The Potential Impact of AI on the Economic Growth of India

A Study by:

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1. *Introduction*

Artificial Intelligence (AI) is created by endowing machines with human like intelligence and capabilities. Artificial Intelligence enables machines to think humanly (i.e., the machine's cognitive processes are very similar to that of a human), think rationally or logically, act humanly or indistinguishably from human beings, and act rationally (negotiate the environment successfully or in a manner similar to human beings). For a discussion of artificial intelligence, see Russell and Norvig (2009). While many definitions of artificial intelligence have been put forward, they match the definition put forward here. Interestingly, NITI Aayog, the premier policy think tank of the Government of India, has framed AI as the capability of machines to perform tasks requiring human intelligence, encompassing areas such as machine learning, natural language processing, robotics and vision[1].

While AI far surpasses human intelligence in regard to scale, speed and accuracy of processing information there are certain characteristics of human intelligence which AI cannot replicate. These include critical thinking, ability to adapt to new situations and the expression and comprehension of complex emotions and are reflected in nuanced creativity, high quality innovation and collaboration exhibited by humans. Given their different comparative advantages, AI and human intelligence can be considered as partners in the march of human civilization. Consider medical care: AI can help doctors in diagnosis and the detailed design of personalized treatment plans because of the ability to process massive amounts of information while doctors can take critical decisions in regard to the course of treatment as well as provide empathetic care to patients. If regulated properly, the channels of development made possible by AI can give rise to new human jobs though certain human occupations might become extinct or shrink as avenues for employment[2].

The digital technology revolution is transforming workplaces in two different ways: first, it is facilitating unbundling of offices by allowing tasks to be completed remotely (RI or Remote Intelligence); second, developments in Artificial Intelligence (AI) have facilitated the automation of various tasks in business processes previously done by office workers and professionals by enabling white collar robots or service robots to complete these tasks.

The development of RI has been spurred by advancements in collaborative software suites, videoconferencing applications and secure cloud-based document sharing and editing. The mentioned developments in AI include the rapid advance of machine learning: while earlier humans could program computers to mimic the analytical behaviour of humans, computers could not do the intuitive unconscious tasks that humans do (identifying faces in photographs or translating passages); this has changed over time and given that computers have become faster and more accurate than humans in the last few years in regard to these tasks, this poses a threat to human jobs.

[1] https://www.niti.gov.in/sites/default/files/2023-03/National-Strategy-for-Artificial-Intelligence.pdf
[2] https://online.maryville.edu/blog/ai-vs-human-intelligence/

The important question is whether AI can be a substitute for RI: whether the mentioned developments in AI can displace remote workers from their jobs. In other words, we need to ascertain whether AI and RI are complements or substitutes. Here one should note that there exist tendencies for both substitution and complementarity. For example, AI driven chatbots are replacing human workers in call centres. This has happened in the Philippines and India. "Robotic Process Automation" is another type of substitution: humans are being replaced in offices by robots who do exactly what these humans did. On the other hand, software for translation can enable offices to employ (at low enough wages) and communicate with remote workers in distant countries, who do not follow the language spoken in these offices. This gives a boost to remote work. This is an example of the mentioned complementarity.

Preliminary evidence collected by Baldwin and Okubo (2024) for Japan suggest that on the whole AI and RI are complements rather than substitutes: there is positive correlation of investments in AI-promoting and RI-promoting software at the firm and worker level, and second workers' expectations regarding telework and software automation are also positively correlated.

However, as mentioned there are tendencies for both complementarity and substitutability and in other countries the conclusion might be different. For example, in India call centres have been major sources of employment and the replacement of humans by chatbots might be a major source of job destruction. More research is needed in regard to the Indian case.

It is very clear from this brief discussion that AI can be both a substitute as well as complement for human productivity and intelligence. In general, systems based on Artificial Intelligence far outdo the human brain in regard to computational power and processing of data[3]. This characteristic of AI provides the basis for AI contributing significantly to economic growth. In this paper we examine the potential role of AI in India's economic growth.

This paper explores the potential impacts of Artificial Intelligence (AI) on the Indian economy, with a particular focus on the opportunities that widespread AI diffusion presents for accelerating economic growth and achieving India's ambitious goal of attaining high-income status by 2047. The central research question guiding this inquiry is: how can AI contribute to India's economic transformation, and what role might it play in accelerating the growth momentum necessary for India to attain high-income status by 2047?

The rest of the paper is structured as follows. *Section 2* looks at the very many ways in which AI can contribute to the Indian economy. *Section 3* compares the developments in India in regard to leveraging the benefits of AI with that in United States and Europe. The rationale for the comparison with United States and the European Union lies in the contrasting yet complementary models these two regions represent: the U.S. approach emphasizes innovation-led growth with minimal central regulation, whereas the EU framework prioritizes ethics, transparency, and rights-based governance. India's evolving AI strategy draws elements from both these paradigms. In contrast, China's highly centralized and state-controlled AI ecosystem operates within a fundamentally different political and data governance structure. Owing to time and scope constraints, this study limits its country comparison to the EU and U.S; however, future research

[3] https://ignitarium.com/human-brain-vs-existing-artificial-intelligence-systems/

could fruitfully extend the analysis to include China and other major economies for a more comprehensive global perspective.

Continuing with the outline, *Section 4* looks at policy and strategy in regard to AI in India. *Section 5* compares regulation of AI in India to that in the United States and Europe. *Section 6* looks at various empirical works on the growth benefits of AI in the case of India and uses these to examine the possibility of India becoming a High-Income Economy by 2047, as targeted. *Section 7* specifically examines the impact of job destruction caused by robotization on the potential for achieving high-income status. *Section 8* focuses on AI, jobs, and India's path to high-income status, and *Section 9* provides a dedicated conclusion that clearly synthesizes the paper's findings. Our findings indicate that AI has the potential to bridge the current growth gap of 1.451 percentage points needed for India to reach high-income status by 2047. This growth boost stems from productivity gains across multiple sectors, including manufacturing, services, agriculture, and healthcare, driven by AI-enabled automation, innovation, and improved efficiency. However, achieving these gains requires strong government intervention to overcome low baseline investment in AI and to manage the risks of job displacement.

2. The Potential Beneficial Impact of AI on the Indian Economy

2.1 AI and Human Capital Formation

In education AI can be used to provide personalized learning experiences to children, with more gifted children learning at a fast pace and the relatively less gifted ones proceeding at a slower pace, with the option of picking up pace later. This differs from the environment of a school classroom in which all children, with varying cognitive skills[4], receive the same education.

How is this personalized learning experience provided? Artificial intelligence is able to identify a student's strengths and weaknesses as well as learning pace and preferences. This data is then used to provide customized lesson plans and resources. Customization allows students to learn at their own pace and absorb the material[5].

The above is one pathway through which AI can add to human capital formation. In India personalized learning provided by AI can be used to supplement schooling in rural areas. Schools in rural areas are characterized by poor infrastructure (classrooms, libraries etc.), lack of competent teachers, textbooks and teaching aids. Residential areas are often very far from the nearest school and connected to it by poor roads; this adversely affects school attendance[6]. Moreover, teacher absenteeism in government primary schools is a significant and well documented phenomenon (Mooij and Narayan, 2010). It is in this context that digital education can greatly enhance the quality and quantity of education available to children in rural areas; as well as enable those

[4] Variations in socio-economic background produce variation in cognitive skills in a group of children (Carlsson et al., 2015; Cunha and Heckman, 2007)
[5] https://www.ucanwest.ca/blog/education-careers-tips/advantages-and-disadvantages-of-ai-in-education
[6] https://www.cry.org/blog/education-in-rural-india/

students with a high level of cognitive skill to make speedy progress in the attainment of knowledge while enabling not so promising students to learn at their own pace.

Digital infrastructure is an equally critical constraint. In rural India, only about 4 per cent of households have a computer (2023)[7], compared to over 85 per cent in OSCE[8] countries, and around 45 per cent of households lack access to the internet[9] (OSCE 8%, 2023). These disparities reveal that while AI-based personalized learning has the potential to transform rural education, its feasibility depends on parallel investments in connectivity and digital access. Meanwhile, significant improvements are taking shape: digital infrastructure in rural areas is gradually improving, driven by the increasing availability of affordable smartphones, the expansion of mobile internet networks, and government initiatives such as the Digital India programme and *the Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA)*, the Prime Minister's campaign to promote rural digital literacy. As a result, the total number of internet subscribers in rural areas has reached 398.35 million out of a potential 954.4 million[10].

AI can also help in dropout prevention: students at high risk of dropping out can be identified through AI on the basis of socio-economic data and test scores. Once such identification is completed, preventive measures such as mentoring/ tutoring/ counselling can be undertaken. By improving learning outcomes and preventing dropouts, AI contributes directly to an increase in the average years of schooling and the effective stock of skilled labour in the economy. A larger and better-trained workforce raises overall labour productivity, expands the pool of employable youth, and enhances the economy's potential growth rate.

