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Industrial strategy in the era of AI

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Abstract

This paper examines how Artificial Intelligence (AI), as a general-purpose technology, is restructuring industrial strategy across major economies and altering the foundations of global competitiveness. Using a comparative analytical framework, the study evaluates cross-country differences in AI capability formation in five key regions—United States, China, the European Union, Japan, and India—drawing on indicators of private AI investment, enterprise-level adoption, estimated productivity gains, compute capacity, and AI-relevant human capital. The analysis reveals substantial asymmetries in the distribution of AI-related resources, with advanced economies benefiting from deeper innovation ecosystems, high compute availability, and mature digital infrastructure, enabling them to capture disproportionately higher productivity returns from AI deployment.

In contrast, developing economies exhibit constraints related to limited high-performance compute infrastructure, uneven sectoral diffusion, and shortages of advanced AI-skilled labor, which collectively restrict their ability to leverage AI for industrial transformation. India's position is characterized by high adoption momentum in digital services but comparatively weak underlying capacity in frontier research, compute intensity, and industrial AI deployment. The comparative findings highlight critical complementarities—such as data richness, institutional capability, and absorptive capacity—that determine the extent to which economies can internalize AI-driven productivity gains.

The paper argues that industrial strategy in the AI era must integrate five core policy pillars: (i) scaled investment in sovereign compute and digital infrastructure; (ii) accelerated development of AI-specialized talent; (iii) sector-specific diffusion mechanisms targeting manufacturing, MSMEs, agriculture, and public services; (iv) adaptive and responsible AI governance balancing innovation with risk mitigation; and (v) strategic international partnerships to ensure access to semiconductors, cloud compute, and frontier AI research. Absent such coordinated interventions, developing countries risk deepening technological dependency and realizing only marginal gains from AI, reinforcing existing global inequalities in technological capability and economic performance.

Key words: Artificial Intelligence (AI), Industrial Strategy, AI governance, Developing economies

Introduction

Artificial Intelligence (AI) has emerged as a transformative technological force in the twenty-first century, significantly altering production systems, labor markets, and global economic competition. Unlike previous technological advancements, AI functions as a general-purpose technology with extensive applications in manufacturing, services, agriculture, public administration, and digital platforms. Its rapid dissemination has challenged traditional assumptions about industrial development and revealed new strategic imperatives for states that aim to enhance productivity, upgrade technological capabilities, and secure competitive advantage in an increasingly digital global economy.

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Historically, industrial strategies have focused on supporting manufacturing sectors, promoting technological upgrades, and addressing market failures. However, fundamental reorientation required in response to AI-driven transformations. The rise of data as a strategic asset, increasing reliance on advanced computational infrastructure, and the dominance of digital platforms with strong network effects have redefined how countries design industrial policy instruments. As nations strive to strengthen their positions in semiconductors, cloud computing, algorithmic innovation, and digital skills, industrial strategies have expanded to encompass the issues of technological sovereignty, national security, and ethical governance. Concurrently, the proliferation of AI presents a significant challenge. While AI promises substantial productivity gains and new opportunities for innovation, it also risks intensifying labor market polarization, widening digital divides, and amplifying biases embedded in data systems. Market concentration in digital industries raises concerns about monopolistic behavior and unequal access to critical technological resources.

These issues underscore the need for a coherent policy approach that balances innovation with inclusion, competition with regulation, and technological advancement with societal wellbeing. In this context, this study examines how industrial strategies are being reshaped in the era of AI. It explores the evolving policy frameworks adopted by major economies, analyzes the economic and social implications of AI-led transformation, and outlines the key components of a modern industrial strategy that can harness the benefits of AI while mitigating the associated risks. By situating AI in contemporary debates on industrial policy, this study aims to contribute to a deeper understanding of how nations can build resilient, inclusive, and future-ready economies in an increasingly algorithmic world.

1. Literature Review

The emergence of Artificial Intelligence (AI) as a general-purpose technology (GPT) has been a prominent focus of scholarly literature. GPTs are characterized by their broad applicability, continuous advancements, and substantial spillover effects across the economy (Bresnahan & Trajtenberg, 1995). Numerous scholars contend that AI now fulfills this role owing to its ability to automate cognitive tasks, analyze extensive datasets, and enhance decision-making processes. Brynjolfsson and McAfee (2017) underscored how AI, in conjunction with machine learning and data analytics, represents a new phase of digital transformation capable of reshaping productivity dynamics.

