance and safety.	Panasonic's AI solutions have contributed to a **10% increase in smart home device sales**.

Note: The Return on Investment (ROI) figures for AI investments represent approximate estimates derived from the author's assessment, industry trends, and historical data.

Sources: [30; 54; 55; 56; 57; 63; 65; 68; 76; 77; 78; 79; 80].

Led by Toyota, Sony, and Hitachi, Fujitsu Japanese companies are at the forefront of AI innovation, filing thousands of AI-related patents.

This makes Japan ranks 3rd globally in AI patent filings **Artificial Intelligence Patent Index (AIPI)**, behind the U.S. and China.

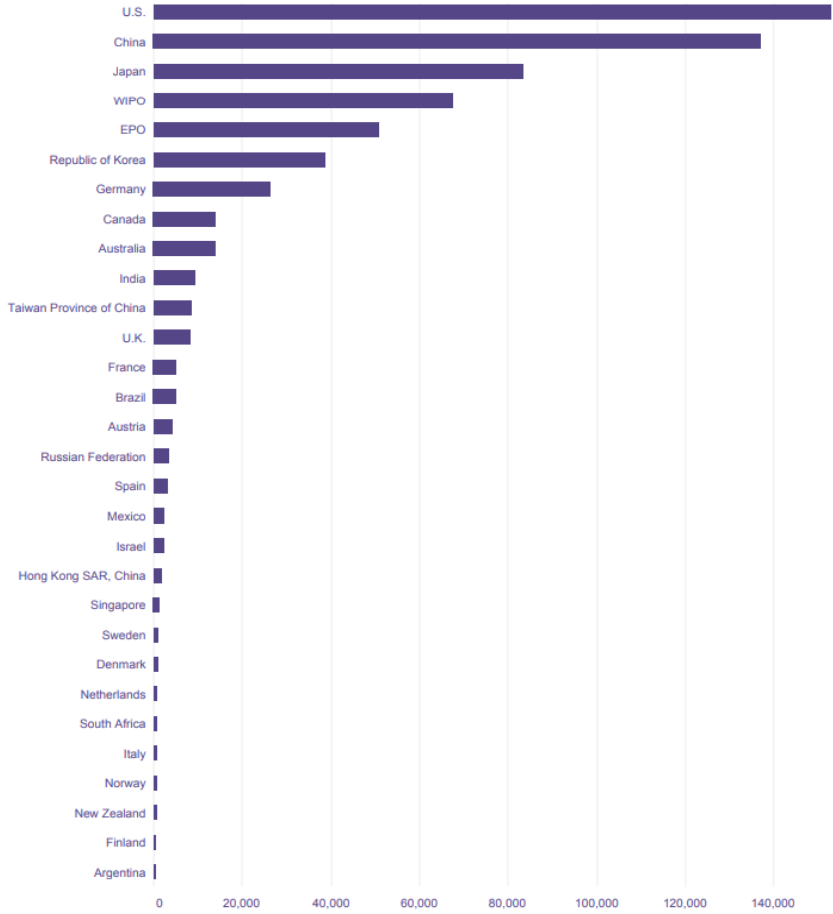


Figure 5. Overall number of patent applications by patent office

Source: [81]

Digital Transformation: How Digital Finance and AI Adoption Drive Economic Outcomes in Japan's Corporate Sector

This section examines the relationship between the **development of artificial intelligence, digital finance**, and the **economic performance of Japanese companies**, with a particular focus on the impact of digital finance and digital transformation.

The Japanese digital finance market has experienced exponential growth, currently valued at ¥2.8 trillion [83] and expanding at a 15.7% annual rate [84], is a crucial factor driving record profits in the Japanese financial sector. This growth is fueled by high digital payment adoption (82.8%, [85]) and a large base of mobile banking users (68.5 million, [86]). The rapid adoption of blockchain technology, with over 40% of financial institutions integrating it for secure transactions [87], and the dominance of digital wallets and contactless payments (65% of retail transactions, [88]) further underscores this trend.

This digital transformation has directly contributed to the record consolidated net profits achieved by megabanks like Mitsubishi UFJ Financial Group, Sumitomo Mitsui Financial Group, and Mizuho Financial Group, following the Bank of Japan's March 2024 policy shift away from negative interest rates. Improved interest margins and increased customer assets under custody have also boosted the performance of brokerage firms such as Nomura Holdings, which anticipates record full-year net profit.

The connection between digital finance and profitability is multifaceted. Digital finance – encompassing technologies like blockchain, AI-driven financial analytics, digital payment systems, and automated supply chain financing – can significantly enhance profitability by reducing costs, improving cash flow management, and enabling data-driven decision-making.

The semiconductor industry, with its focus on innovation, efficiency, and scalability, benefits significantly from the multifaceted relationship between digital finance and profitability. In essence, the technological advancements propelling the digital finance market's rapid expansion are directly fueling the increased efficiency, broader market reach, and improved risk management that are driving record profits in Japan's financial sector. The favorable economic conditions created by the policy shift further amplify

these positive effects. In the context of Japanese semiconductor companies, digital finance plays a pivotal role in optimizing operations, enhancing supply chain efficiency, and driving innovation. Below, we'll specify this connection with examples from Japan's semiconductor sector.

