CHAPTER

# 13

# LABOUR IN THE AI ERA: CRISIS OR CATALYST?

*The rapid advancement of artificial intelligence (AI) presents both unprecedented opportunities and significant challenges for labor markets worldwide. In this context, as policymakers, it is important to pay attention to the evolving technological landscape and the potential impact it can have on the labour market. Historical parallels with earlier technological revolutions reveal the critical role of inclusive institutions in managing disruption and ensuring equitable outcomes.*

*Barriers to large-scale AI adoption persist in the present, which include concerns over reliability, resource inefficiencies, and infrastructure deficits. These challenges, along with AI's experimental nature, create a window for policymakers to act. India's demographic advantage and diverse economic landscape position it uniquely to benefit from AI. However, achieving these benefits requires significant investments in education and workforce skilling, supported by enabling, insuring, and stewarding institutions. These mechanisms can help workers adapt to changing demands while providing essential safety nets.*

*By fostering collaboration between policymakers, the private sector, and academia, India can align AI-driven innovation with societal goals. Ensuring inclusivity and sustainability in this transition is key to maximizing benefits while minimizing disruptions. With robust institutional frameworks and strategic planning, AI can serve not as a crisis but as a catalyst for equitable economic transformation, positioning India to thrive in an increasingly automated world.*

## INTRODUCTION

13.1 Concerns and fears about Artificial Intelligence (AI) disrupting labour markets have intensified as developments in the field have continually demonstrated rapid progress over the last four years. The increasing complexity of the models being developed today represent a paradigm shift in the field of AI, showing the world that in a few years, 'intelligent machines' will be capable of performing tasks that are predominantly handled by humans today. The founder of the AI research and deployment company OpenAI recently stated in a blog post how they are expecting to have office ready 'AI workers' by the end of 2025[1].

1 Reflections by Sam Altman. 6th January 2025, https://tinyurl.com/59t77hv4

13.2 Expectations point toward a trend where AI begins outperforming humans in critical decision-making processes in areas like healthcare, criminal justice, education, business and financial services among others. Adding to the uncertainties of tomorrow is the fact that the speed of research and development is outpacing the regulatory and ethical frameworks needed to manage its risks. Further, with executives optimistic about the capabilities of AI[2] and the cost-saving potential they expect it to possess, the impact of AI on the labour market, particularly entry-level jobs is turning into a point of concern for policymakers. This economic displacement adds to a broader sense of unease about whether AI will exacerbate existing social and economic divides.

13.3 With AI research and development currently concentrated in the hands of a few, very large companies that control the resources to erect high entry barriers, AI adoption in place of humans presents the risk of concentrating the benefits of automation. Korinek and Stiglitz (2021) warn that labour- and resource-saving automation could produce a 'winner-takes-all' approach to the detriment of developing countries who are labour- and resource-rich[3]. Technological developments that worsen inequality can erode any possible benefit that the innovation brings, leaving the public sector responsible for addressing the cost of the transition. This has led to calls for a more responsible approach to AI adoption[4], especially in a country like India where employment numbers make the magnitude of impact something worth paying attention to.

13.4 Although until this point, the use of AI/Machine Learning (ML)[5] enabled tools and applications were already widespread and part of productivity suites for years, the end-user's facetime with the integrated 'AI' features was essentially minimal and unconscious. Examples include the autocomplete function on a smartphone keyboard, Google's and Apple's smartphone virtual assistants, personalised recommendations on e-commerce platforms and media streaming services, and curated feeds on social media sites, among many others. Most users never paid much attention to the host of ML-powered features while enjoying the convenience they delivered. This changed in light of the developments witnessed in the last four years. The perceptions about AI has now drastically shifted, spurring debates about the need to align AI developments with broader societal goals.

13.5 OpenAI has initiated an 'arms race' in AI as between 2022 and 2024, many companies, including big tech firms, have scrambled to capitalise on the demand for AI.

2 2024 Gartner CEO and Senior Business Executive Survey. Gartner. 27th June 2024, https://tinyurl.com/yez68sp8

3 Korinek, Anton and Joseph E Stiglitz (2021). Artificial Intelligence, Globalization, and Strategies for Economic Development. Working Paper 28453. National Bureau of Economic Research, https://tinyurl.com/2vvxkwdx

4 A letter jointly written by Dr. Rajiv Kumar (former Vice Chairman of NITI Aayog), Sridhar Vembu (CEO, Zoho Corporation) & Sharad Sharma (Co-founder of the iSPIRT Foundation) highlights their concerns.

5 While Artificial Intelligence is used to describe the ability of a machine to mimic human intelligence, machine learning is a subset of AI that allows machines to learn from data and improve without being explicitly programmed.

Examples include but are not limited to Google (Gemini), Microsoft (Co-Pilot), Meta (MetaAI with Llama), X/Twitter (Grok), Anthropic (Claude AI), Midjourney, Perplexity AI (Perplexity) and Stability AI (Stable Diffusion), among others. The number of AI patents granted globally increased 62.7 per cent to just over 62,000 between 2021 and 2022[6]. Similarly, the annual global private investments in Generative AI surged from approximately USD 3 billion in 2022 to USD 25.2 billion by the end of 2023[7]. Between 2021 and 2023, global corporate investments in all types of AI totalled USD 761 billion. Additionally, an increasing share of companies have been referencing AI in their earning calls lately[8], with CEOs expecting AI adoption to lower labour requirements.

13.6 If one were to look at these trends and the value generation expected from the investments, it would appear as if the 'AI revolution' is here and labour is soon going to be a thing of the past. Unease about what AI entails for workers and what it means for humanity as a whole has become part of daily discussions among academicians and policymakers, as reflected in many publications and reports. Making sense of these fears and anxieties would require a more in-depth breakdown of the short-term and long-term implications. Since there are many unknowns associated with AI at this point, looking at the present through the lens of previous technological revolutions may provide some insights into the way forward. Advancing the understanding about the challenges and opportunities that lie ahead is the purpose of this essay.

13.7 In this regard Section 2 brings to light the adverse effects that emerged during previous technological revolutions and how they pertain to present-day concerns about Artificial Intelligence. The section also elaborates on the importance of remaining cognisant, as disruptions that are not carefully managed can lead to permanent societal damage for a country like India. Section 3 then goes on to discuss how these risks can be minimised through the creation of Social Infrastructure i.e., Institutions. The priority here is minimisation since the risks can never be fully mitigated. That is the price of innovation induced creative destruction. The various types of institutions detailed in this section can provide a much needed support system to ease the pains of a transition.

13.8 However, building institutions is a time consuming process, requiring concerted effort from the public sector, the private sector and members of academia. In Section 4, we put forward the hypothesis that India, at present, is afforded this time due to the challenging nature of scaling up technological adoption. Deployment at scale will require AI developers to address certain key challenges which requires a non-trivial

6 Figure 1.2.1. Artificial Intelligence Index Report 2024, Stanford University, https://tinyurl.com/y4edef43

7 Ibid.

8 Aakash Kalyani, Serdar Ozkan, Mickenzie Bass and Mick Dueholm, "AI Optimism and Uncertainty: What Can Earnings Calls Tell Us Post-ChatGPT?," St. Louis Fed On the Economy, Sept. 30, 2024, https://tinyurl.com/bdhnyyu7

amount of time. Section 5 then outlines possible opportunities that AI may open up for India. It seeks to visualise a possible labour market evolution where the future of work is augmented by AI. Whether or not we go down this path will depend entirely on how robust our institutions are. Section 6 concludes the essay.

## REVOLUTIONS AND RIPPLES

13.9 The present discourse on AI from international organisations and social science researchers postulates that large scale labour market disruptions due to AI may materialise in the near-term. The International Monetary Fund states that AI poses risks of job displacements, notably for emerging markets and developing economies, which are not well placed to leverage the technology relative to the advanced economies[9]. The International Labour Organisation estimates that nearly 75 million jobs globally are at complete risk of automation due to AI[10]. Estimates for the UK show that 7 per cent of the existing UK jobs face a high risk of automation in the near term, rising to around 18 per cent after 10 years[11]. Industry experts have told media outlets that 'AI models could dramatically disrupt the labour market, including replacing routine jobs in some sectors.[12]' A study by the Bank for International Settlements finds that 45 per cent of the jobs in the upper quartile of the wage distribution remain exposed to AI in the United States. If AI becomes highly capable, exposure increases across all quartiles of the income distribution[13].