Cockburn, Henderson, and Stern (2018) highlight that AI augments innovation by refining the search and discovery processes in scientific research. This "invention of a method distinguishes AI from previous technologies. The GPT nature of AI implies deep complementarities with data, digital infrastructure, and computational power, all of which significantly impact the industrial structure and policy requirements. Historically, industrial strategies have focused on guiding the structural transformation of economies through targeted support, infrastructure investment, and innovation policies (Aiginger & Rodrik, 2020). Traditional industrial policy aims to address market failures, promote learning-by-doing, and catalyze technological upgrades.

However, contemporary literature suggests that digital technologies, and AI in particular, necessitate a reimagined approach to industrial strategy. Rodrik (2021) posited that digital transformation requires new frameworks, as industrial development now extends beyond manufacturing to encompass platform economies, data networks, and algorithmic systems. Aghion et al. (2021) proposed that modern industrial policy must balance innovation support with robust competition policies to prevent digital monopolies. This perspective is reinforced by Rodrik et al., who emphasize the need for flexible, experimental, and collaborative industrial policies capable of adapting to rapid technological shifts.

An expanding body of comparative literature examines the development of artificial intelligence (AI) strategies across various countries tailored to their respective economic structures and governance models. The United States adheres to a market-led innovation model characterized by robust private sector leadership complemented by federal research agencies such as DARPA and NSF (Webb, 2020). The CHIPS and Science Act reflect strategic concerns about semiconductor sovereignty and technological leadership. By contrast, China's strategy is marked by state-led coordination and ambitious national planning. The "New Generation Artificial Intelligence Development Plan" positions AI as a central engine for economic modernization, industrial upgrading, and social governance (Sheehan, 2020). Scholars highlight China's focus on data- driven platforms, manufacturing automation, and the integration of AI into smart cities and public surveillance systems (Crawford, 2021). The European Union emphasizes a human-centric, ethical, and regulated approach to AI. The EU AI Act and Digital Markets Act underscore their commitment to responsible innovation, data privacy, and fair competition (Veale & Borgesius, 2021). The European literature stresses digital rights, data protection, and the prevention of algorithmic harm. India's strategy diverges by prioritizing inclusive and developmental applications of AI. NITI Aayog's "AI for All" initiative focuses on public-sector applications in agriculture, healthcare, and digital public infrastructure (Sundararajan & Narayan, 2022). Scholars emphasize India's unique approach, where AI deployment is linked to digital inclusion and large- scale government platforms, such as Aadhaar and UPI. These comparative studies underscore the diversity of AI-led industrial strategies and the significant influences of political institutions, economic structures, and developmental priorities.

A growing body of empirical literature has assessed the impact of AI on productivity and economic performance. Korinek and Stiglitz (2021) argued that AI has substantial potential to enhance productivity, although its benefits may be unevenly distributed. Studies on smart manufacturing indicate that AI-enabled automation increases efficiency, reduces downtime, and enhances product customization (Jovanovic & Schott, 2020). AI has also augmented innovation systems. Cockburn et al. (2018) demonstrated how machine-learning tools accelerate scientific discovery and create new opportunities for firms in knowledge-intensive sectors. However, the productivity effects of AI remain uneven across countries and industries, reflecting the differences in digital infrastructure, skill levels, and R&D ecosystems. Extensive research has been conducted on the labor market implications of AI adoption. Acemoglu and Restrepo (2019) showed that AI-driven automation displaces routine and middle-skill jobs while increasing the demand for high-skill complementary tasks. Autor et al. (2022) argued that without strong policy interventions, including retraining and labor-market institutions, AI may exacerbate wage inequality.

The literature also highlights concerns regarding the skill-biased nature of AI. Bessen (2020) noted that AI adoption necessitates specialized training, leading to divergent opportunities for skilled and unskilled workers. This gap has influenced industrial strategy debates regarding education systems, vocational training, and lifelong learning. A key theme of the literature is the role of digital platforms and data monopolies. Zuboff (2019) argues that AI-driven economies are increasingly dominated by a few firms with control over vast datasets, resulting in "surveillance capitalism." Varian (2019) and others have shown that digital markets exhibit strong network effects, high entry costs, and economies of scale in data, leading to winner-take-all outcomes.

Recent insights have spurred increased scholarly interest in competition policies and regulations. Scholars have underscored the necessity for contemporary industrial strategies to address challenges such as data protection, algorithmic transparency, and antitrust enforcement (Kamepalli, Rajan, & Zingales, 2020). The Union's regulatory framework is frequently referenced as a paradigm for harmonizing innovation with data rights and market equity. Artificial intelligence is progressively analyzed through the prisms of geopolitics and digital sovereignty.