Table 13

Digital Finance Adoption Impact on Financial Performance of TSE Prime Companies

Operational Efficiency	Fintech solutions like mobile payments, blockchain-based transactions, and robo-advisors enhance operational efficiency, reducing costs and increasing profit margins. The shift away from cash transactions further streamlines operations and reduces overhead.
Market Expansion	Digital banking platforms have enabled financial institutions to reach previously underserved populations, expanding their customer base and driving revenue growth.
Enhanced Risk Management	AI-driven analytics, a key component of digital finance, improves risk assessment and decision-making, leading to fewer losses and contributing to sector-wide resilience and profitability.
Synergistic Effect with Policy Change	The Bank of Japan's decision to end its negative interest rate policy has created a more favorable economic environment, amplifying the positive impact of digital finance adoption on financial sector profitability.
Blockchain Integration's Dual Role	The widespread integration of blockchain technology not only strengthens the digital finance ecosystem but also directly benefits financial institutions by ensuring secure transactions, building trust, and potentially creating new revenue streams, all of which contribute to higher profits.

Sources: [84; 142; 143; 144]

The integration of **digital finance** into the operations of Japanese semiconductor companies has a profound impact on profitability. By optimizing supply chain financing, automating financial processes, enabling data-driven decision-making, and enhancing risk management, digital finance tools help companies like Renesas, Sony, Toshiba, Kioxia, and Rohm maintain their competitive edge in a highly dynamic industry. Furthermore, digital finance supports sustainability initiatives and customer engagement, driving long-term growth and profitability. As the semiconductor industry continues to evolve, the role of digital finance will only become more critical in ensuring financial resilience and innovation-led success.

Table 14

Analysis of Digital Finance Integration and Its Effects on Supply Chain and Financial Outcomes in Japanese Semiconductor Companies

DF technology/ solution	Description	Example (Company)
1	2	3
Supply Chain Financing and Cash Flow Optimization	Semiconductor manufacturing involves complex global supply chains with high upfront costs for materials, equipment, and R&D. Digital finance tools, such as blockchain-based supply chain financing and AI-driven cash flow management, can help companies optimize working capital and reduce financial risks.	**Renesas Electronics**[a] Renesas, a leading Japanese semiconductor company, relies on a global network of suppliers for raw materials like silicon wafers and rare earth metals. By implementing **blockchain-based supply chain financing**, Renesas can ensure faster and more transparent payments to suppliers, reducing delays and improving trust. Additionally, Renesas uses **AI-powered cash flow forecasting tools** to predict demand fluctuations and manage inventory more efficiently. This reduces excess inventory costs and ensures liquidity for critical R&D investments, directly boosting profitability.
Cost Reduction through Automation and Digital Payments	Digital finance enables automation of repetitive financial processes, such as invoicing, payments, and reconciliation, reducing operational costs and human errors. This is particularly valuable in the semiconductor industry, where profit margins are often slim, and efficiency is paramount.	**Sony Semiconductor Solutions**[b] Sony's semiconductor division, a global leader in image sensors, has adopted **digital payment platforms** and **automated invoicing systems** to streamline transactions with its suppliers and customers. By reducing manual intervention, Sony has cut down on administrative costs and improved payment processing times. Furthermore, Sony uses **smart contracts** on blockchain platforms to automate royalty payments for its intellectual property (IP) used in smartphones and cameras. This ensures timely payments and reduces disputes, enhancing overall profitability.

(End of Table 14)

1	2	3
Data-Driven Decision-Making for R&D Investments	Digital finance tools, such as AI-driven financial analytics, enable semiconductor companies to make data-driven decisions about R&D investments. By analyzing market trends, customer demand, and financial performance, companies can allocate resources more effectively to high-potential projects.	**Toshiba Electronic Devices & Storage Corporation**[c] Toshiba uses **AI-powered financial analytics** to evaluate the profitability of its R&D projects in power semiconductors and memory solutions. By analyzing data on market demand, production costs, and competitor activity, Toshiba can prioritize investments in high-growth areas like silicon carbide (SiC) power devices. This data-driven approach has allowed Toshiba to focus on innovations that align with market needs, such as energy-efficient semiconductors for electric vehicles (EVs), leading to higher profitability.
Enhanced Risk Management with Predictive Analytics	The semiconductor industry is highly cyclical, with periods of boom and bust. Digital finance tools, such as predictive analytics and machine learning, help companies anticipate market shifts and manage financial risks more effectively.	**Kioxia**[d] Kioxia, a global leader in NAND flash memory, uses **predictive analytics to forecast demand** for its products in various sectors, including data centers, smartphones, and automotive. By analyzing historical sales data, market trends, and macroeconomic indicators, Kioxia can adjust production levels and pricing strategies to maximize profitability. Additionally, Kioxia employs **AI-driven risk management tools** to hedge against currency fluctuations and commodity price volatility, protecting its profit margins in a highly competitive market.
Blockchain for Intellectual Property (IP) Management and Licensing	Semiconductor companies rely heavily on IP licensing for revenue generation. Blockchain technology can streamline IP management, ensuring transparent and secure licensing agreements while reducing legal and administrative costs.	**Rohm Semiconductor**[e] Rohm, a leading supplier of power semiconductors and sensors, uses **blockchain-based IP management systems** to track and monetize its patents. This ensures that licensing agreements are executed transparently and that royalties are collected efficiently. By reducing the administrative burden and minimizing disputes, Rohm can focus on innovation and commercialization, directly enhancing profitability.

(End of Table 14)

1	2	3
Digital Platforms for Customer Engagement and Sales	Digital finance extends to customer-facing platforms, enabling semiconductor companies to offer flexible payment options, subscription models, and real-time pricing. This improves customer satisfaction and drives sales growth.	**Screen Holdings**[f] Screen Holdings, a major supplier of semiconductor manufacturing equipment, has implemented **digital sales platforms** that offer real-time pricing and financing options to its customers. This flexibility has made it easier for smaller foundries and startups to purchase advanced equipment, expanding Screen's customer base. Additionally, Screen uses **AI-driven customer analytics** to identify upselling and cross-selling opportunities, increasing revenue per customer and boosting profitability.
Sustainability and ESG Financing	Digital finance also supports sustainability initiatives, which are increasingly important for profitability in the semiconductor industry. Companies can use digital tools to track and report environmental, social, and governance (ESG) metrics, attracting socially responsible investors and reducing financing costs.	**SUMCO**[g] SUMCO, a leading supplier of silicon wafers, uses **digital platforms** to monitor and report its carbon footprint and energy consumption. By demonstrating its commitment to sustainability, SUMCO has secured **green financing** at lower interest rates, reducing its cost of capital. This not only enhances profitability but also strengthens SUMCO's reputation as a responsible supplier, attracting customers who prioritize sustainability.