On the other hand, people in India's rural areas lack accessible, affordable and quality healthcare services. Doctors and other medical professionals also avoid practicing in rural areas because of problems such as violence, inadequate housing and crumbling infrastructure. Moreover, healthcare facilities struggle because of inconsistent access to essential medicines. Here is how AI can help: using information from healthcare facilities and surveillance systems AI can match needs to appropriate resources; it can predict demand for drugs and essential medicines and allocate supply to match demand; it can predict healthcare crises so that human and material resources can be pre-positioned[11]. Better rural healthcare translates into higher labour participation rates, reduced absenteeism, and lower productivity losses due to illness. As rural populations constitute a large share of India's workforce, improvements in their health outcomes directly strengthen the country's aggregate labour productivity and raise GDP.

Furthermore, machine learning can employ data on maternal features to accurately predict low birth weight in newborns (Khan et al., 2022). A study by Girotra et al. (2023) shows that 17.29% of newborns have low birth weight in India. Thus, this is a major problem in India. According to the World Health Organisation (WHO) low birth weight infants are about 20 times more likely to

[7] https://www.dataforindia.com/computers/
[8] Organization for Security and Cooperation in Europe
[9] https://www.sia-india.com/wp-content/uploads/2024/07/Bridging-the-Digital-Divide-in-India-via-Satellite-White-Paper.pdf#:~:text=As%20per%20the%20latest%20TRAI%20(%20Telecom,access%20to%20the%20internet%20as%20of%202023.
[10] https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2040566
[11] https://www.healthcareexecutive.in/blog/harnessing-a

die than heavier infants. Low birth weight babies additionally suffer from the following: low oxygen levels at birth; trouble staying warm; trouble gaining weight, infection[12]. Low weight at birth is thus a major source of loss of potential human capital and needs to be prevented. Once low birth weight is predicted by AI models during pregnancy the following steps can be taken to prevent these predictions from being realized: nutritional support to mothers, managing chronic conditions in pregnant mothers, life style modification such as smoking cessation and closer monitoring of pregnancy. The prevention of low birth weight translates into a healthier next generation with lower infant mortality and reduced long-term healthcare costs. Infants born with healthy weight are more likely to attain better cognitive and physical development, contributing to a more productive workforce in the long run and lowered dependency ratio.

AI's impact on human capital is further evident in its application to early cancer diagnosis. Hunter et al. (2022) demonstrate that artificial intelligence approaches such as deep learning and neural networks can make use of data embedded in electronic healthcare records, diagnostic images and pathology slides to detect patterns and help in the early diagnosis of cancer.

In India the number of cases of cancer detected in 2022 was roughly 1.5 million, about 0.1% of the Indian population. Given this statistic it can be inferred that one in nine people are likely to develop cancer during his/her lifetime. According to a study by Krishnan Sathishkumar et al. (2022), the incidence of cancer cases seems to be increasing. Early detection of cancer, which significantly increases the likelihood of successful treatment and cure, is thus a major pathway for preventing destruction of human capital and can thus lead to an increase in the growth rate of GDP.

Additionally, early diagnosis reduces the loss of productive working years that would otherwise result from prolonged illness or premature death; and leads to substantial economic savings by reducing prolonged hospitalization, expensive late-stage treatments. This preservation of labour supply translates into higher aggregate productivity, and reduces the fiscal burden on public health expenditure.

2.2 AI and Productive Sectors

In agriculture, AI can be used in many ways to boost productivity and reduce cultivation costs. The aerial data captured by drones can be used to assess crops and detect diseases; early detection can prevent these diseases from affecting crops to a significant extent. Soil moisture and nutrient levels can also be monitored using AI; corrective steps can be taken on the basis of such monitoring. This data can also be used in precision farming: working out the precise optimal amounts of fertilizer, irrigation and pesticide[13].

The Union Cabinet Committee has approved the *Digital Agriculture Mission* with a substantial financial outlay of Rs. 2,817 Crore[14] on September 2, 2024. The share of the central government will be Rs. 1,940 Crore[15].

[12] https://www.stanfordchildrens.org/en/topic/default?id=low-birth-weight-90-P02382
[13] The discussion in this paragraph is based on Aijaz et al. (2025)
[14] Roughly € 276 million.
[15] Roughly € 189 million.

The scheme is built on two pillars: *Agri Stack* and *Krishi Decision Support System*. *Agri Stack* would create a digital identity for farmers. This digital identity would be linked to various farmer-related data such as land records, livestock ownership, crops sown, and benefits availed. *The Krishi Decision Support System* would provide remote sensing data on crops, soil, weather and water resources.

Further under this mission, development of soil profile maps for 142 million hectares of land has been envisaged. Digital access to various government schemes will be provided, reducing the need for paperwork[16].

Out of 6,44,131[17] villages in the country, more than 6,22,804[18] villages have mobile coverage and out of these, more than 6,14,564[19] villages have 4G mobile connectivity as on September 2024[20]. As of December 27, 2024, over 2.14[21] lakh gram panchayats out of a total of 2.68[22] lakh Gram Panchayats have been connected through *BharatNet* with affordable high-speed internet access. Such mobile and internet connectivity would help Indian farmers use facilities such as the *Krishi Decision Support System.*

Kariyanna and Sowjanya (2024) highlights that use of AI based on computer vision can greatly increase the efficacy of pest surveillance and help to generate early warnings. Such early warnings help to avoid damage to crops, thus enhancing agricultural production.

AI can also play a crucial role in the manufacturing sector. One of the applications of AI is the important role machine learning can play in supply chain management by enhancing its efficiency. A supply chain is all the steps needed in regard to the production and delivery of a good while machine learning (ML) is a type of AI which enables firms to learn from data, identify patterns and make decisions. ML can result in automation of certain supply chain tasks such as inventory management, demand forecasting, and order fulfillment. This frees up staff resources for other tasks. ML algorithms can anticipate delivery delays and product defects a long time before they occur. This helps firms to take proactive measures to mitigate these adverse factors. ML algorithms can optimize delivery routes, thus saving on fuel costs as well as time[23].

In the manufacturing sector, identification of defects in products is an important task. Defects range from superficial irregularities to structural flaws and dimensional inaccuracies. Effective product detection helps in maintaining product quality. This helps to safeguard brand reputation and meet industry standards. Effective production also helps to reduce waste. Machine learning models trained on visual data on defects and non-defective products can combine with the use of cameras to help firms identify defects in products in a more efficient manner than what is possible

[16] https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2051719
[17] The figures in this text follow the Indian numbering system, where "lakh" = 100,000. 6,44,131 corresponds to 644,131 in the European format.
[18] 6,22,804 corresponds to 622,804 in the European format.
[19] 6,14,564 corresponds to 614,564 in the European format.
[20] https://www.pib.gov.in/FeaturesDeatils.aspx?NoteId=153605&ModuleId+=+2
[21] 2.14 lakh corresponds to 214,000 in the European format.
[22] 2.68 lakh corresponds to 268,000 in the European format.
[23] The discussion in this paragraph is based on Mukherjee (2023) https://www.scmr.com/article/machine_learning_techniques_in_supply_chain_management

through human judgment combined with human vision[24]. This spurs profitability of firms and therefore be a contributor to raising the growth rate of GDP.

However, AI adoption has important implications for labor demand. While this reduces the need for manual inspection, it may lead to a reallocation of labor to more technical or supervisory positions, such as those associated with monitoring automated systems or maintaining AI equipment. Thus, opportunities for higher-skilled employment are created, boosting both firm productivity and broader economic growth.

Another application of AI is the development of smart grids. According to the International Energy Agency (IEA), "smart grids are electricity networks that use digital technologies, sensors and software to better match the supply and demand of electricity in real time while minimizing costs and maintaining the stability and reliability of the grid"[25]. A smart grid can help to identify and reduce transmission and distribution losses, improve peak load management as well as quality of service[26]. A smart grid can also help in the better integration of renewables into the grid[27].

India's Economic Survey for 2020-21 reported very high transmission and distribution losses for India. T&D losses represent electricity that is generated but does not reach intended consumers. India's T&D losses have been over 20 per cent of generation. This is more than twice the world average. The ideal level of T&D losses ranges between six to eight per cent[28]. The National Smart Grid Mission of the Ministry of Power, Government of India points out that the use of smart grid can substantially reduce T&D losses for India[29]. Note that T&D losses result in a major loss of GDP and therefore its reduction through installation of smart grids can enhance GDP growth.

Artificial intelligence (AI) can also be used to build *Intelligent Transportation Systems* (ITS). These systems are based on AI processing data for the purpose of safety enhancement, predictive analysis and traffic management. The outcomes are better control of traffic with reduced travel times, lower emissions and lower loss to life through accidents (Afolayan et al, 2024).

Indian city roads have been characterized by increased congestion and rapid motorization. As documented by Pojani and Stead (2017) urban transport problems in emerging economies are often perverse (refers to the paradox where transport issues worsen as the economy grows wealthier). In the Indian context, a study by Singh (2005)[30] highlights that congestion and limited road space has resulted in a decline in the overall speed of vehicular traffic on city roads. Note that this decline serves as a disincentive for economic activity. By helping to manage traffic better, AI can help to check this decline.