13.10 Estimates from private sector firms paint a similar picture. Goldman Sachs economists state that nearly 300 million full-time jobs remain exposed to AI-driven automation[14]. McKinsey estimates demonstrate how, by 2030, up to 30 per cent of current work hours could be automated by generative AI[15] across Europe and the United States. They state that businesses will 'need a major skill upgrade' as the deployment of AI would raise the demand for social and emotional skills along with a need for

9 Cazzaniga, M., Jaumotte, M. F., Li, L., Melina, M. G., Panton, A. J., Pizzinelli, C., ... & Tavares, M. M. M. (2024). Gen-AI: Artificial intelligence and the future of work. International Monetary Fund, https://tinyurl.com/33hjum83

10 Minimizing the negative effects of AI-induced technological unemployment. Janine Berg. ILO. 9th October 2024, https://tinyurl.com/4f7thztd

11 Brione, P., Powell, A., Francis-Devine, B., Rough, E., Codd, F., & Buchanan, I. (2023). Potential impact of artificial intelligence on the labour market. House of Commons Library, https://tinyurl.com/jjj68k86

12 Will ChatGPT take your job – and millions of others? Published in Al Jazeera. 28th March 2023, https://tinyurl.com/bdejbpxk

13 Auer, R., Köpfer, D., & Švéda, J. (2024). The Rise of Generative AI: Modelling Exposure, Substitution, and Inequality Effects on the US Labour Market. Substitution, and Inequality Effects on the Us Labour Market, https://tinyurl.com/3t6hekt4

14 Generative AI could raise global GDP by 7%. Goldman Sachs Research. 5th April 2023, https://tinyurl.com/2vypxt3d

15 A new future of work: The race to deploy AI and raise skills in Europe and beyond. McKinsey Global Institute. 21st May 2024, https://tinyurl.com/48tnydzu

critical thinking and creativity. In line with the IMF estimates, insights from Ernst & Young state that while the impact of AI on emerging economies is lower relative to the advanced economies, one can still expect 57 per cent of occupations in emerging countries to be affected by higher Generative AI adoption[16]. Similar sentiments are prevalent among surveyed CEOs[17] and other private sector estimates[18].

13.11 Anxieties about the effects of AI remain high in India as well, considering our country is a services-led economy. Among white-collar workers, an IIM Ahmedabad Survey highlights how 68 per cent of the surveyed employees expect their jobs to be partially or fully automated by AI within the next five years[19]. Forty per cent of the employees believe AI will make their skills redundant. Copestake et al. (2023) also state that firms have substantially increased AI skill demand across regions, industries, firms and occupations[20]. As per their findings, these jobs pay a 13 to 17 per cent salary premium over baseline estimates. India's banking sector is also witnessing adoption among well-capitalised and larger banks, per a recently published RBI study[21]. With trends expected to continue towards even higher AI adoption by the private sector and the market, NASSCOM estimates that the Indian AI market will grow at 25 to 35 per cent CAGR by 2027[22].

13.12 These estimates are substantial and when viewed through the lens of history, one could argue that concerns, to a degree, are valid. Previous technological revolutions have been painful, and the damage brought on has been long lasting. Andrew Haldane illustrates that in the pursuit of productivity and profits, the substitution of labour for capital has resulted in widespread economic hardship, damaging social cohesion[23]. Each revolution displaced large segments of the workforce. Many struggled to find new employment, especially in geographies and occupations where the scale of impact was unanticipated or underestimated. Consequently, income inequality rose, as those who adapted to new technological demands saw their wages increase, while others experienced declining pay and fewer opportunities. Recent experiences of the same,

16 The impact of GenAI on the labor market. Gregory Daco. EY-Parthenon. 14th February 2024, https://tinyurl.com/m9vs3c4a

17 2024 Gartner CEO and Senior Business Executive Survey. Gartner. 27th June 2024. https://tinyurl.com/mr3ybvss

18 AI Jobs Barometer 2024. PricewaterhouseCoopers, https://tinyurl.com/4dnwpfs8

19 Labour-force Perception about AI: A study on Indian White-collar Workers. Brij Disa Centre for Data Science and Artificial Intelligence, IIM Ahmedabad. August 2024, https://tinyurl.com/2mjmuke4

20 Copestake, A., Marczinek, M., Pople, A., & Stapleton, K. (2023). Ai and services-led growth: Evidence from Indian job adverts. Working Paper, International Monetary Fund and World Bank, Washington, DC, https://tinyurl.com/2ms6y2sz

21 How Indian Banks are Adopting Artificial Intelligence? Shobhit Goel, Dirghau K. Raut, Madhuresh Kumar and Manu Sharma. RBI Bulletin, October 2024, https://tinyurl.com/4jznsbsc

22 AI Adoption Index 2.0. NASSCOM.

23 Ideas and Institutions – A Growth Story. Speech by Andrew Haldane. 23rd May 2018, https://tinyurl.com/246jvy5p

such as the drastic loss of employment among coal mining workers across the United States brought about by the energy transition, demonstrates just how susceptible to shocks the labour market can be[24].

13.13 Societal impacts of these revolutions also extends to economic disparity. Workers may not immediately benefit from the productivity and profitability gains associated with technological advancements. For instance, during the early stages of the industrial revolution, wages frequently lagged behind increases in productivity. These transitions were also protracted, as it could take decades for displaced workers to find alternative livelihoods. The first Industrial revolution exemplifies this dynamic, with workers who were laid off facing sustained unemployment well into the 19th Century – a period known as 'Engle's pause'. Thus, societies where the balance between capital and labour was not carefully managed by capable institutions were marked by enduring hardships for many who were affected.

13.14 Protracted labour displacement is something that a labour-surplus country like India cannot afford. Our primary challenge is the challenge of numbers. As highlighted in the Economic Survey 2023-24, India would have to create an average of 78.5 lakh jobs annually in the non-farm sector by 2030 to cater to the rising workforce. Further, India is a majorly services driven economy, with a significant share of the I.T. workforce employed in low value added services. Such jobs are the most susceptible to automation, as firms in a bid to cut costs may substitute labour for technology. We already see this in case of tech-firms in India[25] and the BPO sector in Philippines[26]. India is also a consumption based economy, thus the fall in consumption that can result from the displacement of its workforce is bound to have macroeconomic implications. If the worst-case projections materialise, this could have the potential to set the country's economic growth trajectory off course.

13.15 In such a situation, placing a higher weightage on the possibility of an adverse consequence is required as complacency can amplify any negative effects by creating a long-lasting impact. It is the uncertainty associated with the timeline and magnitude of effects that demands the attention of policymakers. In the words of Alan Greenspan, 'Uncertainty is not the same as risk…Uncertainty involves unknown probabilities and outcomes with tremendous consequences.[27]' Any outcome with tremendous

24 Mark, E., Rafaty, R., & Schwarz, M. (2024). Spatial–temporal dynamics of structural unemployment in declining coal mining regions and potentialities of the 'just transition'. Energy Policy, 195, 114338, https://tinyurl.com/mz557rfd

25 PhonePe cuts 60% of support staff as AI drives 40-fold transaction surge. Published in Business Standard. 21st October 2024, https://tinyurl.com/2nf8wfua

26 The World's Call Center Capital is Gripped by AI Fever – and Fear. Published in Bloomberg. 28th August 2024, https://tinyurl.com/9r47nk4h

27 We will never have a perfect model of risk by Alan Greenspan. Published in The Financial Times. 16th March 2008, https://tinyurl.com/58ma6ujh

consequences needs to be taken seriously, no matter how low the probability is. Since policymaking is a wicked problem, one would rather overestimate the uncertainties and be overprepared than underestimate the effects and have to manage the fallout.