Note:

Table 14 summarizes key digital finance technologies and their practical applications within leading Japanese semiconductor companies, illustrating how blockchain, AI-driven analytics, automation, and digital platforms optimize supply chains, financial operations, risk management, intellectual property licensing, customer engagement, and sustainability financing. The examples, drawn from Renesas Electronics, Sony Semiconductor Solutions, Toshiba, Kioxia, Rohm Semiconductor, Screen Holdings, and SUMCO, are based on publicly available corporate disclosures and industry reports. This synthesis highlights the integration of emerging financial technologies tailored to the semiconductor industry's complex operational and market environment, driving efficiency and profitability while addressing evolving economic and regulatory challenges.

Sources:

[a] Renesas Electronics. https://www.renesas.com/

[b] Sony Semiconductor Solutions. https://www.sony-semicon.com/

[c] Toshiba Electronic Devices & Storage Corporation. https://toshiba.semicon-storage.com/

[d] Kioxia. https://www.kioxia.com/

[e] Rohm Semiconductor. https://www.rohm.com/

[f] Screen Holdings. https://www.screen.co.jp/

[g] SUMCO. https://www.sumcosi.com/

Digital finance is playing a pivotal role in reshaping Japan's financial ecosystem. There are several key transforming mechanisms. Firstly, the widespread adoption of fintech platforms, including digital payment systems like PayPay and Rakuten Pay, has fundamentally altered consumer transaction behaviors, reducing reliance on conventional banking infrastructure. Secondly, blockchain technology is increasingly utilized for secure and transparent transactions, particularly in supply chain finance and cross-border payments, enhancing operational trust and efficiency. Thirdly, financial institutions are implementing artificial intelligence (AI) and big data analytics to personalize services, detect fraudulent activities, and optimize investment strategies, with robo-advisors expanding access to wealth management. Lastly, supportive regulatory frameworks, such as regulatory sandboxes, have been implemented by the Japanese government to stimulate innovation within the digital finance sector. These initiatives have collectively fostered an environment conducive to the development and adoption of fintech solutions. These initiatives have fostered a conducive environment for fintech development and adoption.

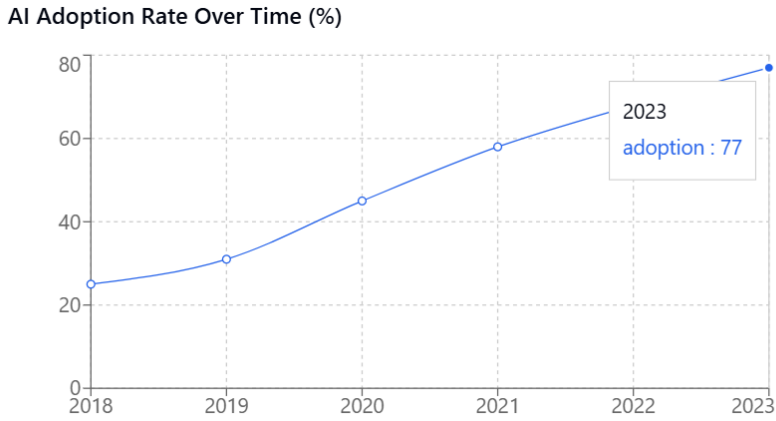


Figure 6. Japan's Digital Finance and AI Adoption

Sources: [85; 89; 90; 91]

Japan has experienced a rapid increase in artificial intelligence (AI) adoption within its financial sector (Figure6), rising from approximately

20% in 2018 to 77% in 2023. This growth reflects a concerted national effort to integrate AI into critical financial operations, including banking, payment systems, and risk management, as exemplified by SoftBank's AI-driven loan services and Mitsubishi UFJ Financial Group's (MUFG) blockchain solutions.

The primary drivers of this adoption include supportive regulatory frameworks, such as the METI's "Digital Transformation Guidelines" (2021) [92] and the establishment of fintech regulatory sandboxes. Additionally, corporate demand for AI solutions is fueled by potential cost reductions, such as through AI-powered fraud detection, and revenue growth opportunities via personalized fintech applications.

Digital Transformation by Sector

Sector-specific trends reveal that the banking and insurance industries exhibit the highest AI adoption rates, reaching near 90% in 2025, according to the Financial Services Agency of Japan as of March 2025. [89]. In contrast, small and medium-sized enterprises (SMEs) lag, primarily due to resource constraints.

The integration of digital finance and AI has had a profound impact on corporate performance. Key metrics include average efficiency, cost reduction and decision-making speed (Figure 7):

Productivity Gains	
Average efficiency	23% increase
Cost reduction	18% increase
Decision-making speed	35% increase
Revenue growth	15% increase

Figure 7. Digital Finance and AI impact on Corporate Performance

Sources: [93; 94; 95; 96]

This study underscores the transformative impact of digital finance and artificial intelligence (AI) on corporate growth within the Japanese economy. The integration of digital finance has not only improved operational efficiency but also strengthened the financial system's resilience to external shocks, such as economic downturns and geopolitical uncertainties. These results highlight the transformative power of digital initiatives in enhancing

both operational performance and competitiveness for businesses in Japan. The financial sector's recovery, facilitated by digital innovations and monetary policy adjustments, highlights the necessity for adaptive financial strategies. Concurrently, the AI-driven expansion has generated significant opportunities for semiconductor-related industries, establishing them as pivotal contributors to Japan's economic growth [97]. However, the findings also emphasize the critical importance of strategic adaptability in response to prevailing geopolitical uncertainties.