Research indicates that competition over semiconductors, cloud infrastructure, rare earth elements, and AI talent has intensified the global technological rivalry (Allen, 2020; Crawford, 2021).

Scholars contend that industrial strategies in the AI era must address supply chain vulnerabilities, particularly those concerning GPUs and advanced chips (Miller & Kim, 2022). The global pursuit of AI leadership has raised concerns regarding cybersecurity, national security, and dual-use technologies. Consequently, industrial strategies increasingly integrate defense innovation, export control, and international collaboration into AI standards. The ethical implications of AI, such as bias, privacy, surveillance, and accountability, have been well documented. Researchers advocate the incorporation of ethical guidelines and regulatory frameworks into industrial strategies to ensure trustworthy AI (Floridi & Cowls, 2019). Environmental considerations are also gaining prominence, with studies indicating that large-scale AI models consume substantial computational energy and contribute significantly to carbon emissions (Strubell, Ganesh, & McCallum, 2019). These perspectives underscore the importance of industrial strategies that align technological progress with both social welfare and environmental sustainability.

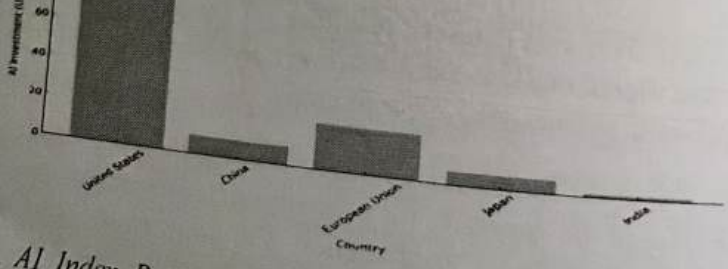
2. Objective of the Study

The objective of this study is to understand how the industrial strategies of different nations are influenced by AI. This study presents a comparative analysis of AI-related investments, adoption patterns, and productivity outcomes across major economies, such as the United States, China, the European Union (Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden), Japan, and India. Using tables and diagrams, this study demonstrates how uneven investment patterns, infrastructure capacity, and diffusion dynamics create divergence in AI- driven industrial transformation.

3. Analysis

3.1 Investment Patterns Across Countries

Figure 1 ("AI Investment by Country, 2024") indicates stark asymmetry in private AI investment across countries. The United States leads by a substantial margin, with an estimated US$109.1 billion invested in 2024. This exceeds the combined investment of China, Japan, the European Union, and India, underscoring the United States' dominance in the global AI ecosystem. The European Union follows distantly with approximately US$22–23 billion, while China's private investment (~US$9.3 billion) reflects a notable decline from earlier years, partly due to its domestic technology slowdown and regulatory tightening of major digital firms.



Source: Stanford HAI, *AI Index Report 2025*, European Parliamentary Research Service (2024), National Digital Reports.

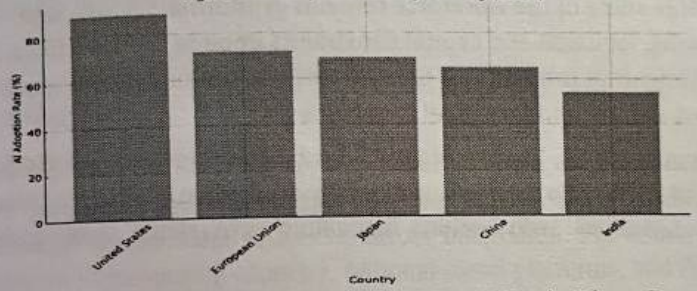
India's investment level (roughly US$1.8 billion) remains relatively small despite its large digital user base. This is consistent with India's broader industrial strategy, which prioritizes digital public infrastructure and applies AI to public services rather than to private AI R&D investment. The low figure reflects limited venture capital availability and the ongoing challenge of scaling deep-tech start-ups in India.

Overall, the comparative investment profile signals an important structural feature: countries that command the largest share of global AI investment also shape their technological standards, innovation trajectories, and global supply chains. This creates potential dependencies for lower-investment economies, such as India, which must navigate the tension between adopting global AI technologies and building indigenous capabilities.

3.2 Adoption Rates and Diffusion Across Firms

Figure 2 ("AI Adoption Rates by Country") highlights that AI adoption varies widely across economies. The United States reports the highest adoption rate (close to **90%** of firms integrating at least one AI tool), followed by the European Union (~70%), and Japan (~69%). China (65%) lags slightly behind the EU average, reflecting structural differences in industry composition and the prevalence of smaller manufacturing units with a limited AI absorption capacity.