13.16 Responding to these uncertainties requires coordinated efforts aimed at addressing the structural issues that can intensify the impact of AI on India's labour market. It is here, the establishment of new, and upgrading existing Institutions will play a pivotal role. Social Infrastructure will provide the required foundation for ensuring that the gains from technology can translate into inclusive growth.

## THE NEED FOR ROBUST INSTITUTIONS

13.17 Minimising the magnitude of the negative effects resulting from creative destruction has always necessitated a 'societal response', one where new social infrastructure is created to foster environments where innovation drives inclusive growth. The most notable work highlighting the importance of institutional capacity is Daron Acemoglu and James Robinson's book, 'Why Nations Fail[28].' Inclusive Institutions can promote broad participation in the gains from innovation and create the conditions for sustained economic growth and prosperity. They are the hands that shape a country's economic destiny.

13.18 Eric Posner reinforces the importance of building adequate institutional capacity by pointing out a grim scenario that is possible if the most optimistic AI projections are to be believed. He states, 'There is no social safety net generous enough to protect people from the mental-health effects, and society from the political turmoil, that would follow from widespread disappointment and alienation [due to substantial and permanent unemployment].[29]' This would be the least desirable outcome.

13.19 High-quality institutions act as mediators, ensuring that technological advancements yield broad-based benefits, while weak or absent institutions often exacerbate disparities, resulting in uneven economic and social outcomes. For India to seriously consider the effects of AI, actions will have to focus on strong Institution Building. In this context, Andrew Haldane splits the institutional requirement along two broad categories; enabling institutions and insuring institutions.

13.20 Enabling Institutions are focused on equipping the workforce with the necessary skills needed to adapt and thrive in a shifting landscape. They impart skills and augment

28 Robinson, J. A., & Acemoglu, D. (2012). Why nations fail: The origins of power, prosperity and poverty (pp. 45-47). London: Profile.

29 The Future of Work in the AI Era by Eric Posner. Published in Project Syndicate. 11th April 2024, https://tinyurl.com/bde9ksce

the content of education, ensuring that learning keeps up with the demands of the job market. Further, as new auxiliary tasks and sectors emerge from the widespread adoption of technology, enabling institutions facilitate the smooth transition of the workforce to these new jobs, reducing the damage to worker income and preventing loss employability. The latter is of paramount importance, because if transitions are not carefully managed, workers can experience a long-lasting unemployment, with little prospect of catching up to market demands. As India's workforce in low-skill and low-value-added services remains vulnerable to AI, robust enabling institutions are essential to help transition workers to medium- and high-skilled jobs, where AI can augment their efforts rather than replace them.

13.21 Insuring Institutions are intended to provide a soft-landing for workers whose finances have been hit and whose well-being has been affected during the transitionary period. These institutions help secure a standard of living during the shift, keep inequalities in check and aid in keeping the social fabric cohesive. They are also responsible for reducing the recession risk, for individuals and for societies. Insuring Institutions build safety nets (such as the National Insurance Act, 1911 and the Beveridge Report, 1942 in the UK), protect worker rights, provide finances (such as credit unions), housing (the emergence of the Young Men's Christian Association during the 19th century), and social and emotional support during periods of displacement.

13.22 In addition to the two outlined by Haldane, we propose the necessity of a third institution, Stewarding Institutions. The products of science are neither good, nor bad and what determines their net-impact on society is how they are applied. This application depends on how society comes to define the technology's utility, the ethics that govern its applications and the rules that structure their place in society. It is important to clarify that stewarding in this case does not imply placing restrictions on innovation or dictating a narrow set of applications for technology. It implies that policymakers demonstrate a certain degree of cognisance when it comes to emerging technologies, so that when the need arises, they stand well-placed to mitigate any adverse effects that emerge as by-products of technological applications. These institutions would be agile, crosscutting across sectors and up to date on the latest developments, so that they are equipped to identify both opportunities and threats. Stewarding institutions will have to be responsible for designing an approach that delicately balances public welfare without stifling innovation. They are also required for fostering the social acceptability of AI by promoting the right levels of transparency and accountability in AI applications. For instance, AI applications in healthcare, health insurance and education would greatly benefit from higher-degrees of transparency and accountability, as these sectors are way more human-centric relative to others. Biases in models being applied to these sectors can result in adverse, unintended consequences.

13.23 Building each of these institutions is a time-consuming process due to the challenges involved in mobilising the required intellectual and financial resources. Their need is not immediately clear and aligning our social structures, regulators, cooperatives, and policymaking institutions towards a distant goal is often an uphill battle. However, unlike previous technological revolutions, advancements in AI today and the utility it has the potential to deliver are being shared by all countries thanks to a globalised world. AI presently being in its infancy has made it so that every nation, irrespective of its income level is on equal footing as far as discovering its applicability goes. This level playing field provides India the time to build the necessary institutions that will minimise the disruptions and maximise societal benefits.

13.24 Another reason we postulate that India has the time available to reinforce and build supporting institutions is due to the nature of technological revolutions. For technologies to be widely adopted, they have to overcome several obstacles that make them ubiquitous. Historically, technologies that have positioned themselves as General Purpose Technologies have done so through refinement and increasing cost-effectiveness. This then created the demand for the technology, reorienting macroeconomic processes around it by changing the way we invest, what we demand, the education we impact and the quantity of labour we demand. The road to a reorientation of this size is long and we hypothesize that it could be no different for scaling AI adoption. For AI to be widely applicable in the real world, it needs to be made practical, reliable, requires the establishment of supporting infrastructure and has to achieve sufficient levels of resource efficiencies to be viable.

## VISION TO VIABILITY: AI'S REAL WORLD CHALLENGES

### Differentiating between Breakthrough and Practicality

13.25 A breakthrough in the context of technology refers to a significant discovery that overcomes a major barrier, enabling new possibilities or dramatically advancing the state of the art. It is also characterized by its ability to solve previously unsolvable problems, introduce novel capabilities, or revolutionise existing systems, processes, or industries. This is the stage at which Artificial Intelligence finds itself right now. Large Language Models are capable of acing exams and achieving high test scores, but the field is still far from having a model come up with original, publishable research.

13.26 Conversely, practicality refers to feasibility, effectiveness, and usefulness in addressing real-world problems or needs. This also encompasses ease of implementation, cost-effectiveness, scalability, user access, and the ability to deliver clearly measurable benefits. Achieving this stage is the most challenging part since many innovations

that emerged over the years have been clear breakthroughs but failed to find the mass acceptance that comes to characterise a General Purpose Technology. AI today has the potential to deliver clearly measurable benefits in terms of productivity, but the costs, especially in terms of investment required is high.

13.27 At its current stage of development, AI is more experimental as it is still finding its footing. This is not inherently negative, as it signifies innovation's curious and exploratory nature. However, from a practical standpoint, its experimental nature makes its real-world utility unclear despite the technology demonstrating impressive capabilities. For instance, the pursuit of smarter AI models promises to propel the applicability of self-driving cars but identifying why they are needed, their cost-effectiveness, and social acceptability remains an ongoing challenge. Similarly, chatbots can convincingly simulate human conversation but their practical effectiveness in customer service is not established since customers prefer having their complex questions dealt with by humans[30].

13.28 The industry has placed its chips on increasing AI adoption, hoping that if the technology reaches as broad an audience as possible, users will, on their own, eventually come up with more applications, thus validating the technology. For now, while AI is useful in exploring and optimising certain jobs, particularly ones that are knowledge-based or creative, the full scope of its practicality is still limited due to the degree of human intervention necessary in order to extract useful outputs. AI models, particularly overly complex generative AI which are too rich and have too many parameters are unconcerned with the truth, unconcerned with the 'correctness' of its output and unconcerned with the realities of the world. It is known to 'hallucinate' and generate outputs that are not based on what is true but rather on what is the best fit for question[31]. Utilising AI to the best of its abilities right now requires one to be fully aware of its limitations.