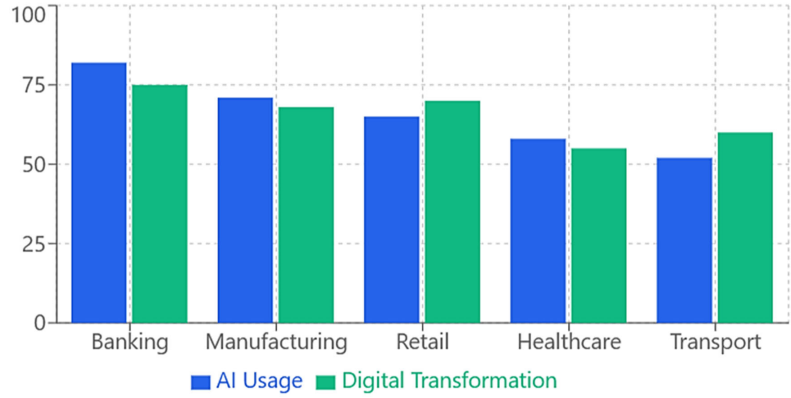


Figure 8. Sector-Specific AI and Digital Transformation Adoption Rates (%)

Source: [98; 99; 100; 101; 102]

Figure 8 illustrates the percentage of AI usage and digital transformation implementation across five key sectors in Japan. The data shows the relative adoption rates, highlighting variations in AI and digital transformation maturity among banking, manufacturing, retail, healthcare, and transport industries. Notably, the banking sector exhibits the highest AI usage, while digital transformation implementation is comparatively consistent across sectors. Data is presented as percentages of companies within each sector actively utilizing AI technologies or implementing digital transformation strategies.

Digital transformation in Japan has progressed at varying rates across different sectors, with banking and finance leading the charge. This sector

demonstrates the most advanced digital adoption. 75% of consumers have adopted digital banking [110; 119]. Furthermore, AI is widely used in risk assessment 82%, [93], and automated trading systems are prevalent 65%, [111; 116]. While making strides, manufacturing lags behind finance. Smart factory adoption has reached 58% [112], and AI-driven supply chain optimization is being implemented by 47% of companies [113; 118]. Retail falls between finance and manufacturing in terms of digital transformation. E-commerce penetration stands at 72% [114; 120], and the Japan AI in retail market is projected to grow significantly from $ 460.71 million in 2023 to $5,480.14 million by 2032, registering a robust CAGR of 31.66% during forecast period [115; 117].

Analysis of Japan's AI readiness reveals a position above the global threshold, indicating high AI absorption capacity and significant potential for economic impact. This status is supported by Japan's mature digital infrastructure and strategic policy initiatives, such as Society 5.0. Key strengths include robust AI investment, evidenced by substantial corporate and governmental R&D funding, as well as a strong innovation foundation, characterized by high patent output and innovative business models. Additionally, Japan boasts a significant output of STEM (Science, Technology, Engineering, or Mathematics) graduates. However, labor-market flexibility remains a comparative weakness, with redundancy costs impeding AI-driven job transitions. Comparative weaknesses also include lower technology utilization among SMEs and gaps in cross-border data flows compared to Western economies. While automation potential in manufacturing is high, adoption in services is slower. Overall, Japan leads in **applied industrial AI** (such as robotics, precision manufacturing) and ranks 4th globally in AI adoption (2024), behind the U.S., China, and Germany.

A comparative analysis of Japan's AI adoption across key dimensions reveals that investment and research scores of Japan 18/20, slightly below the U.S. (20/20). This reflects strong corporate research and development, exemplified by companies like Toyota and Fanuc. However, venture capital funding remains comparatively limited, with Japan attracting $2.1 billion compared [111]to the U.S.'s $47 billion in 2023 [124; 125]. Japan's score of digital absorption is 15/20, trailing China (19/20). While 5G and cloud adoption are high, the adoption of AI tools among small and medium-sized

enterprises (SMEs) is lower, at approximately 40% [126]. Human capital Japan scores 17/20, marginally below Germany (18/20). The country boasts a high output of STEM graduates [126], but rigid labor laws impede AI-driven job transitions. Economic impact scores 16/20, compared to the U.S.'s 20/20. AI implementation in manufacturing, such as at Toyota, has yielded significant productivity gains (+25%) [127]. However, the services sector's adoption lags. Finally, Japan's policy support scores 17/20, just below China's 20/20. METI has allocated $1.6 billion to an AI fund in 2024 (Ministry of Economy, Trade and Industry, 2024). However, the rollout of 5G and quantum computing technologies has been slower than in some peer nations. This score breakdown highlights Japan's strengths in R&D and human capital, alongside areas for improvement, including venture capital investment, SME digital absorption, and labor market flexibility.

Table 15

Japan's AI Adoption Score in Global Context (2024)

Rank	Country	Total Score	Key Strengths
1	U.S.	92	VC funding, generative AI
2	China	88	Surveillance AI, smart cities
3	Germany	85	Industry 4.0, automotive AI
4	**Japan**	**83**	Robotics, quality-control AI

Source: [122; 123; 127; 82]

Policy implications suggest a need for labor reforms to align with AI-driven job markets, targeted support for SMEs to improve digital absorption, to accelerate startups, chips, and enhanced global collaboration to strengthen connectivity, particularly through data partnerships.