[24] The discussion in this paragraph is based on that in https://viewmm.com/en/defect-detection-in-manufacturing/
[25] https://www.iea.org/energy-system/electricity/smart-grids
[26] https://www.nsgm.gov.in/en/smart-grid
[27] https://innovationatwork.ieee.org/smart-grid-transforming-renewable-energy/
[28] https://economictimes.indiatimes.com/industry/energy/power/economic-survey-flags-high-td-losses-in-power-sector/articleshow/80585965.cms?from=mdr
[29] https://www.nsgm.gov.in/en/smart-grid
[30] A more recent reference is available here: https://indianexpress.com/article/trending/top-10-listing/top-10-indian-cities-with-slowest-traffic-in-2024-25-bengaluru-mumbai-slip-from-1-spot-9776331/?utm

2.3 AI for Risk Mitigation and Economic Stability

Flood forecasting helps to prevent damages to assets and prevents loss of life and human capital. The Google Flood Forecasting Initiative uses advances in machine learning, applied to on-ground data from government agencies, to provide flood forecasts in real time and warnings to those at risk of being affected. Flood forecasts not only predict when a flood will occur but also the severity of the event. These forecasts and the warnings they facilitate help save lives and prevent economic damage[31].

AI is also displaying major potential to transform pandemic preparedness. According to Professor Moritz Kraemer[32], it will help us anticipate better where outbreaks will start and will be able to predict their trajectory, using climatic and socio-economic data. It will also help to predict the impact of disease outbreaks on individual patients by studying the interaction between the immune system and pathogens. All in all, AI has a potential to save lives and make the world better prepared for pandemics[33]. Better preparedness implies that outbreaks will not evolve into pandemics.

Note the massive losses felt by India due to the Covid-19 pandemic: millions of jobs lost and millions of people pushed into poverty. Agriculture, forestry and fishing suffered a slowdown in growth of gross value added. In manufacturing; electricity, gas and water supply; and mining and quarrying the growth turned negative as activity suffered (Junuguru and Singh, 2023). As mentioned, some of these losses could have been prevented through better preparedness.

Hence, AI-driven preparedness has a direct economic implication: by enabling early containment and efficient resource allocation, it prevents large-scale production shutdowns, labour market disruptions, and fiscal strain on public health systems. The mitigation of such economic shocks stabilizes GDP growth and ensures continuity of economic activity even during crises.

Moreover, AI based surveillance can lead to a decrease in crime. Smart solutions such as biometrics, facial recognition, smart cameras and video surveillance systems are tools that are increasingly being used for the purpose of reducing crime. It has been pointed out by a research study that AI could help cities reduce crime by 30 to 40 percent[34]. The International Data Corporation (IDC) has predicted the use of digital tools, such as live video streaming and shared workflows[35], by 40 percent of police agencies by 2022.

Crime discourages economic activity as it can cause significant loss to life and property. The estimation of such social cost of crime has become an important field of study in the last few decades. The costs of crime have been investigated by various authors. Brand and Price (2000) find a total cost of crime for Wales and England which is 6.5% of the GDP. Anderson (1999) estimates this to be 11.9% for the United States.

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[31] https://indiaai.gov.in/case-study/using-ai-to-predict-floods-and-save-lives

[32] Lead author of a paper (which is available here- https://www.nature.com/articles/s41586-024-08564-w) from the University of Oxford's Pandemic Sciences Institute.

[33] https://www.pasteur.fr/en/press-area/press-documents/how-ai-will-make-it-easier-anticipate-future-pandemics

[34] https://www.deloitte.com/an/en/Industries/government-public/perspectives/urban-future-with-a-purpose/surveillance-and-predictive-policing-through-ai.html

[35] See Chan and Lo (2025)

The National Crime Records Bureau (NCRB) in India data reports a high crime rate in some Indian cites: in 2023, Delhi reported 1832.6 crimes per 100,000 population. In Jaipur, Indore, Kochi and Patna the number of crimes per 100,000 population were high as well at 916.7, 767.7, 626.7 and 611.7 crimes per 100,000 respectively[36].

Given the high economic cost of crime and the significant incidence of crime in some Indian cities, it is clear that reduction of crime in the Indian case through the use of AI can also yield rich dividends in terms of economic growth. A reduction in crime has direct economic benefits: it lowers the substantial financial losses associated with theft, vandalism, and organized crime. Reduced crime rates enhance investor confidence, and stimulates business and tourism activities. Moreover, safer urban environments improve property values and labor productivity by fostering social stability and reducing transaction costs linked to insecurity.

2.4 AI and Services Sector

Artificial Intelligence (AI) is being used in the banking sector in both internal operations and customer-facing applications. For example, AI-driven fraud detection enhances the security of financial transactions, which can increase customer trust in banks. Similarly, AI-powered financial advice and automated investment recommendations help customers make better decisions, potentially increasing both the efficiency and quantity of investments. As a result, customer service and fraud detection are being improved[37]. This can enhance the quantity of both savings and investment. Financial development impacts the saving rate, the fraction of saving channelled to investment and the social marginal productivity and through these factors, the rate of economic growth (Pagano, 1993). In empirically determining the causation running from financial development to economic growth the problem lies in the fact that there might be a reverse causation going from growth to financial development. Further, while financial development might indeed enhance the efficiency of the financial system and therefore the proportion of saving channelled to investment as well as help to better identify the yields of projects competing for investment, there is also a tendency for household credit to increase with financial development, a factor which can reduce the saving rate. Therefore, the impact of financial development on saving and hence on economic growth is ambiguous. This implies that while AI can spur financial development this might or might not stimulate economic growth.

In the retail sector, tailored product recommendations and individualized marketing messages based on past buying behavior of customers can be generated through AI. These form the basis of highly personalized shopping experiences for customers[38]. This encourages customers to spend more. In India, the country's retail industry is becoming increasingly organized: from about 4% - 5% 10 years ago to 17% today[39]. Since it is the organized part that should see an increased use of

[36] https://www.orfonline.org/expert-speak/crime-in-india-s-largest-cities-an-analysis
[37] https://www.ibm.com/think/topics/ai-in-banking
[38] https://www.sap.com/resources/ai-in-retail
[39] https://www.thehindu.com/business/retail-sector-may-soon-jump-into-a-9-10-growth-mode-retailers-association-of-india/article69748032.ece

AI with attendant benefits, this trend implies that the benefits of AI in retail would flow to a much larger portion of the population over time.

Robots are being used in the tourism sector for hospitality services and interaction with guests. In developed countries robots are currently being used as concierges and as waiters in restaurants. These provide the customer with improved services while reducing costs (Palrao et al, 2023). In 2021 the sales of robots in the global hospitality industry increased by 85% according to the International Federation of Robotics (2022). It is inevitable that robots will see widespread adoption in the Indian hospitality industry.

The Indian Government has set ambitious targets in regard to tourism in India. There is a plan to attract 100 million inbound tourists by 2047. Forecasts say that this sector's contribution to GDP will grow up to $511.5 billion by 2034. Demand for hotel accommodation for leisure and official purposes is also registering a strong growth[40]. The introduction of robots in the Indian tourism and hospitality sector can play a useful role in the planned expansion of the tourism and hospitality sector. While the adoption of robots may reduce routine service roles in India's tourism and hospitality sector, it also generates opportunities for higher-value employment, such as data-driven customer personalization, personalized travel planning, event coordination, and digital concierge services. AI-driven efficiency and improved service quality can further expand tourism demand, creating additional jobs in areas like tour design, virtual assistance, and smart facility management. However, whether these gains fully offset potential job losses depends on the pace of sector growth, workforce adaptability, and the availability of training programs.

In regard to job search, AI driven recruitment platforms are helping to match the needs of employers to appropriate job seekers looking for employment[41]. Thus, job search is made faster, pushing the economy towards full employment and a higher GDP.

Drenik (2024) observes that AI should also accelerate Research and Development because it is able to process data and identify patterns much faster than human researchers[42]. This helps to speed up the generation of insights. Acceleration in innovation would be a key input into raising the growth rate of GDP.

3. Benefits from AI in Major Sectors: A Comparison Among India, the US, and EU

Artificial intelligence is transforming production practices all over the globe; the major global economies of India, the United States and European Union are no exception. While there are

[40] https://www.ibef.org/industry/tourism-hospitality-india
[41] https://economictimes.indiatimes.com/news/how-to/top-ai-tools-and-strategies-to-follow-for-a-faster-job-search/articleshow/116043752.cms?from=mdr
[42] https://www.forbes.com/sites/garydrenik/2024/06/18/how-ai-is-accelerating-innovation-in-research-and-development/

differences in the impact of AI on production in these three regions, there is also a convergence caused by commonality in challenges in regard to governance, competitiveness, and ethics.

The United States stands at the forefront of the global AI race, with its AI market (i.e., the value of all AI-related products, services, and applications) valued at $146.09 billion in 2024, and expected to surge to $851.46 billion (CAGR of 19.33%) by 2034[43]. According to the Stanford University 2025 AI Index Report[44], the U.S. developed 40 advanced AI models in 2024 alone, vastly exceeding the output in China (15 models) and Europe (3 models) by a significant margin. The scale of this accomplishment is underpinned by a vibrant ecosystem of research universities such as Massachusetts Institute of Technology, tech giants such as Google and Microsoft, and federal initiatives such as the National AI Research Institutes (NAIRIs).