## Reliability

13.29 In most day-to-day use cases involving personal use, even an error rate of 10 per cent would not have any significant impact since the user would most likely identify the error and correct it. The stakes are much higher when it comes to deploying AI in business and real-world applications as the severity of the consequences will vary from one application to another. A customer service chatbot might have many chances to correct misunderstandings, whereas a path planning algorithm for an autonomous vehicle gets only one chance to get it right. Ignoring the reliability problem and hasty implementation results in severe, unintended consequences.

30 Cogito Customer Experience Survey Results. 6th August 2024, https://tinyurl.com/ynf37mm6

31 Hicks, M. T., Humphries, J., & Slater, J. (2024). ChatGPT is bullshit. Ethics and Information Technology, 26(2), 38, https://tinyurl.com/3cun5e9d

13.30 Several examples noted in a publication by McKendrick and Thurai (2022) demonstrate the non-negotiable nature of reliability[32]. A self-driving car fatally struck a pedestrian on a four-lane road because it failed to recognize the individual as a pedestrian, as the person was not near a crosswalk, which was the typical circumstance represented in its training data. Application of AI in recruitment turned out to prefer male candidates over female applicants due to the larger number of males in its training sample. The company attempted several times to make the AI screener gender-neutral but failed. Predictive Policing using AI also tends to have a bias against minorities[33].

13.31 Time-tested liability frameworks applicable to commercial products may not apply in a straightforward manner to AI products as solving the reliability problem is also necessary to mitigate risks from AI applications[34]. Additionally, given the nuanced relationship between humans and accountability, individuals tend to feel less responsible as their direct involvement in actions decreases. This phenomenon becomes particularly significant when artificial intelligence is used to replace human decision-making within firms and organizations. The introduction of AI further distances humans from the ethical responsibilities traditionally tied to decision-making, potentially exacerbating a lack of accountability. In such frameworks, where firms increasingly rely on AI as a substitute for human judgment, the importance of ensuring AI's reliability becomes paramount. This is because, unlike humans, AI lacks the inherent capacity for accountability, making the ethical and operational implications of its use even more critical to address.

13.32 Arvind Narayanan and Sayash Kapoor of Princeton note that LLMs are 'not reliable enough to be successful products' – yet[35]. They state that for AI to achieve mass adoption, companies need to start approaching AI development like Software development. The product needs to be reliable and dependable. Until such a time, the labour displacement effects of AI may not be widespread since human oversight will be a must for any kind of AI application.

## The Infrastructure Challenge

13.33 The third criterion for the diffusion of new technology is growth in supporting infrastructure. As illustrated by Carlota Perez in her book investigating the history of technological revolutions[36], the necessary infrastructure is crucial for the proliferation

32 McKendrick, J., & Thurai, A. (2022). AI isn't ready to make unsupervised decisions. Harvard Business Review, 15, 10, https://tinyurl.com/4uxf3bbz

33 Predictive Policing Algorithms are racist. Will Douglas Heaven. MIT Technology Review. July 2020, https://tinyurl.com/yaef2evv

34 Rahul Matthan (Trilegal), Unpublished Manuscript, December 2024.

35 AI Agents that Matter. Sayash Kapoor and Arvind Narayanan. 3rd July 2024, https://tinyurl.com/3pd7ftkk

36 Perez, C. (2002). Technological revolutions and financial capital: The dynamics of bubbles and golden ages. In Technological revolutions and financial capital. Edward Elgar Publishing.

of new technology as it provides the externalities that facilitate adoption and widespread use. The infrastructure is installed in the initial phase when the excitement over the potential of the new technology runs high, creating the conditions for the full deployment of the technology in the coming decades.

13.34 Canals, waterways, and turnpike roads provided the connectivity required for the industrial revolution, facilitating the movement of inputs and finished goods. The age of the automobile gained momentum due to the construction of roads and highways all across the United States. The expansion of the electricity grid provided households access to power, thus fuelling the demand for home appliances and leading to the era of mass production. The proliferation of computers and infrastructure created for telecommunications gave impetus to the adoption of the Internet.

13.35 Once a technology had proven its practicality (more than its reliability, as reliability would be fine-tuned with subsequent iterations of the technology), infrastructure creation naturally followed. However, since building infrastructure is a highly time-consuming process, the full potential of the technology could not be harnessed till the support infrastructure was widely available. The development of AI, and the rate of adoption is similarly going to depend on the availability of quality infrastructure and the pace of its creation.

13.36 Infrastructure, in the case of AI, is not as straightforward as in previous technological revolutions since its requirements transcend the physical realm. Apart from the already-known aspects such as land, reliable chip supply, and data centres, chief among AI infrastructure is data, which is the lifeblood of AI development. Training AI models cannot be done on raw data, as previously discussed; data is highly prone to bias the model. Additionally, data in its raw form can include instances of toxicity, vulgar content, and other dimensions that can lead to the model performing unexpectedly. More often than not, prior to data making its way into the training set for a model, it is extensively cleaned by humans who filter the dataset for any and all of the issues mentioned above. Cleaning introduces its own set of biases as data can be included or excluded at the discretion of the developers, biasing the overall output of the model.

13.37 For AI to be widely adopted across industries, a holistic infrastructure that combines technological resources, human expertise, and organisational readiness is needed. Changes of this magnitude take time to materialise, and even longer to reach the point where the new technology seamlessly synergises with the entire value-addition process. Thus, concerns over AI displacing labour may be somewhat ameliorated by the time it takes for complementary facilities needed for AI adoption at scale, to emerge.

## The Resource Challenge

13.38 The most critical obstacle to the large-scale proliferation of AI in the medium term is resource efficiency. For AI to scale effectively, technological advancements and performance gains must be coupled with significant reductions in costs and more efficient utilisation of scarce resources—an achievement that remains elusive. The challenge is compounded by the fact that modern AI systems, still in their developmental infancy, demand enormous investment in research and development. Moreover, the prevailing trajectory in AI development prioritises performance over cost-effectiveness, driven by a belief that any compromise on model performance in favour of cost savings would lead to subpar outcomes. This approach, while understandable, underscores the urgency of addressing the pressing need for sustainable and efficient AI innovations.

13.39 Training AI models are becoming increasingly expensive as the availability of data is saturating and high-quality data acquisition costs are rising. Training the first 'Transformer' model developed by Google, which laid the foundation for ChatGPT, cost around USD 930 dollars. In stark contrast, training OpenAI's GPT-4 cost the company USD 78.4 million, while the costs incurred by Google for training Gemini Ultra stood at USD 191.4 million[37]. As costs are only expected to go up, developers have been exploring the idea of using 'Synthetic Data', but this is rife with its own set of challenges. Artificially generated data come with data distribution bias, are characterised by completeness which influences the model's resilience, can contain many inaccuracies and errors, can neglect temporal and dynamic aspects found in real data and are highly inconsistent when evaluated on factors present in real data[38]. Utilising synthetic data to augment previous training data leads to the model's learning essentially coming to a halt and repeated use of synthetic data leads to 'model collapse'.

13.40 Secondly, developing more sophisticated models comes with significant costs as well. Since processing user queries utilises vast computational resources, AI firms incur running costs for the model. For instance, in the case of OpenAI's o3 model mentioned earlier, the breakthrough in processing capability came at a very high cost. In running the ARC-AGI benchmark, which is considered one of the most challenging tasks for an AI to undertake, OpenAI incurred a cost of USD 200,000[39] for its low-efficiency model. While the firm asked the author not to disclose its high-efficiency cost, the author does state that the amount to compute was 172 times the low-efficiency model's figure. Running increasingly complex models is computationally tasking, exerting hardware, energy and other resource demands.