Figure 2: AI Adoption Rates by Country (2024)



Source: McKinsey Global AI Survey (2024), OECD AI Use in Firms Report (2024), OECD ICT and AI Integration Survey (2024), National AI Development Report (2024), NASSCOM and McKinsey India AI Adoption Report (2024)

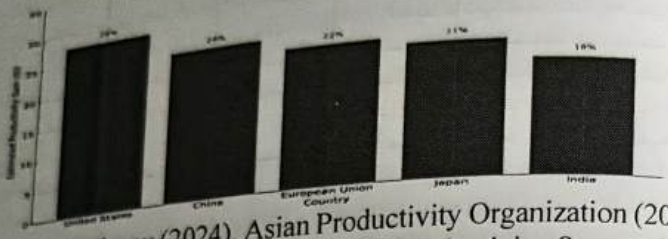
India's adoption rate (~54%) is modest but significant given the early stage of AI ecosystem development. Most adoptions in India occur within the IT services sector, financial technology firms, and large multinational subsidiaries. Domestic manufacturing, agriculture, and MSMEs exhibit slower uptake, largely owing to constraints in digital infrastructure, computing capacity, and AI-skilled labor availability.

The diffusion gap across countries suggests that AI adoption is strongly correlated with infrastructure availability, digital maturity, firm size, and sector composition. Countries with well- developed digital ecosystems, strong cloud penetration, and high R&D spending have demonstrated greater adoption, reinforcing path-dependent technological dynamics.

3.3 Productivity Gains and Efficiency Enhancements

As shown in Figure 3 ("Estimated Productivity Gains from AI"), AI-associated productivity ... follow a similar pattern to that of investment and adoption rates. The United States has the ... estimated gain (~28%), followed by China (24%), the European Union (22%), Japan (21%), and ... (18%). These differences reflect varying degrees of digital integration, as productivity improvements rely not only on the deployment of AI systems, but also on complementary organizational changes, employee reskilling, and process redesign.

Figure 3: Estimated Productivity Gains Attributable to AI (2024)



Source: OECD and McKinsey (2024), Asian Productivity Organization (2024), European Commission Digital Economy Report (2024), METI Japan AI Productivity Survey (2024), NITI Aayog Digital Economy Evaluation (2024) The lower productivity gains in India can be partly explained by its sectoral composition: a large share of the workforce remains in informal sectors, where AI integration is minimal. In manufacturing, logistical and capital constraints impede the shift toward Industry 4.0. This highlights a central insight: AI productivity benefits are not automatic and require coordinated investment in skills, infrastructure, and firm-level capabilities.

The data support the argument in the literature that AI contributes to a "productivity J-curve," where short-term disruptions (e.g., restructuring costs, technology absorption challenges) precede long-term efficiency and growth. Countries with mature innovative ecosystems show earlier and larger productivity gains.

3.4 Discussion

Investment and productivity patterns indicate a clear concentration of AI capabilities among a few advanced economies. The United States accounts for nearly half of global private AI investment, while China and the EU together constitute another significant share. Despite its large population and expanding digital economy, India accounts for less than 1–2% of global private AI investment. The following table shows the patterns of the AI readiness indicators in the selected countries.

Table 1. Summary Comparison of AI Readiness Indicators (2024)

(Investment, Adoption, Skills, and Infrastructure)

Indicator	United States	European Union	China	Japan	India
Private AI Investment	Very High	Moderate	Moderate	Moderat e	Low
Enterprise AI Adoption	Very High	High	High	High	Moderate
Digital Infrastructure	World- leading	Strong	Strong	Strong	Improving
Compute Capacity (GPUs/HPC)	Very High	High	Very High	High	Low– Moderate
AI Skills Availability	High	High	Moderate	High	Low– Moderate
AI Policy Maturity	Advanced	Advanced (regulated frameworks)	Advanced (state-led)	High	Developing

Source: Compiled from Stanford HAI (2025), OECD Digital Economy Reports (2024–25), European Commission (2024), METI Japan, and NITI Aayog (2024).

This concentration poses a risk to global technological inequality. Countries with limited AI investments may struggle to influence global standards, supply chains, and regulatory frameworks. Moreover, as AI becomes embedded in the advanced manufacturing, logistics, and strategic sectors, the technology gap could exacerbate broader economic inequalities. Therefore, industrial strategy must confront issues of technology sovereignty, ensuring that countries like India develop sufficient indigenous capabilities to remain competitive.

The data also highlight the significance of computing capacity and semiconductor supply chains as determinants of the AI capability. The top investors in AI—the United States, China, the EU, and Japan—also dominate the global semiconductor production, high-performance computing, and AI-related hardware markets. India's dependence on foreign chip production and cloud infrastructure represents strategic vulnerability.