In contrast, the European Union has decided to strictly regulate the development of AI through the *EU AI Act* and the *General Data Protection Regulation (GDPR)*, which together set a benchmark for responsible AI innovation. As documented by Balcioğlu et al. (2025), EU's emphasis on assigning humans a role in developing and deploying AI systems (human oversight), cross-border collaboration, and sustainable digital infrastructure is a major balancing force within the global AI ecosystem. Meanwhile, India has emerged as one of the fastest-growing AI hubs worldwide, with a projected market size of $28.8 billion by 2025 and an exceptional CAGR of 45%[45]. Between 2016 and 2023, its AI-skilled workforce grew 14-fold, placing it among the top five fastest-growing talent pools globally. As reported by the Wheebox India Skills Report 2024[46], demand for AI professionals is expected to reach 1 million by 2026. Crucially, India's AI ecosystem is fueled by government policy support, academic research institutions, and a vibrant startup ecosystem driving a wave of innovations across sectors from healthcare and agriculture to education and finance, which are rapidly deploying AI solutions to address sectoral challenges while creating new avenues for economic growth and technological leadership.

According to a *Press Note of the Government of India, Press Information Bureau*, India's digital infrastructure has reached very healthy levels and is getting rapidly upgraded: On July 1, 2025, India celebrated 10 years of its Digital India journey. The aim of this journey was to use technology to make life simpler for every Indian. Healthcare, education, banking and other services have become accessible through a few clicks. The digital economy contributed 13.42% of national income in 2024-25 and this proportion has been growing very fast. By 2030 this proportion is going to increase to 20%. Internet connections jumped from 0.25 billion in March 2014 to 0.97 billion in June 2024, registering a growth of 285.53%. The corresponding increase in broadband connections was from .06 billion to .95 billion. Out of 6,44,131 villages, 6,15,836 villages have 4G mobile connectivity in the country, as of December 2024. However, computer ownership remains unsatisfactory[47]: only 10% of Indian households own a laptop or computer as opposed to 75% in most developed countries. Moreover, this proportion has grown slowly in India over the last two decades.

[43] https://www.precedenceresearch.com/artificial-intelligence-market
[44] https://hai.stanford.edu/ai-index/2025-ai-index-report
[45] https://wheebox.com/assets/pdf/ISR_Report_2024.pdf
[46] https://wheebox.com/assets/pdf/ISR_Report_2024.pdf
[47] www.dataforindia.com

Furthermore, only 1 in 5 adults know how to use a computer, as of 2025. This proportion has also been growing slowly. However, smartphone ownership and ability to use smartphones is quite high in India. This has made access to digital services easy.

Given the above facts, we can conclude that while certain aspects of digital infrastructure have shown rapid improvement, others such as the ownership of computers and ability to use them is not only unsatisfactory but growing slowly over time. This might hamper the use of AI in services, manufacturing, agriculture and retail, especially on the supply side.

We now look at the impact of AI in each of the 3 regions in various sectors.

i. Education

In India, the New Education Policy (NEP) 2020 marks a foundational shift by explicitly assigning a role to AI in various levels of education, from secondary to higher studies. The All India Council for Technical Education (AICTE) has systematically introduced the study of AI, data science, IoT, and data engineering into technical streams, while the Central Board of Secondary Education (CBSE) has made AI an optional subject for students in high school. These reforms are supplemented by national programs such as *'AI for Youth'*, under the IndiaAI Mission (2024), reaching over 25,000 students across 7,000+ schools. The NEP also mandates the establishment of Centres of Excellence at leading institutions such as Indian Institute of Technology (IITs) and Indian Institutes of Information Technology (IIITs) to drive cutting-edge AI research and model development. In the private sector, a vibrant ecosystem of startups and innovations is reinforcing this transformation. Indian EdTech startups and innovations including BYJU'S, Embibe, and Leverage Edu personalize learning, using AI in the development of appropriate practice materials, while tools such as *Teachmint* automate administrative tasks, allowing teachers to focus more on instruction to students and mentorship. Google's *Read Along* app and Microsoft's AI-powered text-to-speech tools break language and disability barriers, especially benefiting visually impaired students in rural areas to access digital content in regional languages. Together, these collective efforts have placed India at the forefront of global AI skill penetration[48]: according to the Stanford AI Index 2024[49], India leads with a score[50] of 2.8, outpacing both the US (2.2) and Germany (1.9), with a staggering 263% growth in AI talent since 2016.

In comparison, the United States advances AI education through strategic national initiatives such as the *White House Task Force* on AI Education and the *Presidential Artificial Intelligence Challenge*, fostering broad partnerships to familiarize students, enrolled at levels ranging from kindergarten to Grade 12, with AI; make AI a crucial element of higher education; and undertake workforce development. In the private sector, adaptive learning tools such as Khan Academy's *Khanmigo* and *Altitude Learning* provide personalized tutoring by adjusting content based on

[48] AI Skill Penetration refers to how widely AI-related skills are used or required across different jobs and occupations. Here, "penetration" means the extent or level of presence. If an occupation has high AI skill penetration, many tasks in that job require AI knowledge or the use of AI tools, and vice versa.

[49] https://hai-production.s3.amazonaws.com/files/hai_ai-index-report-2024-smaller2.pdf

[50] It is a normalized score indicating the prevalence of AI-related skills in a country's workforce relative to the global average. A score of 1.0 reflects the global average, while India's score of 2.8 means its workforce possesses AI skills at 2.8 times the global rate.

student responses, with the adjustment accomplished through AI. Similarly, *Panorama Education* and *iTeachApp* support teachers with analytics for targeted interventions. The National AI Research Institutes (NAIRIs) integrate advanced AI research into higher education by fostering interdisciplinary collaboration and innovation. Complementing these efforts, landmark programs such as *AI4K12* unify curricular standards nationwide, ensuring conceptual consistency. In parallel, partnerships involving *Code.org* and leading universities MIT and Stanford significantly scale both AI literacy and advanced research. These coordinated efforts are progressively shaping tangible outcomes: a survey by American School District Panel (2024)[51] reveals that over 59% of U.S. schools have trained some or all their teachers in the use of AI tools for teaching or evaluation, leading to widespread adoption.

On the other hand, Europe's approach places strong emphasis on inclusivity, collaboration, and ethical integration of AI in education. *The Digital Education Action Plan (2021-27)* aims to create a high-quality, inclusive digital education landscape across member states, with programs like *Erasmus+* promoting AI literacy through scholarships and mobility exchanges. Finland's *ViLLE* platform exemplifies data-driven personalization, offering real-time feedback to enhance learning outcomes. Notably, the *'Elements of AI'* course, launched by the University of Helsinki, has reached over a million learners[52] including strong engagement from Germany, France, and Estonia. Furthermore, *AI4EDU* fosters collaboration among educators, researchers, and legislators to ensure the ethical integration of AI into classrooms.

All three regions aim to expand AI literacy and integrate AI into education. India emphasizes large-scale policy reforms and private sector engagement, the US focuses on nationwide standardization and research partnerships, while Europe prioritizes inclusivity, ethics, and collaborative frameworks.

ii. Healthcare

India's healthcare sector is experiencing a rapid transformation driven by artificial intelligence, with the market projected to reach $1.6 billion by 2025 and exhibiting a compound annual growth rate (CAGR) of over 40%[53]. This transformation is underscored by large-scale, government-backed platforms, such as *eSanjeevani*, which surpassed 100 million teleconsultations in 2023[54], effectively bridging the urban-rural divide and expanding the access to healthcare of underserved populations. Indian health-tech startups and innovations in AI are similarly revolutionizing diagnostics: *Qure.ai* supports early detection of tuberculosis and pneumonia using deep learning analysis of X-rays; *Amruth Swasth Bharath* uses smartphone-based AI for non-invasive blood testing; and Niramai's *Thermalytix* enables radiation-free breast cancer screening through thermal imaging. Google-backed ventures, such as Forus Health and AuroLab[55], further apply AI to diabetic eye disease detection. Moreover, AI's use in medical imaging such as CT scans and MRIs

[51] https://www.rand.org/pubs/research_reports/RRA956-31.html
[52] https://www.helsinki.fi/en/news/artificial-intelligence/elements-ai-has-introduced-one-million-people-basics-artificial-intelligence
[53] https://indiaai.gov.in/article/ai-in-indian-healthcare-emerging-trends-and-opportunities-in-2025
[54] https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=1899855
[55] https://blog.google/intl/en-in/company-news/technology/supporting-a-healthier-and-greener-india-with-our-ai/

helps reduce diagnostic errors, while streamlining drug discovery and clinical workflows, cutting costs and enabling real-time, data-driven decisions.