37 Visualizing the Training Costs of AI Models Over Time. Visual Capitalist, https://tinyurl.com/bderacpn

38 Hao, S., Han, W., Jiang, T., Li, Y., Wu, H., Zhong, C., ... & Tang, H. (2024). Synthetic data in AI: Challenges, applications, and ethical implications. arXiv preprint arXiv:2401.01629, https://tinyurl.com/zkau6cn4

39 OpenAI o3 breakthrough high score on ARC-AGI-PUB. Francois Chollet. 20th December 2024, https://tinyurl.com/2xy69wu8

13.41 In this regard, AI's energy requirements are no mystery. Globally, all data centres already consume more electricity than countries such as Italy, Taiwan, Australia, Spain and Malaysia among others[40]. These requirements will only increase with greater adoption. A recently published Bloomberg analysis estimated that powering Data Centres for AI around the world is expected to reach up to 1580 terawatt-hours, which is as much electricity as India consumes[41]. Hardware also needs cooling, which is reliant on water, much of it drinking quality. Cooling is estimated to need over a billion litres of water per day. Further, Data Centre campuses are built on a vast amount of land, and finding the right piece of land that fulfils the power and water requirements is going to drive up land prices in resource-rich areas. The chips powering AI are reliant on a steady supply of minerals such as silicone, gold, silver, aluminium, tin, and other rare earth minerals. The magnitude of scarce resources required for AI proliferation would not be much of a concern if there were no competing needs driving demand for the same resources. However, this is not the case and scaling up AI has the potential to start a bidding war for minerals, land, and water, driving up prices for essential resources.

13.42 Without ground-breaking innovations and strategies to make AI scaling economically viable—both financially and in terms of resource consumption—efforts to democratise AI will jeopardise critical global priorities such as energy security, water security, and even housing or food security. The construction of sprawling data centres risks displacing essential land use, further exacerbating these challenges. The imperative for AI developers is clear: scaling down resource consumption while simultaneously boosting performance is not just a technical hurdle but the defining bottleneck that will shape the future of AI. The time to address this pressing issue is now.

13.43 Technological revolutions that achieved mass adoption only did so because, over the course of time, they got the delicate mix of the factors outlined in the previous sections right. Practicality, reliability, infrastructure and efficiency need to all work in tandem before true large scale adoption happens. No amount of investment can force mass adoption unless the technology makes economic sense for the user and for the society. In the case of AI, if it makes sense for the former and not the latter, policymakers have to step in and take some hard decisions.

## AI AND INDIA: ARE THERE OPPORTUNITIES?

13.44 As India contemplates the integration of AI into its economy, the lessons of past technological revolutions underscore the critical importance of proactive institutional response. The time afforded now must be well utilised to minimise the adverse effects

40 AI is already wreaking havoc on Global Power Systems. Bloomberg. 21st June 2024, https://tinyurl.com/rdk9p3c9

41 Published in Bloomberg, 13th December 2024, https://tinyurl.com/4c66sa22

to the best of our capabilities involves equipping the workforce with future-ready skill. We must also use this time to put in place mechanisms to cushion societal impacts, a challenge that resonates deeply with India's unique demographic and economic landscape.

13.45 Looking ahead, the nation's predominantly services-driven economy, coupled with its young and dynamic population, offers a fertile ground for leveraging the benefits of emerging technologies, only if proactively and carefully managed. Technology does not always have to displace labour but instead can be put to use in augmenting the productivity of the workforce. Just as history provides a reason for caution, history also provides a cause for optimism about the effectiveness of strong institutions which can foster an environment where man and machine work together.

13.46 Further, the exposure of medium- to high-skill jobs to AI driven automation may not be as high as certain estimates, due to the inherent limitations of AI as detailed in Box XIII.1. Thus, the labour augmenting potential of AI should also not be ignored.

**Box XIII.1: Demystifying Artificial Intelligence**

In the simplest terms, the 'AI' tools on the market today, particularly Generative AI, are statistical models, utilising significant computing power, that are a function of large amounts of text, images, and other forms of data fed into them. The processing of any input is broken down across many layers for the most complex models, with each layer containing several thousand nodes (or neurons[42]). This combination of layers and nodes allows the model to 'think', 'reason', and process data at unimaginable scales, generating an output along the parameters the model has been trained for.

When you ask any modern chatbot driven by an underlying large language model a simple question such as 'Where does the sun rise and set?', the model does not interpret the language in the question as an actual human does. This is because 'AI' has no understanding of the concepts of letters and syllables. The machine processes input text using a series of mathematical computations involving matrices. First, the text is broken into smaller units called tokens in a process known as tokenisation, where each token is mapped to a unique number. For example, the phrase 'AI revolution' might be tokenised to [342, 2591], where these numbers correspond to the indices of the words in the model's vocabulary.

Once tokenised, the model uses mechanisms to compute the frequency of token pairs, triplets, and other sequences between each word and all other words in the input. This allows the model to assign importance (weights) to different words based on their context.

42 In the 1940s, Warren McCulloch and Walter Pitts developed a mathematical model to mimic how the brain processes information. They proposed that neurons in the brain function like switches, turning "on" or "off" based on signals they receive from other neurons. Their model used simple logic, where a neuron activates if the sum of incoming signals surpasses a certain threshold, similar to binary decision-making in computers. This foundational concept inspired the development of artificial neural networks, computer systems designed to emulate the brain's signal processing for tasks like pattern recognition, decision-making, and problem-solving.

These weighted representations are passed through layers of the neural network, where patterns and relationships are refined. The network output assigns probability values to each possible token, representing how likely each one will appear next. The tokens with the highest probabilities are selected and mapped back to their corresponding words in the vocabulary, generating a coherent text output. The new tokens generated are then fed back into the model, making it appear that the bot is equipped to have a flowing conversation with the user.

Thus, to respond to a user's query, the data analysis performed by the model is essentially a game of 'guess the next word'. In other words, it is a highly complex version of the autocomplete function we already see on our computers and smartphones. Generative AI are trained to simply predict the next word in a sequence of words by calculating probabilities based on the user input text. Considering the non-linearity and complexity of language, such an exercise is computationally very expensive. To generate a single-line response to the user's question (in our example, 'The sun rises in the east and sets in the west'), the model may need to perform anywhere between 10 to 20 trillion arithmetic operations to generate a 11-word response. Similar principles govern the functioning of other generative AI.

Strides made in AI-research is awe-inspiring and will most likely be helpful in the coming years[43]. However, Michael Wooldridge from the University of Oxford had suggested that claims of intelligence required more rigorous scrutiny, stating that large language models, despite their dazzling appearance of human-like competence, are not 'AI'[44]. While capable of some superficial logical reasoning and problem-solving, these models are limited in their extended capabilities. Anything additional expected from these models must be explicitly coded into them, which is very different from what is traditionally considered 'intelligent'. To claim that machines are 'learning' is to assign the wrong label since these models use predictive and probabilistic statistics to generate an output.

Consider an AI-powered marketing tool that determines campaign success based solely on click-through rates and conversions. While efficient, it might ignore brand perception, customer loyalty, and the long-term impact of the campaign on the business. In education, implementing an AI-based grading system for students that evaluates essays based on grammar, structure, and word count can be quick and efficient. But the AI may miss the value brought by creativity, originality, and critical thinking expressed in the content.

Along similar lines, AI in healthcare can recommend treatments that prioritise statistical outcomes since it cannot factor parameters such as quality of life, patient preferences, and ethical considerations. Relying on AI for judicial decisions also involves risks since predicting recidivism or determining bail requires balancing subjective considerations such as fairness, individual circumstances, and social impact. Judgements passed in courts are much more than simple prediction tasks and are a product of personal experience combined with domain-specific knowledge, the former of which AI lacks.

43 However, the efficiency of the models is still a research question that remains unanswered thus far in the Generative AI community. Larger models drive up the demand for more computational resources and energy, which in turn drives up the cost of running these models.

44 ChatGPT is not 'true AI'. Michael Wooldridge, 2023, https://tinyurl.com/45s6dkad

Advancements in computer science may just as well address these concerns in the future. However, in the meantime, just as machines are designed for specific tasks rather than universal application, AI functions as a tool tailored to particular purposes. This means it is more suited to supplement human action rather than be a total replacement for work performed by them.