The global tensions around semiconductor access illustrate that industrial strategies in the AI era are deeply intertwined with geopolitics. Countries cannot rely solely on market forces; they must invest strategically in computer infrastructure, cloud services, chip manufacturing, and secure data-storage networks. Without these capabilities, domestic AI innovation remains limited, as demonstrated by the Indian case.

Taken together, the data visualizations and cross-country tables reveal several patterns directly relevant to industrial strategy.

a. **Infrastructure and investment lead AI capability.**

The massive investment levels and high adoption rates in the United States show that early and sustained financial commitment fosters broad AI integration. For countries such as India, strategic public investment in computing capacity, national cloud platforms, and AI research hubs is essential to catch up.

b. **AI diffusion is uneven and shaped by sectoral composition.**

Countries with strong services and high-tech sectors demonstrate faster adoption. Therefore, industrial strategies must target lagging sectors, particularly manufacturing and MSMEs, to broaden technological spillovers.

c. **Productivity gains depend on complementary capabilities.**

Education, killing, organizational change, and digital literacy are critical. Without these, AI investment yields weaker productivity outcomes, as shown in India and Japan.

d. **Market concentration and global inequalities require regulatory and institutional responses.**

Strong antitrust regulations, open data frameworks, and innovation support are required to ensure broad-based benefits.

e. **Geopolitical competition shapes industrial priorities.**

Access to semiconductors, computing power, and artificial intelligence (AI) talent has become a matter of national security, requiring long-term strategic planning.

4. Conclusions and policy implications

This study examines how artificial intelligence is reshaping industrial strategies across major economies, drawing on comparative indicators of investment, adoption, productivity, computing

capacity, and AI skills development. The findings demonstrate that AI is not merely an incremental technological upgrade, but a foundational general-purpose technology that reorganizes production, innovation, and competitive structures.

Three broad conclusions emerge from the analysis.

First, AI capabilities are highly concentrated, with the United States retaining a dominant lead in private investment, talent concentration, and innovation output. China and the European Union follow distinct models: state-driven industrial upgrading in China and a regulation-aligned innovation ecosystem in Europe. Japan has demonstrated steady and technologically mature adoption, driven by robotics and advanced manufacturing.

Second, India remains in an emergent position in the global artificial intelligence (AI) landscape. While its enterprise adoption rate has grown rapidly, from approximately 20 percent in 2020 to about 54 percent in 2024, its absolute investment, computing infrastructure, and talent base remain comparatively limited. The projected scenarios indicate that India's trajectory could diverge substantially depending on the scale and direction of policy interventions.

Third, productivity analysis underscores that AI generates significant potential gains, but these gains are uneven across countries and sectors. Higher returns accrue when complementary capabilities—digital infrastructure, R&D capacity, skilled labor, data availability, and organizational readiness—are already strong. Differences in these factors explain why countries with similar adoption rates (e.g., China and the EU) experience different productivity outcomes.

Taken together, these findings show that the industrial strategy in the AI era requires a multifaceted approach: simultaneously expanding technological capacity, broadening diffusion, strengthening institutional readiness, and ensuring equitable access. Countries able to mobilize such a coordinated strategy will disproportionately shape the future global economic order.

4.1 Policy implications

The comparative analysis highlights that developing countries must adopt a coordinated, capability-building industrial strategy to benefit meaningfully from AI-driven economic transformation. The priority is a scaled investment in sovereign computing and digital infrastructure, including national GPU facilities, data centers, and high-speed connectivity, to close the foundational capacity gap with advanced economies. In parallel, governments must accelerate the development of AI-specialized human capital through curriculum reforms, advanced research programs, and industry-linked training pathways, ensuring that firms have access to the expertise required for AI integration. A third imperative is the creation of sector-specific AI diffusion mechanisms, particularly for manufacturing MSMEs, agriculture, and public services, in which targeted support can rapidly expand adoption and generate broad-based productivity gains.

Equally critical is the establishment of adaptive and responsible AI governance frameworks that safeguard against risks, such as algorithmic bias, data misuse, and concentration of digital power, while maintaining regulatory flexibility to support innovation. Finally, developing countries must deepen strategic international partnerships to secure reliable access to semiconductors, cloud computing, and frontier AI research capabilities that remain globally concentrated and difficult to develop domestically at scale. Together, these five policy pillars provide a coherent roadmap for building the institutional, technological, and human capital foundations necessary to leverage AI as a driver of inclusive and sustainable industrial transformation.

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