In the United States, AI platforms such as *IBM Watson Health* have revolutionized drug discovery and clinical trial matching: research and development has been speeded up and costs have been reduced by up to 50%[56]. The FDA-approved *IDx-DR* enables early diabetic retinopathy diagnosis without specialists, while *Epic Systems* and *Tempus* apply predictive analytics and machine learning to tailor treatment in oncology, cardiology, and chronic disease management. Additionally, AI chatbots and virtual assistants such as *Babylon Health* and *Buoy Health* streamline patient engagement through symptom triage (using symptoms to rapidly assess the need for treatment), appointment scheduling, and medication reminders. A study by the University of Minnesota's School of Public Health reports that over 60% of U.S. hospitals use AI for diagnostics, workflow automation, and remote monitoring[57]. Public health surveillance similarly benefits from AI-enabled platforms such as *BlueDot*, which monitor infectious disease outbreaks in real time. Notably, AI systems developed by the Mayo Clinic have achieved diagnostic accuracies as high as 85% in predicting cardiac conditions[58], while *Google Health's* deep learning algorithms have demonstrated performance that is superior to radiologists in evaluating mammograms for breast cancer screening.

In Europe, AI is reshaping healthcare through digital integration in diagnostics, and patient engagement. *Smart4Health* enables secure cross-border sharing of digital health records, while *AIMind* analyzes EEG and MRI scans for early detection of Alzheimer's. Widely used platforms like *KRY*, and *Ada Health* offer AI-based triage, symptom checks, and virtual consultations, improving access and resource efficiency. At the institutional level, European hospitals are swiftly embracing AI technologies aimed at workflow optimization, advanced radiology, and predictive analytics. *Siemens Healthineers' AI-Rad Companion*, for instance, automates image analysis and reporting, enhancing diagnostic accuracy. This technological momentum aligns with Europe's regulatory focus on explainable AI and cross-border interoperability, crucial for ethical deployment and public trust. As reported by the European Parliamentary Research Service, growing regulatory clarity around AI applications and increasing trust in data-driven medical technologies have contributed to the rising integration of AI in Europe's healthcare sector[59]. Furthermore, the *KONFIDO* platform boosts cybersecurity in health data sharing through AI-driven threat detection, while Poland's *Infermedica* supports clinical decision-making. Europe also pioneers AI applications in robotic surgery and rehabilitation: Switzerland-based *MindMaze* combines AI with virtual reality to aid stroke recovery, while Germany and France apply AI to optimize hospital resource planning (staff deployment, bed management, and equipment use) and operational forecasting (patient inflow and care delivery schedules).

AI is leveraged across India, the US, and Europe to improve healthcare efficiency, diagnostics, and patient outcomes. India concentrates on expanding access and diagnostic capabilities, the US

[56] https://patentpc.com/blog/ai-in-drug-discovery-how-ai-is-accelerating-pharma-research-key-stats?utm_source=
[57] https://www.sph.umn.edu/news/new-study-analyzes-hospitals-use-of-ai-assisted-predictive-tools-for-accuracy-and-biases/?utm_source=
[58] https://www.mayoclinic.org/departments-centers/ai-cardiology/overview/ovc-20486648?utm_source=
[59] https://www.europarl.europa.eu/RegData/etudes/STUD/2022/729512/EPRS_STU(2022)729512_EN.pdf

on precision treatment and workflow optimization, and Europe combines technological adoption with regulatory oversight and ethical integration.

iii. Agriculture

The value of AI in the Indian agriculture market is set to expand from USD 1.7 billion in 2023 to USD 4.7 billion by 2028, with a 23.1% annual growth rate over the specific period[60], fuelled by a convergence of government support, agritech innovation, and real-time data integration. AI technologies ranging from satellite imagery and drones to machine learning are transforming crop health monitoring, enabling early detection of pests and diseases, and improving yield forecasts. Government programmes like *'Per Drop More Crop'* and the National Pest Surveillance System are embedding AI into irrigation and pest control strategies, reducing resource use and mitigating climate-induced risks. The rise of multilingual tools like the *Kisan e-Mitra* chatbot enhances farmer awareness and decision-making, while startups such as *Fasal* combine soil sensors with AI to optimize fertilizer use, cutting costs by up to 20%[61]. Similar innovations include ICAR's automated irrigation systems driven by real-time soil and weather data, and *Microsoft-ICRISAT's* AI Sowing App, which has raised yields by up to 30%[62] through tailored weather-based advice. Notable outcomes include[63]: in Karnataka, AI-enabled smart farming has achieved water savings of 30 - 40% without yield loss; in Raichur, precision farming lifted yields by 22% and farm profitability by 18%; in Marathwada, predictive AI apps have helped over 10,000 farmers reduce crop failure and increase incomes by 30%. Meanwhile, over 40% of new indoor farms are expected to adopt AI by 2025[64], with widespread use of IoT (84%) and machine learning (78%) already driving 25 - 40% gains in productivity.

According to Mississippi State University (2023)[65], AI is transforming U.S. agriculture through precision technologies like *John Deere's See & Spray*, which uses computer vision to reduce herbicide use by 77%. Platforms such as *Prospera, Climate FieldView*, and *Granular* integrate drone imagery, soil data, and weather forecasts to optimize irrigation, planting, and pest control across more than 50 million acres (Getahun et al., 2024). Since 2019, over half of major crop acreage has adopted automated guidance systems, while yield mapping (a technique which uses GPS and physical sensors to track and analyze crop yield) has surged from just 5% in 2004 to 89% in 2023[66]. Meanwhile, firms such as Indigo Agriculture leverage AI to enhance seed selection and

[60] https://indiaai.gov.in/article/india-s-ai-driven-agricultural-growth-the-future-of-indian-agriculture
[61] https://www.binstellar.com/blog/ai-in-agriculture/
[62] https://news.microsoft.com/en-in/microsoft-and-icrisats-intelligent-cloud-pilot-for-agriculture-in-andhra-pradesh-increase-crop-yield-for-farmers/
[63] https://medium.com/@ajayverma23/artificial-intelligence-in-agriculture-the-growing-revolution-in-india-aabfcdac12b7
[64] https://farmonaut.com/asia/ai-indoor-farming-industry-in-india-2025-innovations
[65] https://extension.msstate.edu/publications/see-spray-technology
[66] https://farmonaut.com/precision-farming/crop-yield-mapping-7-powerful-ways-technology-boosts-yields

soil health, increasing yields by up to 15%. Vertical farming leaders such as *AeroFarms* and *Plenty* apply robotics and analytics to achieve 95% water savings and significantly higher productivity[67].

In Europe, AI supports climate-resilient farming through tools like the EU's explainable AI model, which detects droughts, heat waves, and extreme rainfall to enhance agricultural risk management. Startups like Denmark's *Greena* promote carbon-neutral farming, while Switzerland's *Gamaya* uses AI and hyperspectral imaging to assess crop and soil health. Supercomputing efforts like *IT4LIA*, along with initiatives such as *AI4EU* and *AgriDataSpace* drive cross-border agritech innovation. Farmers integrate Copernicus satellite data with AI for precision irrigation and pest control, while companies like Priva, Lely, and BASF enable smart greenhouses, robotic milking, and reductions in chemical use upto 30%[68]. Furthermore, Spain's *Agroguía* and France's *FarmWise* optimize operations through AI-guided tractors and autonomous weed removal.

All three regions use AI to enhance productivity, sustainability, and resource efficiency. India relies on government-backed programs and agritech startups, the US on precision technologies and large-scale automation, and Europe on climate-resilient solutions and cross-border innovations.

iv. Governance and Finance

In governance, India leverages AI tools such as *Bhashini*, India Urban Data Exchange (IUDX), Ideal Train Profile, and *Digidhan Mitra Chatbot* to improve citizen engagement and service delivery across linguistic and regional lines. The judiciary leverages AI through platforms like *SUVAS*, which translates legal documents across 11 Indian languages, and *SUPACE*, which uses natural language processing to extract vital facts, laws, and precedents, reducing case preparation times by up to 60%[69]. Administrative functions are being modernized via *e-Vidhan* and the *MyGov Chatbot*, which answers millions of citizen queries in regional languages. In finance, platforms like Paytm and Razorpay leverage AI for fraud detection, real-time monitoring, and dynamic credit scoring, reducing fraud by up to 40%[70]. Startups such as *Perfios* and *Crediwatch* use AI to analyze cash flows and GST filings, accelerating micro-loan underwriting by nearly 70%. Aadhaar-enabled e-KYC systems further shorten customer onboarding from days to minutes, especially benefiting rural populations.

In U.S. the judiciary has embraced AI with platforms like *ROSS Intelligence* and *LexisNexis AI* that expedite legal research and precedential analysis. The IRS uses AI to process over 260 million tax returns annually, with fraud detection accuracy above 90%[71]. Tools like *Casetext* and *Lex Machina* increase litigation efficiency by over 30%. In finance, major banks deploy AI tools like *COiN* (Contract Intelligence), capable of interpreting 12,000 commercial loan contracts in seconds, a task formerly requiring 360,000 human hours. Technologies like *Zest AI* improve loan

[67] https://www.emergenresearch.com/industry-report/vertical-farming-market#:~:text=Additionally%2C%20vertical%20farming%20uses%20up,you%20stay%20ahead%20of%20disruption

[68] https://agriculture.basf.com/global/en/innovations-for-agriculture

[69] https://amvlaw.in/blogs/the-weight-of-justice-comparing-caseload-pressures-and-ai-innovations-in-india-and-beyond

[70] https://www.cybersource.com/en/solutions/case-studies/razorpay-india.html?utm_source=

[71] https://www.nytimes.com/2023/09/08/us/politics/irs-deploys-artificial-intelligence-to-target-rich-partnerships.html

approval rates by up to 25% without increasing risk, using behavioral and alternative data[72]. Visa and Mastercard apply AI for real-time fraud detection, while regulatory bodies like the SEC use machine learning for market surveillance and enforcement.