## THE LABOUR MARKET EVOLUTION

13.47 Labour and Technology, when integrated in the right way, have complemented one another rather than being substitutes. Further, technical change did not always lead to declining employment in the affected industry; rather, it has resulted in strong employment growth during the decades the technology was being refined. For instance, Bessen (2018)[45] investigated the impact automated manufacturing had on the textiles, steel, and automotive industries of the United States. The findings demonstrated that productivity gains due to automation led to robust job growth and higher earnings for workers over the course of nearly four decades before plateauing.

13.48 Studies assessing the introduction of robots in factories corroborate the same. While the employment share in routine manual jobs declined due to the adoption of automated robots on the factory floor, this in no way led to capital substituting for labour in the advanced economies[46]. Such effects were also visible in developing countries, where robots in fact reduced unemployment growth as robotic work and human work integrated with one another over time[47]. Specifically in the case of India, a study by Mani (2018) illustrated how the introduction of robots only accounted for the replacement of only 10 jobs per 10000 in the manufacturing sector by 2016[48]. This was primarily concentrated in automobiles, while the rest of the manufacturing sector remained largely unaffected by automation.

13.49 Similarly, Albanesi et al. (2024) introduced some much-needed balance to the literature on the effects of AI/ML led automation on white-collar jobs[49]. Their assessment of the impact of AI/ML on white-collar jobs in Europe suggests that there exists a positive association between AI-enabled automation as the sector-occupation employment share of high-skilled workers increases in the range of 3.1 per cent to 6.6 per cent over the course of a decade.

45 Bessen, J. (2019). Automation and jobs: When technology boosts employment. Economic Policy, 34(100), 589-626, https://tinyurl.com/2c7zmj3c

46 De Vries, G. J., Gentile, E., Miroudot, S., & Wacker, K. M. (2020). The rise of robots and the fall of routine jobs. Labour economics, 66, 101885, https://tinyurl.com/5ffv2wjm

47 Focacci, C. N. (2021). Technological unemployment, robotisation, and green deal: A story of unstable spillovers in China and South Korea (2008–2018). Technology in Society, 64, 101504, https://tinyurl.com/mvfmxck4

48 Mani, S. (2017). Robot apocalypse: Does it matter for India's manufacturing industry?. Centre for Development Studies Working Paper, (474), https://tinyurl.com/5vtbfc4v

49 Albanesi, S., Dias da Silva, A., Jimeno, J. F., Lamo, A., & Wabitsch, A. (2024). New technologies and jobs in Europe. Economic Policy, eiae058, https://tinyurl.com/ymarmumr

13.50 Research has already demonstrated how the introduction of generative AI assistants augmenting customer support personnel increased productivity by 14 per cent on average, including a 34 per cent improvement for new and lower-skilled workers[50]. Employees were able to substantially improve their problem resolution, leading to higher customer satisfaction. Cogito, a customer support firm, has been encouraging the use of AI assistants, which are able to analyse customer sentiments and provide real-time feedback to customer support representatives, improving the efficiency of issue resolution. Implementing AI as a tool helps bridge the skill gap in this domain, allowing low-skilled workers to produce outputs closer in quality to the work high-skilled workers do without any tools. The reduction in skill inequality is a big positive on aggregate since the overall productivity increases.

13.51 In more complex fields such as scientific research, Human-AI teams are able to generate high-quality outputs by capitalising on the best of human and machine intelligence. For instance, Charness et al. (2023) find that AI-assisted research design benefits in five core aspects: Questions and Literature, generating testable hypotheses and methodologies for testing, instructions and comprehension checks, generating experimental code and related documentation, and auditing for errors[51]. Prof. Noshir Contractor of Northwestern University also cites several other instances in his research where AI-enabled researchers benefitted from the capacity of the machine for processing vast amounts of scientific data for hypothesis generation, enhanced data collection, manuscript review, and meta-analysis, among others[52].

13.52 Supplementing human decision-making with AI assistants would be the ideal and the most desirable outcome for maximising the micro- and macroeconomic benefits of the technology. This is what the leading AI firms seek to achieve as well. In his most recent blog, Sam Altman (the co-founder of OpenAI) stated that their intentions are to put 'great tools in the hands of people', with the goal of achieving broadly distributed outcomes[53]. Similarly, in Alphabet Inc.'s 2024 Q3 earnings call, the CEO of Google stated that the company internally is using AI to augment their engineers' productivity by automating low level tasks, which allows their people to focus on more complex tasks[54].

13.53 Further, factors such as accountability, an understanding of the subjective and practical realities of the world, consistently adapting reasoning, cognisance of

50 Generative AI at work, NBER Working Paper 31161, November 2023, https://tinyurl.com/m2uzkkkt

51 Charness, G., Jabarian, B., & List, J. A. (2023). Generation next: Experimentation with AI, https://tinyurl.com/3d4yfnwh

52 Scientific Research: Two Paradigm Shifts? Presented by Prof. Noshir Contractor at the Vienna University of Technology, Austria, https://tinyurl.com/yh7yj9sf

53 Reflections by Sam Altman. 6th January 2025, https://tinyurl.com/49xwbtam

54 2024 Q3 Earnings Call. Alphabet Investor Relations. 29th October 2024, https://tinyurl.com/34mkpesz

consequences, and critical thinking are all important factors which human capital brings to any enterprise. Replacing authentic, intelligent deliberation with a brutal, calculative algorithm will result in a society where algorithms serve as an escape from reason, an excuse not to think. AI must be seen for and utilised as what it is supposed to be, a tool, as the arc of technological history does not bend towards the replacement of humans by machines.

## AUGMENTING INDIA'S SERVICES SECTOR

13.54 India is a services-driven economy, and the opportunities for enhancing the productivity of the workforce are ample. Further, the younger population of the country makes a rich talent pool available for capitalising on emerging technologies. This is significant because the study by Albanesi et al. (2024) analysing the effects of AI/ML implementation in Europe revealed that youth and high-skilled workers were the demographic most capable of understanding and adapting to technological changes[55].

13.55 Education and skilling are going to play a critical role in driving the success of human-centric AI adoption in the country while minimising labour displacement as best we can. If history has taught us anything, it is that with each subsequent technological revolution, the floor for what is considered a basic skill has risen. As automation handles the routine and mundane tasks, the mind is now free to focus on more complex questions and issues, thus raising skill requirements. The Industrial Revolution demanded a labour force skilled in handling factory machines and engineers who maintained them. The Age of Steam and Railways shifted the employment landscape towards industrial and urban jobs, primarily in construction, operations and maintenance. The Age of Steel, Electricity and Heavy Engineering demanded a workforce capable of handling large-scale machinery, electrical equipment and several other jobs in the technical fields. With the Information and Telecommunications era, jobs shifted towards knowledge-based and service-oriented jobs.

13.56 As developments in the field of AI create tools capable of automating basic knowledge creation and processing, skills such as critical thinking, higher degrees of creativity, and the capacity for more specialised knowledge may well be the new normal. Thus, India's employment challenge is not just about numbers but also about raising the overall 'quality' of the workforce. Quality in this case does not just mean imparting knowledge through a step-by-step guide to leveraging AI, or providing very specific training related to 'AI oriented jobs.' Technology specific skills run the risk of becoming obsolete very soon, especially in today's world where the requirements shift rapidly.

55 Albanesi, S., Dias da Silva, A., Jimeno, J. F., Lamo, A., & Wabitsch, A. (2024). New technologies and jobs in Europe. Economic Policy, eiae058, https://tinyurl.com/yjn8y9ju

13.57 In addition to the above, improvements in the quality of the workforce must focus on more foundational skills as well, such as soft skills and core competencies which are valuable across industries and roles. Foundational skills support the learning of tech-specific skills by fostering adaptability and cognitive agility and are significantly more resistant to the risk of becoming obsolete. The silver lining is that due to the R&D nature of AI, India, this time, has the opportunity to catch up with, if not get ahead of the curve and prepare its workforce.

13.58 Furthermore, Bessen (2018)[56] finds that technological change is only labour displacing and brings about mass unemployment if the demand for the product/service offered by the industry is saturated. If the market has large, unmet needs, then labour augmented by machines increases productivity and employment. This implies that new technology should increase employment if the demand elasticity for the sector is high.