Growth of AI in Financial Services

The financial services sector in Japan is increasingly adopting Artificial Intelligence (AI). This trend aligns with a global move to use AI to improve financial operations, from managing risk to serving customers.

AI applications are changing how financial institutions use data, make decisions, and interact with customers. A key focus is on detecting and preventing fraud. AI algorithms analyze large amounts of transaction data in real-time to find unusual patterns and potential fraud. This improves security for both institutions and customers [92].

Risk management is another important AI application in finance. AI analytics assess and predict risks by analyzing past data, market trends, and economic factors. This helps institutions make better decisions about investments, lending, and managing portfolios. Predictive analytics and machine learning models allow for more accurate risk assessment and financial planning.

Customer service is also changing with AI through chatbots and virtual assistants. These tools provide instant customer support, handling inquiries, transactions, and account management. This improves customer experience, lowers operating costs, and makes service delivery more efficient.

AI is also used in algorithmic trading and investment strategies. Advanced AI models analyze market data and execute trades quickly and precisely, offering a competitive advantage. These models can also adapt to changing market conditions and improve trading strategies.

The Japanese financial sector is actively investing in AI technologies and innovation due to both local and global competition. Financial institutions are working with tech companies and startups to develop and implement new AI solutions.

In summary, the growing use of AI in Japanese financial services shows the sector's commitment to using technology to improve security, efficiency, and customer experience. As AI continues to develop, its impact on the financial industry is expected to increase.

Future Projections, Government Initiatives, Startup Ecosystem, Industry Challenges

The Japanese Artificial Intelligence (AI) market, valued at USD 7.56 billion in 2024, is projected to reach USD 26.80 billion by 2030, exhibiting a compound annual growth rate (CAGR) of 23.30% throughout the forecast period [121].

The AI market encompasses the research, development, deployment, and application of computational systems designed to emulate cognitive functions associated with human intelligence. These systems engage in tasks such as data-driven learning, pattern recognition, decision-making, and problem resolution. The market's scope includes diverse technological domains, notably machine learning, natural language processing, robotics, and computer vision.

Market growth is primarily propelled by advancements in data analytics methodologies, the increasing integration of AI solutions across sectors including healthcare, finance, automotive, and retail, and the augmented accessibility of large-scale datasets and high-performance computing infrastructure. Organizational investment in AI is motivated by the potential to optimize operational efficiencies, foster product and service innovation, and establish competitive advantages. The market is segmented into AI software, hardware, and service components, with participation from both established technology corporations and specialized emergent enterprises. The anticipated trajectory of AI technology evolution suggests substantial market expansion, with transformative implications for various industries and the creation of novel avenues for innovation and economic development.

Japan's market potential for AI is unparalleled, with AI adoption projected to unlock $736 billion in productivity gains by 2030. Key sectors driving this growth include manufacturing, healthcare, and entertainment, supported by its status as the second-largest market for cloud services globally [111].

In 2025, the IT Services market in Japan is predicted to generate revenues of US$95.82 billion. IT Outsourcing is expected to be the largest part of this market, with a projected value of US$39.64 billion in the same year. Over the next four years, the total revenue of the IT Services market is forecast to increase by 5.23% annually. This growth is expected to push the market volume to US$117.48 billion by 2029[106].

This growth in the IT Services market is closely linked to the increasing adoption of advanced technologies within Japan. Specifically, projections indicate significant growth in both the AI market, which is expected to reach ¥4.5 trillion, with a year-on year growth rate of 35.5% [50] and digital transformation spending, forecasted to hit ¥3.2 trillion. Furthermore, cloud adoption, a crucial enabler for both AI and digital transformation. The Japan cloud computing market size is forecast to increase by USD 20.47 billion at a CAGR of 14.8% between 2024 and 2029 [107]. In the dynamic technology landscape, cloud computing continues to be a game-changer, with businesses embracing its benefits.

Estimates suggests that use of generative AI to supplement work activities could help unlock JPY148.7 trillion (USD1.1 trillion) of productive capacity across the economy, equivalent to 27% of GDP in 2022 [109], anticipating

that AI-driven innovations will contribute ¥8.5 trillion to Japan's GDP by 2026, with the Manufacturing industry as the largest contributor to this potential. Globally, according to IDC, business spending on adopting artificial intelligence (AI), integrating AI into existing business operations, and delivering enhanced products/services to business and consumer customers will have a cumulative economic impact of $19.9 trillion through 2030, driving 3.5% of global GDP in that year [110].

This dynamic landscape of technological integration within Japanese firms aligns with the broader principle that changes related to information and communication technologies (ICT) in firms are a typical process of search and experimentation, leading to the success and growth of some, and the failure and disappearance of others. Consequently, countries with a business environment that enables such processes, the so-called creative destruction, have a greater chance of reaping the positive effects of ICT [108].

Government Initiatives, Startup Ecosystem

The Japanese government has played a pivotal role in fostering digital transformation through policy support and funding. Government funding and investment in AI research and development (R&D) are key drivers. Public funds support basic research and applied AI projects. This encourages collaboration among universities, industries, and government bodies. For example, the Japan Science and Technology Agency (JST) and the New Energy and Industrial Technology Development Organization (NEDO) are important in supporting AI R&D. This financial support helps advance AI technologies and fosters innovation. It also helps Japan maintain its position in AI [121].