Europe leads in AI regulation through frameworks like the EU AI Act and General Data Protection Regulation (GDPR). Governments deploy AI for translation, functioning of smart cities, and border control using tools like *iBorderCtrl* and *KrattAI*. Judicial systems utilize platforms such as *Predictice* and *RAVEL* to optimize caseload management and decision forecasting. In finance, banks like ING and BBVA adopt AI for anti-money laundering, transaction monitoring, and onboarding reducing compliance costs by up to 30%. HSBC and Barclays use AI[73] for behavioral analytics and credit scoring, cutting onboarding costs by up to 40%. FinTech firms like Klarna and N26 offer real-time credit insights and personalized financial advice to over 200 million users globally.

AI supports operational efficiency, transparency, and decision-making across all regions. India focuses on improving citizen services and financial inclusion, the US on efficiency and large-scale automation, and Europe on compliance, regulation, and building public trust.

4. Policy Initiatives taken in India

The Taskforce on AI was constituted by the Ministry of Commerce and Industry in 2017 to leverage AI for economic benefits[74]. Among the domains of relevance identified by taskforce are the following: Manufacturing, FinTech, Agriculture, Healthcare, and Technology for the differently-abled, National Security, Environment, Public Utility Services, Retail and Customer Relationship, and Education.

The Taskforce has several goals and recommendations. It recommends the exploration of the use of natural language generation and translation systems for 50-90 million differently abled and disabled people. Natural language generation (NLG) is defined as the use of artificial intelligence (AI) to create human readable text or speech from structured and unstructured data[75]. It helps those who have problems with information processing, reading or writing to communicate with machines.

The Taskforce recommends making algorithms used by public bodies available to all citizens so as to enhance transparency and build trust. At the same time, it identifies the unique identification system, which stores information collected from citizens, as a rich store of biometric/ demographic data. Important applications are in biometric recognition and in-service delivery.

[72] https://whatfix.com/blog/ai-in-financial-services/
[73] https://home.barclays/news/2024/01/how-Barclays-is-harnessing-AI/
[74] The discussion of the Taskforce on AI is based on https://cis-india.org/internet-governance/blog/the-ai-task-force-report-the-first-steps-towards-indias-ai-framework
[75] https://www.ibm.com/think/topics/natural-language-generation

The Taskforce proposes creation of a Digital Data Marketplace and enactment of a data protection law. A digital data marketplace is a platform where individuals and organizations can buy, sell, and exchange data assets. This will help in acquisition and further processing of data and will help to leverage the data for economic benefits. At the same time, a data protection law will help establish property rights over data and thus incentivize generation and processing of data.

Finally, the Taskforce recommends creation of a National Artificial Intelligence Mission. This is supposed to be a centralized nodal agency for facilitating research and collaboration and catalyzing startups. This mission has made steady progress: India's national compute capacity has crossed 34,000 Graphics Processing Units (GPUs) while 15,916 GPUs are being added; 367 datasets have been uploaded to *AI Kosh*, a secure medium for data sharing.

The NITI Aayog announced the *National Strategy for Artificial Intelligence* in *June 2018*[76]. There are three objectives of this strategy: generation of opportunity or economic benefits, addressing social inequalities and development goals, and making India into a global innovation lab for scalable AI solutions for developing countries. Economic benefits are sought to be achieved through the following instruments: intelligent automation of complex tasks, enhancement of labor and capital productivity, and catalysis of innovation. It has identified four focus sectors: health (objective of enhancing access); agriculture (food security and farmer support); education (prevention of dropout, personalized learning, automation of grading); and development of smart cities (optimization of lighting and safety in public spaces).

5. *AI Regulation: Contrasting Frameworks across India, the EU, and the United States*

India's regulatory journey in artificial intelligence has evolved through a layered and progressive approach, beginning with the enactment of the Information Technology Act (2000). Although not explicitly designed for AI, this legislation laid the foundational infrastructure for digital governance, cybercrime, e-commerce, and electronic communication. A major pivotal shift emerged in 2018 with the release of '*AI for All'* by NITI Aayog: India's first cohesive attempt to position AI as a tool for inclusive economic growth and social empowerment. This developmental thrust was further refined in 2021, with the introduction of 'Principles for Responsible AI' by NITI Aayog: a policy framework built on safety, inclusivity, transparency, and accountability to ensure ethical, human-centric AI in India. These principles underscored the government's ambition to establish AI as a technological force while simultaneously managing ethical risks to guide not just policymakers but also industry and civil society in responsible deployment of AI technologies.

The same year, India expanded its regulatory oversight with the adoption of the Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules, 2021**.** These rules were aimed at enhancing accountability from digital platforms such as social media, OTT services, and digital news providers, many of which increasingly rely on AI for content recommendation

[76] https://www.niti.gov.in/sites/default/files/2023-03/National-Strategy-for-Artificial-Intelligence.pdf

and delivery. In 2023, India took a decisive step forward with the passage of the Digital Personal Data Protection Act, which introduced a comprehensive framework for the lawful processing of personal data. This act sought to balance the right to privacy of individuals with the state's interest in data access for governance and innovation, thereby strengthening the legal base upon which AI systems operate. Building upon this foundation, the Ministry of Electronics and Information Technology (MeitY) issued a series of AI-related advisories in 2024, explicitly targeting emerging risks such as algorithmic bias, deepfake proliferation, and the spread of AI-generated misinformation. These advisories compelled AI platforms to adopt operational transparency, implement safeguards against generative model misuse, and adhere to compliance obligations under threat of legal consequences. Complementing these regulatory efforts, the government launched the IndiaAI Mission (2024), a landmark initiative that aims to catalyze AI innovation through public-private partnerships, enhance compute infrastructure, and promote ethical, inclusive AI adoption. All these cumulative efforts culminated in the introduction of the Draft AI Bill in 2025: India's first comprehensive legal framework for AI governance[77]. The bill proposes a risk-based classification (high risk: finance sector & low risk: general purpose tools) of AI systems, mandatory registration and audit mechanisms for high-risk applications, and ensures alignment with existing data protection laws. In doing so, it formally transforms India's regulatory vision into a structured, enforceable legal architecture that seeks to balance innovation with ethical accountability.

Parallel to these centralized efforts, sector-specific regulators have also played a pivotal role in shaping India's AI landscape. The Reserve Bank of India's Regulatory Sandbox framework (2019) enables controlled testing of AI-driven financial innovations such as credit risk assessment and fraud detection while safeguarding consumer interests and financial stability. Similarly, SEBI mandates quarterly disclosures from Market Infrastructure Institutions (MIIs)[78] on their use of AI/ML systems, reinforcing algorithmic transparency and accountability in capital markets.

Yet, while India's policy evolution demonstrates a clear commitment to harnessing AI for inclusive growth, a deeper question arises regarding who truly benefits from such technological progress. As highlighted by Acemoglu and Johnson (2023), their work challenges the notion or common belief that technological progress automatically leads to widespread prosperity. It makes the point that technological progress has often served to makes elites richer at the expense of majority of the workforce. This is true of the agricultural advances of the Middle Ages, the early industrial revolution and the emergence of artificial intelligence in the digital age.

Note that technological progress is shaped by the interests of the elite and often takes the form of reduced use of labour and increased surveillance of labour. These tendencies seem to be very strong in the current AI age and would end up impoverishing majority of the population. This implies that the growth rate of GDP might be lowered through reduction in aggregate demand (workers tend to consume a higher proportion of their income as compared to elites, including

[77] Several countries have advanced distinct legislative frameworks like the EU's AI Act, the US Executive Order, and the UK's pro-innovation stance. India's Draft AI Bill seeks to align with these global trajectories while adapting its provisions to domestic priorities.

[78] https://www.sebi.gov.in/legal/circulars/jan-2019/reporting-for-artificial-intelligence-ai-and-machine-learning-ml-applications-and-systems-offered-and-used-by-market-infrastructure-institutions-miis-_41927.html

capitalists), a reduction in human capital formation and social and political instability. Thus, Acemoglu and Johnson argue that there is a need for policy and regulation to ensure that AI is directed towards the creation of high-quality jobs and generation of broad prosperity through tax reforms as well as strengthening of worker bargaining power. These recommendations should apply for India.

In India, digital exclusion has hampered the education of children from poorer households; digital illiteracy has limited the use of welfare schemes; automation of routine tasks through AI has displaced workers; and AI based video analytics are being used to conduct surveillance of workers[79].