**Box XIII.2: Connecting the dots - Employment, automation and demand-elasticities**

What happens to work in the presence of automation? Often automation does away with sub-tasks within a job, in turn leading to a modification of the job profile than the job being suppressed entirely (ILO,2019)[57]. The role of a bank-teller over time exemplifies how automation leads to new sub-tasks being taken up alongside other routine, so far un-automated work. For instance, the introduction of labour-saving innovations such as the ATM did not lead to a loss of bank employment. Rather bank employment has grown, and the role of the bank teller has shifted from clerical work to sales and counselling over time (Bessen, 2015)[58].

Ultimately, the capacity of a sector to create jobs in response to automation depends on whether the new grouping of sub-tasks into specific job profiles is deemed profitable (ILO,2019). This is in turn a function of the demand for particular services delivered than the supply of skills to fill these jobs (Acemoglu and Autor, 2011[59]; Bessen, 2018[60]). Understanding the nature of demand for a particular sector can therefore reveal clues as to how the sector will respond to technological change.

To gauge the employment impact of a technological revolution, it makes sense to look at how employment in the past responded to the industrial revolution of the early 20th century.

56 Bessen, J. (2019). Automation and jobs: When technology boosts employment. Economic Policy, 34(100), 589-626, https://tinyurl.com/2c7zmj3c

57 International Labour Organisation 2018, The Economics of AI: Implications for the future of work, https://tinyurl.com/5n7kcz9e

58 Bessen, J. (2015). How computer automation affects occupations: Technology, jobs, and skills, Law and Economics Research Paper No. 15-49 (Boston, Boston University School of Law), https://tinyurl.com/yshuxcm6

59 Acemoglu, D. Autor, D. 2011. "Skills, tasks and technologies: Implications for employment and earnings", in O. Ashenfelter and D. Card: Handbook of labor economics (Amsterdam, North Holland), Vol. 4B, pp. 1043–1172, https://tinyurl.com/4w3muny8

60 Bessen, J. (2018). Automation and jobs: When technology boosts employment. Economic Policy, 34(100), 589-626, https://tinyurl.com/53vrz2w5

Gleaning insights from the days of the industrial revolution, Bessen (2018)[61] looks at data since the 1930s for the US cotton, steel, motor vehicle and textile industries. He finds that technological change is only labour displacing and brings about mass unemployment if the demand for the product/service offered by the industry is saturated. If the market has large, unmet needs, then labour augmented by machines increases productivity and employment. This implies that new technology should increase employment if the demand elasticity for the sector is high.

While some level of worker displacement is inevitable for those unable to align with shifting skill requirements, the scale of this displacement is shaped by the interplay between displacement effects and productivity gains. For instance, in highly demand-elastic markets, the "reinstatement effect" has historically acted as a counterbalance against the displacement effect caused by automation. Technological advancements in markets with unmet demand often give rise to auxiliary tasks where labour maintains a competitive edge. As Acemoglu and Restrepo (2019)[62] observe, such tasks not only enhance productivity but also reinstate labor into a broader spectrum of roles, thereby altering the task composition of production in labor's favor.

**Elasticities for India's services sectors – An estimation**

As established in the section before, demand elasticities can help gauge a sector's ability to raise employment because of productivity enhancements from automation. As shown by Bessen (2018), the per capita real demand for a sector (D) can be written as a function of real wages (w) and real prices (p). This is shown by equation (1)

$$\ln D(p/w,w) = \alpha + \beta_1 \ln \frac{w}{p} + \beta_2 (\ln \frac{w}{p})^2 + \gamma_1 \ln w + \gamma_2 (\ln w)^2 + \epsilon \quad (1)$$

This can also be re-written[63] as,

$$\ln D(A.s,w) = \alpha + \beta_1 \ln A.s + \beta_2 (\ln A.s)^2 + \gamma_1 \ln w + \gamma_2 (\ln w)^2 + \epsilon \quad (2)$$

Where A denotes labour productivity and s is the labour share of income

The elasticity of demand is given by $\epsilon_D = \frac{(\partial \ln D)}{(\partial \ln w/p)}$ (3)

Further the elasticity of demand with respect to labour productivity can then be interpreted as:

$$\frac{(\partial \ln D)}{(\partial \ln A)} = \epsilon_D (1 + \frac{\partial \ln s}{\partial \ln A}) \quad (4)$$

On the right-hand side, $\epsilon_D$ is the price elasticity of demand while the partial derivate shows the influence of productivity on labour's share of output. The equation shows that price elasticity of demand and productivity elasticity of demand are positively correlated.

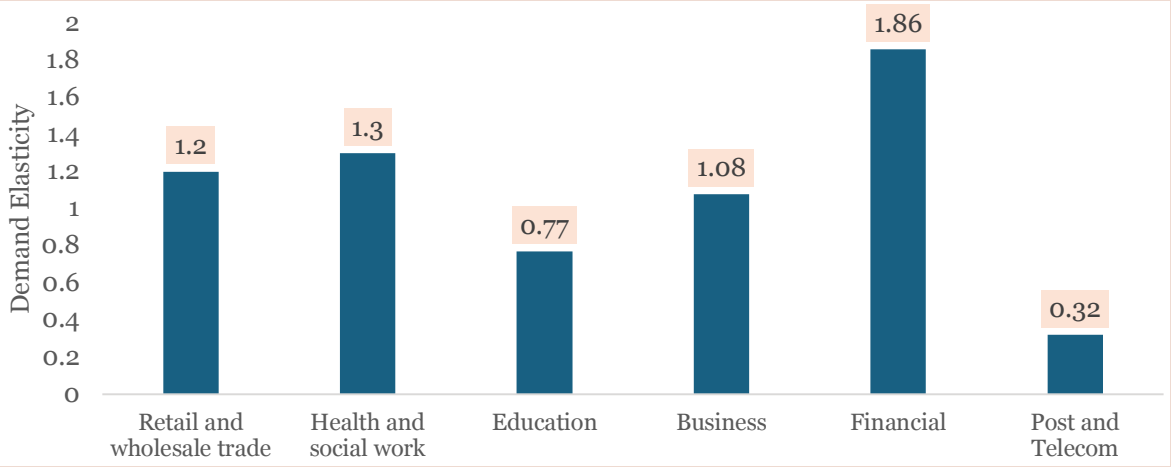
61 Ibid

62 Acemoglu, D., & Restrepo, P. (2019). Automation and new tasks: How technology displaces and reinstates labor. Journal of economic perspectives, 33(2), 3-30, https://tinyurl.com/yeynaaj4

63 Since share of income can be re-written as $s = \frac{wL}{pY} = \frac{w}{pA}$

To understand the potential for employment increases in India's services sector, Bessen (2019)'s theoretical model is replicated with the help of data from RBI's KLEMS database. The data studied is for the period of 1994 to 2023. The demand elasticities estimated for India's services sectors (based on the classification provided by RBI KLEMS)[64] are shown by chart XIII.1. Note that elasticities for transport services and hotel services were insignificant at the 10 per cent level and are hence not depicted in the chart.

**Chart XIII.1: Demand Elasticities across services sectors for India**




Source: Author's estimates

As the estimates show, the financial sector shows the highest elasticity at 1.86 followed by Health and social work (1.3), Retail and wholesale trade (1.2), Business services (1.08), Education (0.77) and post and telecom (0.32). It must be noted that the elasticity estimation is at a broad level which does not consider aspects such as product quality. Further, since the classification is sufficiently broad (i.e, industries instead of sectors), it may well be that sub-sectors within the industry show higher or lower elasticities than the industry average.

**Implication for the services sector in India**

A sectoral comparison of estimates reveals that demand elasticities are high for sectors such as financial services, trade services, health and social work and business services.

The high elasticity in financial services could be indicative that the sector is yet to reach a stage of market saturation. Productivity enhancement may therefore prove employment generating for the financial sector. Research also corroborates that information technology improvements tend to raise employment in finance, retail and wholesale industries[65].