According to the Digital Agency of Japan Annual Report 2023, the Digital Agency budget is nearly ¥560 billion [103]. While AI research grants - ¥120 billion [104]. METI has been advancing development of rules for markets surrounding digital platforms, the building of a framework for helping stakeholders share challenges that they are facing and conducting comprehensive surveys for digital markets that are changing dramatically. Governments are providing large-scale, long-term and comprehensive support for strategic sectors with mid- to long-term growth potential, such as climate change and digitalization, to attract private companies to

invest in domestic establishments. Digital transformation subsidies reached ¥450 billion [105]. The Digital Agency of Japan (2024) has also launched a nationwide digital literacy program, aiming to train 10 million workers in AI and data analytics by 2025.

Japan's startup ecosystem is attracting increasing capital inflows, fueled by deep-technology solutions addressing complex challenges and other inherent strengths. Recognizing this momentum, the Japanese government has strategically intervened to catalyze further growth through the Startup Development Five-year Plan, initiated in 2022. This ambitious plan aims to amplify both public and private sector investment in startups tenfold, targeting an aggregate of ¥10 trillion (approximately US$65.8 billion based on an exchange rate of US$1 = ¥152) by March 2028 [145].

Across diverse sectors of Japanese industry, companies are integrating AI to generate novel forms of value. Notably, entrepreneurial startups are demonstrating a wide array of innovative AI applications, underscoring the dynamism and technological sophistication within this emerging segment of the Japanese economy. This proactive government support and the dynamism of AI-driven startups are key factors in attracting greater investment and fostering a vibrant innovation landscape in Japan.

The government has also created strategic frameworks and partnerships. These aim to integrate AI into industries like manufacturing, healthcare, and transportation. By promoting AI adoption and creating an environment for innovation, these efforts accelerate AI development and commercialization.

Furthermore, the Japanese government is working to build a strong AI talent pool. This involves educational programs and training. Investing in AI education and skills development ensures a continuous supply of skilled professionals. These professionals will drive the AI industry forward. Overall, the government's active role in supporting the AI ecosystem significantly contributes to the market's growth and development.

The Role of Digital Transformation and Industry Challenges

Between 2020 and 2024, the Japanese economy navigated inflationary and deflationary pressures, yen depreciation, and geopolitical tensions. However, the adoption of digital finance and Artificial Intelligence (AI) has served as a mitigating factor. These technologies have boosted productivity, fostered innovation, and enhanced global competitiveness [139].

For instance, AI-driven automation and digital finance tools have streamlined operations and reduced costs in the semiconductor industry, a significant contributor to Japan's exports. This has enabled Japanese firms to maintain market share despite rising tariffs and supply chain disruptions [128].

The depreciation of the yen during this period presented a dual impact. While increasing import costs, it enhanced the global competitiveness of Japanese exports, particularly in the semiconductor and electronics sectors. Digital finance facilitated companies' ability to capitalize on this advantage through real-time currency risk management and optimized international pricing strategies [129].

For export-oriented companies, the yen's depreciation in the latter half of 2024 positively affected earnings. Toyota Motor and Japan Airlines, for example, benefited from production recovery, price adjustments, and favorable exchange rates, leading to an increased projected consolidated operating profit for Toyota to ¥4.7 trillion for the fiscal year ending March 2025. However, this weaker yen did not correlate with increased equity prices for companies expanding internationally [112].

Japan's economic environment, characterized by alternating periods of deflation and inflation, has posed unique challenges. Digital finance and AI have provided tools for businesses to manage these fluctuations. AI-powered predictive analytics have enabled firms to anticipate shifts in consumer demand and adjust production accordingly, reducing risks of overproduction or shortages. Digital finance platforms have also broadened access to alternative financing options like peer-to-peer lending and crowdfunding, particularly relevant in a low-interest-rate context.

Despite these positive trends, Japanese companies face risks from U.S. tariff policies. Potential tariffs on Mexico and Canada could reduce consolidated ordinary profits for Japanese automobile-related companies by approximately 1.2%. Companies like Asahi Kasei and Panasonic Holdings are proactively restructuring supply chains and reviewing production systems to mitigate these potential impacts [130].

Geopolitical unrest, conflicts, and increasing restrictions on semiconductor technologies and raw materials have created significant vulnerabilities in global semiconductor supply chains. These disruptions

have exacerbated labor shortages, fostered illegal trading networks, and reshaped the global competitive landscape. International cooperation between governments and industry is crucial to ensure the resilience and integrity of these vital supply chains, including safeguards against improper handling by harmful actors [131].

The increasing weaponization of economic interdependence has spurred collective action among allied nations. The G7 launched an initiative in May 2023 to counter economic coercion, committing to joint action against the leveraging of economic dependence for political gain. This commitment was reinforced in May 2024 with an agreement to promote economic resilience and confront non-market policies that distort competition and threaten economic security, explicitly including the semiconductor industry through the establishment of a "Point of Contact" group. The conflict in Ukraine has highlighted the challenges in controlling sensitive technology flows, leading 39 countries to implement coordinated export controls and sanctions against Russia [132; 133].

Trade restrictions are significantly reshaping semiconductor supply chains and the global competitive landscape. As countries like the U.S., Japan, and the Netherlands implement stricter export controls on semiconductor technologies for China, China has responded by strengthening its own export controls on critical materials like gallium, germanium, graphite, and rare earth elements. These actions underscore the growing link between trade policy and national security, particularly in the semiconductor sector [134; 135].

Escalating trade restrictions, particularly between the US and China, have a multifaceted impact on the deeply integrated Japanese semiconductor industry, creating both challenges and opportunities. Japan's reliance on the global supply chain makes it vulnerable to trade and technology transfer restrictions, potentially impeding the flow of essential materials and equipment. For instance, Japanese companies dependent on Chinese rare earth elements face export restrictions, necessitating the sourcing of alternatives, which may increase costs and lead times. Similarly, Japanese equipment manufacturers face market access limitations if unable to sell to Chinese firms. Trade restrictions can limit the ability of Japanese companies to sell specialized equipment or materials to either China or US-aligned countries, potentially reducing market access and revenue. The volatility of

trade policies also creates uncertainty, hindering investment and long-term planning. Sourcing alternative suppliers and adapting to new export control regulations can increase operational expenses.