Unlike India's developmental trajectory, the European Union's approach to AI regulation emerged from a normative emphasis on fundamental rights, institutional transparency, and democratic accountability. This foundational orientation first materialized through the General Data Protection Regulation (GDPR) in 2016. Building on this foundation, the EU introduced the Digital Services Act (DSA) and the Digital Markets Act (DMA) in 2022, both of which directly address the role of algorithms in online ecosystems. Importantly, India has no current equivalent to these competition-focused or transparency-enforcing regulations. The EU further expanded its regulatory perimeter with the revised Product Liability Directive (2024). The culmination of the EU's legislative agenda came with the passage of the Artificial Intelligence Act (2024): the world's first comprehensive AI law. This act employs a risk-based approach, categorizing AI applications into four risk levels (unacceptable, high, limited, and minimal), and imposes strict obligations on developers of high-risk systems[80].

In contrast to India and the European Union, the United States has adopted a distinct regulatory approach to artificial intelligence: sector-specific, decentralized, and strongly oriented towards fostering innovation. As of 2025, there remains no comprehensive federal legislation exclusively targeting AI in U.S. The National Defense Authorization Act (2019), and National AI Initiative Act (2020) marked one of the earliest federal efforts to engage with AI. In 2023, the National Institute of Standards and Technology (NIST) introduced the *AI Risk Management Framework* to adopt best practices for fairness, transparency, and accountability in AI deployment, while the Algorithmic Accountability Act was reintroduced in Congress later that year.

A key milestone was established through President Biden's Executive Order on AI (2023), which articulated a coordinated federal vision to advance safety, equity, privacy, and national security. Regulatory momentum gained further traction at the state level with the Colorado AI Act (2024), which takes a risk-based regulatory approach similar to the EU's AI Act and Texas Responsible Artificial Intelligence and Generative Accountability Act (TRAIGA, 2025), one of the most comprehensive state laws to date. Similarly, the Federal Aviation Administration Reauthorization Act (2024) includes provisions for comprehensive AI oversight in the aviation sector. In early 2025, the federal government released the AI Action Plan, a strategic roadmap aimed at fostering

[79] A. Oxfam India's India Inequality Report 2022: Digital Divide; B. Future of Technology Services 2030 - Leading with AI, McKinsey and Company and NASSCOM C. Newspaper reports

[80] For readers who wish to explore further, this paper (https://www.cespi.it/sites/default/files/osservatori/allegati/ai_article_final_def.pdf) by CeSPI provides useful perspectives.

safe, trustworthy AI through coordinated efforts in research, workforce training, and international alignment. Most recently, President Donald Trump's 2025 Executive Order, reflects a deregulatory turn, emphasizing minimal governmental interference in private sector AI initiatives.

Taken together, these contrasting approaches of these three regions reveal fundamental differences in legal philosophy and governance style. Looking ahead, the future of global AI governance may depend less on convergence and more on how effectively these models respond to rapid technological disruption, transnational externalities, and the growing demand for trust, accountability, and shared standards in an increasingly AI-driven world.

6. The Impact of AI on Economic Growth in India: A Look at Empirical Models

India's ambition to attain high-income status by 2047 demands a bold acceleration in economic growth, requiring an average GDP expansion of about 7.951 percent annually over the next two decades. Yet, with current projections hovering near 6.5 percent, the nation faces a persistent gap of roughly 1.451 percentage each year. One transformative lever lies in the substantial and sustained adoption of artificial intelligence, whose potential to drive productivity gains, reshape industries, and accelerate technological diffusion could provide the very boost India needs to realise its growth vision.

According to Accenture (2017)[81], AI could raise India's annual GDP growth rate by 1.3 percentage points by 2035. According to the report, AI will cause 957 billion US$ or 15 percent of gross value added to be added to the baseline scenario (without AI). The means would be those highlighted in the National Strategy mentioned above. The sector wise sources of this increase will be as follows: enhancement of profitability due to the installation of AI powered systems in manufacturing; and AI based innovation in ordering and retail. The report also mentions that the vast majority of entrepreneurs responding to a survey anticipate making moderate to extensive investment in one or more AI technologies.

There is a lack of clarity about the fundamentals of the Accenture Study, except that that the gains are achieved by replacing human labour with more productive AI. ICRIER (2020) attributes the significant and widespread impact of AI to the fact that it is a *General-Purpose Technology (GPT)* akin to the steam engine or electricity. A GPT is a technology which has applications in diverse sectors of the economy. Its impact is also not immediate: while enabling a GPT, resources have to be diverted from immediately productive activities towards training of personnel, revamping the organizational structure of the firm and installing fixed capital; it is only in the longer run that diffusion of the GPT occurs and its contribution to GDP becomes visible.

[81] https://www.accenture.com/content/dam/accenture/final/a-com-migration/r3-3/pdf/pdf-153/accenture-ai-for-economic-growth-india.pdf

A GPT such as AI is thought to impact the growth of Total Factor Productivity (TFP), defined as the measure of an economy's ability to generate income from its inputs. The inputs in question are the economy's factors of production. ICRIER (2020) sought to find out the impact of AI intensity growth on GDP through a two-fold econometric exercise:

(a) The first regression tried to find out the impact of AI intensity on TFP growth (dependent variable) after controlling for several relevant variables.
(b) The second econometric model attempted a decomposition of growth in Gross Value Added into contribution of factor inputs and TFP growth.

In regard to the first regression, AI intensity[82] is measured as the ratio of investment in software to total sales. The control variables used were firm size (total assets net of software stock), disembodied technological intensity (ratio of royalty and technical know-how to sales of the firm), advertisement intensity (ratio of advertisement expenditure to sales) and those relating to time period and industry category. For the independent variables in this regression, a panel dataset of 1553 firms, for the period 2007-08 to 2016-17, was used. The source was *Centre for Monitoring of the Indian Economy (CMIE) Prowess Database*. Only those companies with non-zero investments in software in the period of analysis are considered. The data on TFP growth has been extracted for 26 industry categories from the *Reserve Bank of India's KLEMS database*. The second regression is based on panel data for 27 KLEMS categories for the period 2008-17.

The first regression yields the result that a unit increase in AI intensity will increase TFP growth by 0.05% whereas the second yields the result that 50% increase in rate of growth of GVA can be attributed to TFP growth. From these two statements it is inferred that a unit increase in AI intensity of AI using firms will increase GDP by 2.5% or 67.25 billion USD in the immediate term.

How do these findings enable us to answer the question that is primary in regard to this paper: that relating to the possibility of AI helping India become a high-income economy by 2047. The 2023 cutoff for becoming a High-Income Country, according to the World Bank, in terms of per capita income (Atlas Method) is $14005[83]. In 2023, India's per capita income was $2580 by the Atlas method[84]. Therefore, to become a high-income country its per capita income needs to grow at average by 7.3% in 2023-47. According to the United Nations Department of Economic and Social Affairs/Population Division (2023), the growth rate of population in India for the period 2017-50 is 0.651%, Thus, the average annual growth rate of GDP (or more precisely GNI) over this period needs to be 7.951%. The actual rate of growth over the last 2 years and that predicted in the near future is around 6.5%. Thus, an increase of 1.451 percentage points is required.

The prediction from ICRIER (2020) is that a unit increase in AI intensity will increase GDP by 2.5% in the immediate term. Given that AI intensity is defined as the ratio of investment in software to sales, it is not possible to have a unit increase in AI intensity every year or every two years. In practical terms, most firms invest only a small fraction of their sales in software, meaning that achieving a unit increase through normal business growth alone is unrealistic. This illustrates

[82] AI intensity: When this ratio increases by 1, meaning investment in software becomes much larger than total sales, it has a positive effect on TFP growth.
[83] https://datahelpdesk.worldbank.org/knowledgebase/articles/906519#High_income
[84] https://data.worldbank.org/indicator/NY.GNP.PCAP.CD?locations=IN

why, although a unit increase can have a substantial positive effect on Total Factor Productivity (TFP), business-as-usual investment patterns are insufficient to significantly boost AI intensity and, consequently, overall productivity.

This limitation underscores the importance of targeted government intervention. Policy programs can accelerate AI adoption by providing incentives, funding, and guidance to firms, enabling them to make larger and more coordinated investments in software and AI infrastructure. For example, the Ministry of Finance's AI program is projected to increase AI intensity by 1.3 times, generating spillover benefits equivalent to 3.2% of India's GDP. Such interventions not only help firms overcome the practical constraints of large-scale AI investment but also ensure that the resulting gains in productivity and technological diffusion are realized across the economy.

Moreover, it can be argued that after a unit increase in AI intensity is achieved, the amount of capital stock in the form of software available to a firm gets enhanced for years to come. In this way a boost is given to growth and therefore the needed 1.451% increase in GDP growth can materialize.

AI has emerged as the new general-purpose technology and has been characterised by falling computation costs, a fact which has led to an increase in the scale of adoption. Thus, market capitalization of AI-related firms in the S&P 500 has increased by around USD 12 trillion since 2022[85]. However, affordable, sustainable and reliable electricity supply will be needed for AI development according to this report. In other words, electricity supply has to have these characteristics for AI led economic growth. A typical AI-focused data centre consumes as much electricity as 100,000 households, but the largest ones under construction today will consume 20 times as much.

Demand for electricity by data centres is expected to more than double by 2030, according to this report. In the United States, data centres will account for more than half of the growth in demand for electricity between 2025 and 2030. However, while AI will make new demands on electricity and other energy it will help to optimise its production: AI is already being deployed by energy companies to transform and optimise energy and mineral supply, electricity generation and transmission, and energy consumption.