High elasticities in the health and social work industry shows that automation can aid productivity and employment gains in this sector. For instance, as research by Shwalbe and

64 The detailed concordance between National Account Statistics and RBI KLEMS classification can be accessed at https://tinyurl.com/4cnemd5y

65 Gaggl, Paul, and Greg C. Wright. "A Short-Run View of What Computers Do: Evidence from a UK Tax Incentive." Working Paper (2014), https://tinyurl.com/4dn6prc6

Wahl, 2020[66] shows, AI can aid productivity through interventions in diagnosis, patient mortality risk assessment, disease outbreak prediction and health policy and planning. In the social work industry, AI can maximise the effectiveness of frontline workers.

The high elasticity in retail and wholesale trade in the country is indicative of a large consumption base in the country. Thus, effective productivity gains are likely to make it profitable for new roles to co-exist with automated tasks on average for this industry. Productivity gains for businesses engaged in retail and wholesale activities include identifying customer preferences, enhanced marketing techniques and inventory management and forecasting.

The business sector is a export-oriented sector with activities such as IT and IT enabled services, R&D services in the areas such as accounting and legal professions. The sector's elastic demand shows that, on average, services employment may rise in the presence of AI for this particular sector. However, it should be noted that the elasticity estimate does not give a picture of sub-sector elasticities. It is possible then for employment in lower value-added sub-sectors in the industry (such as Business Process Outsourcing Units) to respond negatively to automation as compared to higher value-added sub-sectors (such as Global Capability Centers).

The education sector shows an inelastic demand for services. Theoretically, this may imply that productivity enhancements through AI-based learning models can lead to a decline in teacher employment. For instance, there maybe a reduction in the need for personnel as a result of cost-effective access to high quality interactive learning media, and customised learning paths for students. However, the essential nature of the service and its high degree of regulation are likely to act as buffers which will ensure that productivity improvements will not come at the expense of teacher employment.

Interestingly, post and telecom also show low elasticity. This sector in particular has reached a high degree of market saturation over the past three decades. The oligopolistic nature of the industry may also imply that increases in labour productivity may come with lower costs which would translate to higher profit margins (and not necessarily lower prices). A high degree of market saturation and oligopolist market structure imply that prices may not reflect declining costs. Automation may therefore behave as a labour-displacing force than a labour augmenting one.

13.59 While initial displacement is to be expected for workers who fail to catch up to the market demands, the magnitude of displacement also depends on how displacement and productivity effects weigh against each other[67]. For a sufficiently demand-elastic market, the displacement effects historically have been counterbalanced by the 'reinstatement effect'. Demand for new products and services due to new technology in a market with unmet demand has created new, auxiliary tasks where labour has a

66 Schwalbe, N., & Wahl, B. (2020). Artificial intelligence and the future of global health. Lancet (London, England), 395(10236), 1579–1586, https://tinyurl.com/mr3t97cv

67 Acemoglu, D., & Restrepo, P. (2019). Automation and new tasks: How technology displaces and reinstates labor. Journal of economic perspectives, 33(2), 3-30, https://tinyurl.com/yeynaaj4

competitive advantage. Acemoglu and Restrepo (2019) state that, 'such new tasks not only generate a positive productivity effect, but also a reinstatement effect – reinstating labour into a broader range of tasks and thus change the task content of production in favour of labour. This increases labour demand and labour share.'

13.60 Looking at the history of the labour market through this lens, we can now decode why, despite major new technologies that automated economic value addition, the employment-to-population ratio rose over the 20th century[68]. Along these lines, the future of work is 'Augmented Intelligence', one that expands the workforce to accommodate both humans and machines, with the aim of improving humanity while also bringing about a greater level of efficiency in how we perform our jobs[69].

13.61 What new opportunities will emerge from the spillover effects of AI will only be clear once AI goes from experimental to practical, but reinforcing the point made earlier, it is up to policymakers, academia, and the private sector to work together to raise the overall quality of human capital in India. This tripartite compact is also going to be instrumental in ensuring that the gains from productivity are distributed widely creating a social surplus, rather than concentrating in the hands of an increasingly oligopolistic sector[70].

## CONCLUSION

13.62 In the seven decades since the development of Artificial Intelligence began, the progress made in the last decade lays down an important milestone for the domain. While impressive in its own right, AI still remains in its developmental stage and has a long way to go before it achieves the scope of adoption that have made technologies such as the personal computer and the internet ubiquitous. The scale of challenges left unaddressed are significant, and so is the time required by developers to come up with cost-effective and resource-efficient solutions. Therefore, as the essay suggested, estimates about the magnitude of labour market impacts may be well above what might actually materialise. Nevertheless, complacency about the 'low probability-high impact' nature of the issue at hand could prove to be very costly for a country like India.

13.63 As policymakers, it would benefit us to ask ourselves the question, "What were the problems in the world that demanded AI as the answer?" In other words, is AI a solution in search of a problem? This question is not easily answered as innovation does

68 Autor, D. H. (2015). Why are there still so many jobs? The history and future of workplace automation. Journal of economic perspectives, 29(3), 3-30, https://tinyurl.com/bdprpw9a

69 AI Should Augment Human Intelligence, Not Replace It. David De Cremer and Garry Kasparov. Harvard Business Review. 18th March 2021, https://tinyurl.com/42pt7r8j

70 The AI Octopus by Eric Posner. Published in Project Syndicate. 8th January 2024, https://tinyurl.com/y9hv7kdf

not always respond to a problem, rather emerges as a product of human ingenuity. Thus, in some sense, AI represents the human drive for improvement, for creating something previously thought impossible. However, when innovation has the possibility of coming at great societal cost, the value of innovation must then be judged in the context of its potential loss generation.

13.64 Despite the limitations of AI and the pre-requisites necessary for its widespread application, it is worth taking notice of the fact that labour markets are shifting at present in anticipation of a distant future. Nobody knows how long these changes may last, but they can definitely leave a lasting impact on the physical and mental well-being of those affected. The responsibility for course correction will then fall in the hands of the public sector. Therefore, from a policymaker's perspective, it may be costly to dismiss fears as exaggerated and adverse impacts as overestimated. Rather, they underscore the need for constant vigil and timely action.

13.65 Learning from the lessons of the past, capacity building and institution building is the need of the hour for India to capitalise on the opportunity that lies ahead. Structural changes to how we educate our children will be required in addition to safety nets that can shield existing workers from economic and social fallouts. Additionally, regulatory frameworks will need to be revisited and amended to ensure that the use of AI aligns with societal values, balancing innovation with accountability and transparency. However, regulations will go only thus far.

13.66 The corporate sector has to display a high degree of social responsibility. Although the impact of AI on labour will be felt across the world, the problem is magnified for India, given its size and its relatively low per capita income. If companies do not optimise the introduction of AI over a longer horizon and do not handle it with sensitivity, the demand for policy intervention and the demand on fiscal resources to compensate will be irresistible. The state, in turn, has to resort to taxation of profits generated from the replacement of labour with technology to mobilise those resources, as the IMF suggested in its paper[71]. It will leave everyone worse off and the country's growth potential will suffer, as a result.

13.67 Utilising this window of time available during the nascent stages of AI to build robust institutions can ensure that we, as a nation, are well placed to minimise the costs as much as possible. This can then help tilt the scale towards the benefits, bringing a balance to the 'cost-benefit' aspect in a labour driven, services dependent economy like India. Navigating this transformation necessitate coordinated participation from all

71 Cazzaniga, M., Jaumotte, M. F., Li, L., Melina, M. G., Panton, A. J., Pizzinelli, C., ... & Tavares, M. M. M. (2024). Gen-AI: Artificial intelligence and the future of work. International Monetary Fund, https://tinyurl.com/33hjum83

agents of the economy. A tripartite compact between the government, private sector and academia can ensure that the gains from AI-driven productivity are widely distributed, taking us in the direction of the ideal inclusive growth strategy. The probability of success in this endeavour is directly proportional to the appreciation of the enormity of the challenge and the gravity of the consequences of failure.

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