However, trade restrictions impacting US or Chinese firms could allow Japanese companies to increase their market share, especially in niche markets like automotive semiconductors. The Japanese government is actively supporting the domestic semiconductor industry through subsidies and policy initiatives to mitigate negative impacts and facilitate investments in R&D and manufacturing capacity. Trade disruptions also necessitate more diversified and resilient supply chains, offering opportunities for Japanese companies to forge new partnerships and strengthen their position in alternative networks [136; 137; 138].

Global competition for skilled engineers and researchers is intensifying. Increased worldwide investment in domestic semiconductor industries poses a greater challenge for Japan in attracting and retaining talent, especially given potentially higher salaries and more advanced research opportunities elsewhere. Japan possesses established expertise in specific semiconductor technology areas, such as materials and equipment. Focusing on these specializations can help Japanese companies maintain a competitive advantage and reduce dependence on technologies subject to trade restrictions [128; 129].

Despite its strong history, the Japanese semiconductor industry faces significant challenges that threaten its competitive edge. These include a persistent skills gap, high implementation costs, and the difficulty of integrating legacy systems with modern technologies.

A pressing challenge is the growing skills gap in Japan's workforce, driven by the rapid transition to digital finance and AI. Industry reports highlight a significant shortage of skilled professionals, particularly in advanced chip design, AI integration, and next-generation manufacturing processes. According to a Nikkei Asia analysis, Japan's semiconductor sector struggles to attract young talent, as many graduates opt for higher-paying careers in software or finance. Additionally, demographic shifts – including an aging workforce and declining interest among younger generations in traditional engineering roles – have exacerbated the issue. While some studies suggest that nearly 70% of firms face talent shortages, the lack of consistent, authoritative data underscores the need for more

rigorous workforce assessments. To further support this transformation, Japan is prioritizing human resource development through regionally focused collaborations between public, private, and academic sectors. These initiatives include the creation of consortiums dedicated to cultivating professionals and global talent. These individuals will be crucial for leading the design and manufacturing of next-generation semiconductors, as well as driving broader innovation within the digitally transformed and AI-driven economy [139].

Rising R&D costs and capital expenditure pose another challenge for the global semiconductor industry, impacting Japanese firms. The development of advanced data center semiconductors drives up R&D costs throughout the supply chain. Increased sophistication in semiconductor design and manufacturing complexity are very expensive. Designing an advanced AI accelerator can cost up to $540 million [139].

In fabrication, new technologies like gate-all-around (GAA) transistors are being developed. These aim to overcome physical limits in shrinking transistors. Breakthroughs in materials and equipment are also needed for advanced manufacturing and packaging. This could concern Japanese firms, which generally spend less on R&D relative to their revenue compared to international competitors. In the innovative semiconductor industry, lower R&D spending can lead to lower profitability. This, in turn, can limit future R&D reinvestment.

The high demand for data center semiconductors is also causing a sharp increase in capital expenditure, especially for leading-edge manufacturing. Building a leading-edge 3-nanometer (nm) fab costs about $20 billion. A next-generation 2nm fab is expected to cost $28 billion [139].

This capital-intensive landscape could disproportionately affect Japanese semiconductor companies, which, on average, allocate a smaller proportion of their revenue to R&D compared to their international counterparts. In such a rapidly evolving and innovation-driven sector, lower R&D spending can translate to diminished profitability, creating a negative feedback loop that limits future reinvestment in crucial technological advancements. Furthermore, the comparatively lower capital expenditure by Japanese front-end manufacturers risks eroding their manufacturing competitiveness in an industry demanding continuous upgrades to cutting-edge fabrication technologies.

This situation aligns with the trend observed in 2024, where the Tokyo Stock Exchange delisted a record 94 companies – the highest figure since its merger with the Osaka Securities Exchange in 2013. This surge reflects a confluence of factors, primarily the tightening of listing standards and heightened investor expectations regarding corporate governance and capital efficiency. Simultaneously, some entities opted for privatization to gain operational flexibility [144].

The TSE has actively promoted enhanced corporate governance, implementing reforms to incentivize underperforming companies to bolster their market value. A key aspect of this involves stricter criteria for remaining in the Prime and Standard market segments, with a March 2026 deadline for compliance. Furthermore, listed companies were directed to formulate concrete plans for medium-to-long-term value enhancement, with particular emphasis on those exhibiting a price-to-book (P/B) ratio below 1.0. The P/B ratio, a metric comparing a company's market capitalization to its book value, serves as an indicator of potential undervaluation or overvaluation.

From a macro perspective, these delistings and the associated pressure for improved corporate value are anticipated to foster greater market efficiency. By removing companies that do not meet evolving standards, the overall quality and attractiveness of the listed market should increase, thereby contributing to a long-term appreciation in aggregate corporate value. This drive towards efficiency aligns with the TSE's objective of creating a more robust and investor-friendly market environment. Therefore, addressing the R&D and capital expenditure gap is crucial for Japanese semiconductor firms to not only thrive in the global market but also to maintain their standing on the Tokyo Stock Exchange.