The IEA is extremely positive regarding the growth of electricity production in India: while coal remains the primary source, renewable sources are being marked by enhanced shares in growing electricity generation[86]. This implies that the need of a rapidly growing AI infrastructure for electricity will be met in the future. Recent years have also seen a significant increase in energy efficiency and if this continues into the future it will free up electricity supply to meet the needs of the AI sector.

[85] https://www.iea.org/reports/energy-and-ai
[86] https://www.iea.org/countries/india

7. *The Impact of Job Destruction Caused by Robotization on the Potential for Achieving High Income Status*

Traditionally growth in TFP and capital accumulation has driven growth in India. Investment as a proportion of GDP has started declining since 2008 with slight pickup in 2022 and 2023. Over 2000-19 the labour force participation rate fell from 58 to 49 percent, a result of employment growing much slower than population in the working age group. If AI destroys jobs the fall in the labour force participation rate might be enhanced, another reason for a slowdown in growth, especially because of declining demand.

Though AI will boost the supply side, as is captured in the Accenture and ICRIER studies, it might cause damage to the demand side. The ILO says that up to 70% of existing jobs in India are at high risk due to automation and AI. According to the Bank of Baroda AI could destroy 20–25 million jobs in India by 2030, predominantly in sectors like IT services, customer support, retail, and finance[87]. In Bangalore, 50,000 IT employees were laid off in 2024, primarily due to the impact of AI and automation[88].

The mentioned job losses will curtail demand; as businesses cut back production in response to the fall in demand more retrenchment will follow which will in turn reduce demand and so on. The economy may get caught in a recessionary spiral. In spite of the positive changes on the supply side caused by AI this recessionary spiral might present difficulties in the mission of attaining a 1.5 percentage point increase in GDP growth in the period, 2023-47 that will make India a high-income economy by 2047.

The Government of India must pay close attention to the creation of jobs if it is serious about India becoming a High-Income Economy by 2047. Such creation can serve as a complement to the supply side stimulus provided by AI. Hospitality and tourism and geriatric care are some of the sectors in which the government can incentivize expansion by entrepreneurs, leading to the creation of jobs. Note that the demand for hospitality and tourism is bound to increase with economic growth as citizens acquire the purchasing power to travel more; this sector can offer a diversity of jobs in hotel management, event planning and food and beverage services. Similarly, the demand for geriatric care will expand due to a rapidly aging population and an increasing awareness of the need for specialized care of the elderly. There is also a huge potential captive demand for agro-processed output; with economic growth this demand will grow and its satisfaction can lead to significant job creation.

8. *AI, Jobs, and India's Path to High-Income Status*

Artificial Intelligence (AI) is set to revolutionize India's job market, driving significant job creation and workforce transformation across diverse sectors. According to NITI Aayog, AI has the

[87] https://www.fortuneindia.com/opinion/over-2-crore-jobs-at-risk-can-india-surpass-ais-disruption/123401
[88] https://sightsinplus.com/news/layoffs/bengaluru-it-sector-faces-ai-disruption-50000-jobs-lost-in-2024/

potential to create nearly four million new jobs by 2030[89]. This projection builds on the 2019 report by the Ministry of Electronics and Information Technology (MeitY), which anticipated that digital technologies, including AI, would redeploy 40-45 million workers in India by 2025 through reskilling and retraining programmes. The same report also forecasted the creation of an additional 20 million jobs, primarily in Information Technology and Business Process Management (IT-BPM), manufacturing, agriculture, and logistics, as AI-enabled systems become integral to both production and service delivery. Further evidence from NASSCOM (2020) supports this trend, suggesting that AI and data-driven innovations could add between USD 450–500 billion to India's GDP by 2025, with about 45 per cent of this growth emerging from consumer goods, retail, agriculture, and banking, and the remainder from sectors such as telecom, energy, healthcare, transport, and auto manufacturing.

The integration of AI into production systems automate tasks and redefines the nature of work itself. While routine and repetitive activities are increasingly handled by intelligent machines, this shift enables human workers to focus on higher-order cognitive and creative functions. Employees now collaborate with AI systems to optimise efficiency, improve decision-making, and enhance innovation. Such changes have amplified the demand for new competencies in data science, machine learning, and AI system design. Leading Indian firms are responding to this transformation with ambitious recruitment and training drives: Infosys has announced the recruitment of 20,000 new graduates in FY 2025–26, with a substantial focus on AI-driven roles. Beyond new hires, the company has trained over 275,000 existing employees in AI and allied technologies[90]; Tata Consultancy Services (TCS) has doubled its AI-skilled workforce to 160,000, adding 18,500 new hires in a single quarter[91]; Databricks has invested over USD 250 million in India to expand its AI operations, hiring more than 100 engineers and launching a Data + AI Academy to nurture local expertise[92]; Capgemini India has initiated a mega recruitment drive of 40,000–45,000 employees, with a strong emphasis on AI, digital, and cloud-based competencies[93]; and Wipro plans to recruit 10,000–12,000 freshers with explicit AI training. Wipro has further invested in reskilling, ensuring that over 220,000 employees complete AI fundamentals training, with 30,000 advancing to specialised AI programmes[94]. This surge in AI-driven employment is not limited to the IT sector: Foxconn's ₹15,000 crore investment in Tamil Nadu is expected to generate 14,000 high-value jobs, reinforcing how AI and automation are transforming

[89] https://timesofindia.indiatimes.com/education/news/niti-aayog-says-ai-could-create-4-million-jobs-by-2030-what-jobs-can-ai-actually-create/articleshow/124499699.cms#:~:text=NITI%20Aayog's%20Roadmap%20for%20Job,%2C%20and%20human%2DAI%20collaboration.

[90] https://www.indiatoday.in/amp/business/story/infosys-hiring-new-20000-jobs-freshers-it-sector-vacancy-ceo-salil-parekh-report-ai-tcs-layoff-2763457-2025-07-30?utm_

[91] https://economictimes.indiatimes.com/markets/expert-view/tcs-ai-skilled-workforce-doubles-to-1-6-lakh-18500-new-hires-in-q2-with-focus-on-future-ready-skills/articleshow/124453937.cms?utm_

[92] https://www.reuters.com/world/india/databricks-boost-hiring-invest-250-million-india-ai-expansion-2025-04-24/?utm_

[93] https://enterpriseai.economictimes.indiatimes.com/amp/news/industry/capgemini-india-plans-to-hire-45000-employees-by-2025-with-focus-on-ai-skills/123072881

[94] https://www.business-standard.com/companies/news/wipro-to-train-all-employees-on-ai-to-become-an-ai-first-company-124032800645_1.html

manufacturing for electronics production[95]. More detailed research can also highlight sector-wise job creation, providing deeper insights into how AI is reshaping employment patterns across India.

The cumulative impact of AI-driven gains in job creation, skill development, and productivity is set to fundamentally propel India's economic growth over the next two decades. By generating employment in high-value and emerging sectors, reskilling millions of workers for future-ready roles, and enhancing workforce efficiency, AI can collectively deliver the additional 1.45 percentage points of annual GDP growth required for India to achieve a per capita income of $14,005 by 2047, thereby attaining high-income status. These effects are deeply interconnected: as more individuals are trained and integrated into AI-powered industries, innovations stimulate further productivity gains across sectors ranging from healthcare and agriculture to manufacturing and finance. This virtuous cycle, in turn, boosts consumer demand and investment, driving economic expansion while supporting a broader and more inclusive distribution of wealth.

9. Conclusion

The paper comprehensively demonstrates the transformative potential of Artificial Intelligence (AI) across India's economy, highlighting its role as a vital driver for India's ambition to become a high-income nation by 2047. AI's distinct capability to enhance productivity, innovation, and technological diffusion is identified as a key mechanism capable of bridging the current 1.451 percentage gap in annual GDP growth needed for this transition. Empirical evidence from ICRIER and Accenture suggests that increased AI intensity can raise Total Factor Productivity and contribute meaningfully to GDP growth.

While AI provides a strong supply-side stimulus by boosting efficiency and technological capacity, the paper emphasizes that its ultimate impact also depends on demand-side dynamics. AI-driven automation risks displacing jobs, which could suppress aggregate demand and slow economic expansion. Nonetheless, AI also has the capacity to create many new and higher-skilled jobs in sectors such as hospitality, healthcare, digital services, tourism, geriatric care, and data-driven innovation. However, achieving such growth demands deliberate government intervention to overcome practical investment constraints, ensure workforce transition, and expand infrastructure capacity. Although, the paper concludes that AI holds the promise to be a powerful catalyst for India's economic transformation toward high-income status by 2047, realising this potential hinges critically on proactive policy frameworks, equitable growth strategies, workforce transition support, and sustained infrastructure investments. This integrated approach will be essential to harness AI's benefits inclusively and sustainably while mitigating socio-economic risks inherent in technological disruption.

[95] https://economictimes.indiatimes.com/tech/technology/foxconn-to-invest-rs-15000-crore-in-tamil-nadu-create-14000-jobs-industries-minister-trb-rajaa/articleshow/124520173.cms?utm_

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