Conclusion

The projected record profitability of Tokyo Stock Exchange (TSE) Prime 150 companies underscores a powerful synergy: financial innovation and AI-driven technological advancements are key drivers of their corporate growth. This is reflected in the strategic financial orientation of top-tier TSE Prime corporations, which are actively allocating capital towards AI initiatives to optimize operations, refine customer engagement, and pioneer new offerings. Their corporate finance profiles reveal a spectrum

of fintech integration, ranging from digital platforms and AI-enhanced risk management in financial institutions to the embedding of AI for supply chain optimization and advanced product innovation in industrial and technology conglomerates. These leading entities, particularly within the strategically vital semiconductor industry, are not only boosting Japan's economic performance but also significantly shaping global technological innovation and market dynamics, leveraging Japan's established strengths in foundational technologies and supportive governmental policies to solidify their position as key global players.

Japan's multifaceted **competitive advantages** in AI and financial innovation stem from its established leadership in robotics, automation, and precision manufacturing, providing a strong base for advanced AI deployment across diverse industries. A mature and technologically sophisticated financial infrastructure, with early adoption of select digital finance solutions within its prominent banking sector, further fosters innovation in areas like blockchain and digital payments. The nation's robust intellectual property regime and consistently high ranking in the Global Innovation Index underscore its substantial capacity for technological advancement, supported by significant and increasing investment in long-term research and development ensuring a continuous pipeline of advanced technologies.

The prevailing trend indicates a growing recognition of AI's potential to enhance corporate performance. Early adopters, particularly within the financial services and manufacturing sectors, are beginning to demonstrate tangible ROI through optimized processes, enhanced efficiency, and the development of innovative products and services. Larger TSE Prime companies, benefiting from scale advantages and more mature data infrastructure, often exhibit higher ROI conversion rates from AI spending. Furthermore, strategic investments in AI integration capabilities, beyond mere technology adoption, correlate with improved returns. While a potential lag between initial investment and significant ROI exists, the long-term outlook suggests that AI will be a crucial driver of enhanced profitability and competitive advantage for Japanese corporations.

The Japanese **semiconductor industry**, despite cyclical market corrections, remains a critical global actor, underpinned by deep expertise in specialized materials, advanced manufacturing equipment, and niche chip

production. Strategic governmental support, including substantial subsidies and the comprehensive Semiconductor Revitalization Strategy, aims to fortify domestic production, secure critical supply chains, and propel the development of next-generation semiconductor technologies vital for AI, EVs, and high-performance computing. **Collaborative initiatives between public entities and private enterprises**, exemplified by projects like Rapidus, are crucial for navigating the complexities of advanced fabrication and ensuring technological sovereignty.

High R&D costs for advanced semiconductors and increasing capital expenditure for leading-edge manufacturing present significant challenges specifically for Japanese semiconductor companies. Their generally lower R&D spending and capital investment compared to international competitors create a risk of falling behind in this rapidly evolving and highly capital-intensive market. This disparity could hinder their ability to innovate and maintain manufacturing competitiveness. Strategic focus and specialization can offer opportunities for growth without requiring massive investment. Japanese companies can focus R&D efforts on areas where they already possess a competitive advantage, such as semiconductor materials and equipment. This targeted approach can maximize the impact of limited R&D budgets. Identifying and focusing on specialized, high-value niche markets within the semiconductor industry, such as automotive semiconductors, rather than attempting to compete across the entire spectrum of leading-edge areas, can be a more pragmatic and resource-efficient strategy. This allows for concentrated investment in specific technologies and applications where Japanese expertise and market position offer the greatest potential for success and sustainable growth.

Strategic governmental initiatives, coupled with Japan's inherent strengths in foundational technologies and a sophisticated financial infrastructure, create a fertile ground for Tokyo Stock Exchange (TSE) Prime companies to pioneer cutting-edge AI applications and digital financial solutions. The semiconductor sector, bolstered by focused governmental investment and public-private collaborations, is poised for significant recovery and sustained global leadership, driven by escalating international demand for AI-related technologies.

The Japanese **government plays a crucial catalytic role** in fostering digital transformation and technological leadership through substantial

financial allocations, strategic policy frameworks such as Society 5.0, and the establishment of regulatory sandboxes to encourage fintech innovation. These proactive measures aim to accelerate the widespread adoption of AI across diverse sectors, modernize the financial ecosystem, and enhance the resilience of strategically important industries like semiconductors.

Japan's AI investment landscape reflects a concerted national strategy, with significant contributions from both the public and private sectors. Simultaneously, private sector investment is steadily increasing, driven by the projected growth of the AI market and the potential for significant returns in areas like automation, fintech, and advanced manufacturing. The overall trend indicates a collaborative approach, with governmental initiatives often catalyzing private sector innovation and commercialization efforts. This dual-pronged investment strategy underscores Japan's commitment to harnessing the transformative power of AI for sustained economic growth and global competitiveness.

Japanese companies operate within a complex and increasingly **volatile global landscape** characterized by **escalating geopolitical tensions**, particularly the intricate relationship between the US and China. These tensions pose significant systemic risks to international supply chains, market access, and technology transfer, necessitating proactive strategies for diversification and resilience. Trade restrictions and potential tariff policies demand careful navigation and the cultivation of robust alternative partnerships within the international trade architecture.

The **depreciation of the yen** exhibits a heterogeneous impact on the Japanese economy. While increasing the cost of imports, it simultaneously enhances the global competitiveness of Japanese exports, particularly in key manufacturing sectors like automotive and electronics, potentially improving the balance of trade. This provides opportunities for increased market share and improved overseas earnings, contingent on companies leveraging sophisticated digital finance instruments for effective currency risk management and optimized international pricing strategies within global markets.

A recognized factor influencing the pace of Japan's digital transformation is the prevailing **organizational culture**, characterized by established employment models, hierarchical structures, and a significant base of legacy IT infrastructure. Evolving beyond these deeply ingrained operational norms

to foster enhanced agility and cross-functional collaboration is crucial for fully leveraging the transformative potential of AI and digital finance in alignment with global financial best practices.

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