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The Impact of Artificial Intelligence on the Labor Market in the Finance and Manufacturing Industry

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ABSTRACT

This paper examines the impact of artificial intelligence (AI) on the labor market within the finance and manufacturing industries. The primary objective is to identify the new skills required, the emerging types of jobs, and the extent to which these sectors will be affected by AI advancements. By employing the Solow growth model, the study forecasts potential economic outcomes and provides a framework to understand AI's influence on productivity and employment.

Keywords: Artificial intelligence, finance industry, manufacturing industry, jobs, Solow growth model

Introduction

The Dartmouth Conference in 1956 marked the introduction of artificial intelligence (AI), or the ability of machines to mimic human behavior to carry out intelligent tasks that resemble human duties. Artificial intelligence (AI) has advanced, opening up new possibilities, with the arrival of the big data era and information technology breakthroughs like cloud computing and 3D printing only accelerating its growth. AI is a versatile and practical technology that can be applied across various fields of social production. It represents an emerging scientific discipline with the potential to significantly enhance production efficiency. Scholars are actively exploring the implications of AI's rapid development on human society, contemplating its transformative effects on various aspects of life.

AI is a concept with ambiguous boundaries, making it somewhat challenging to define. However, one useful $definition^1$ is: "A machine-based system capable of influencing the environment by producing outputs—such as predictions, recommendations, or decisions—based on a given set of objectives. It utilizes machine and/or human-based data and inputs to: (i)

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perceive real and/or virtual environments; (ii) abstract these perceptions into models through automated analysis (e.g., machine learning) or manual methods; and (iii) use model inference to formulate outcome options. AI systems are designed to operate with varying levels of autonomy."

Applications with generative AI, such as ChatGPT, are becoming easier to use; they are frequently offered for free or at a discounted cost. Concurrently, there are more workers who possess the abilities needed to use these technologies. Between 2012 and 2019^{2} the workforce more than $Tripled^{2}$. The rise in productivity for employers is another important source of motivation. Because AI is an automation technology, it may increase productivity and save costs, giving organizations a competitive advantage. The belief among employers is that organizations who fail to adopt technologies like artificial intelligence (AI^{3}) may eventually become outdated and unable to compete in a future business environment. Additionally, it will enable firms to lower labor expenses. Concerns regarding job security in the upcoming years are shared by nearly 20% of workers in the industrial and banking sectors. Artificial intelligence's (AI) capacity to automate non-routine jobs sets it apart from earlier technologies. As a result, AI has made considerable progress in domains related to non-routine cognitive tasks, such as information ordering, memorization, perceptual speed, and deductive reasoning.

2. OVERVIEW OF AI IN THE LABOUR MARKET

Automation has transformed workplaces across industries. In banking, for example, repetitive tasks such as customer service, data input, and transaction processing are easily automated, resulting in significant cost savings and greater efficiency ($Brynjolfsson \ \& \ McAfee, 2014^{4}$). According to the McKinsey Global Institute, automation could cause the loss of 800 million jobs by 2030, including routine and predictable tasks ($Manyika \ and \ colleagues, 2017^{5}$). However, this change also creates new opportunities. Companies are increasingly looking for specialists to design, implement and manage these new technologies. This is translated into an increase in the demand for data analysis and automation management skills ($Acemoglu \ \& \ Restrepo, 2020^{6}$). Automation in manufacturing is often seen as a tool for enhancing productivity and increasing wages by supplementing human workers (Solow 1956).

The impact on the financial sector is more subtle. Some roles may be replaced by automation, and this may lead to stagnation or a decline in wages for these positions. The highly specialized and technical skills needed for AI development are higher wages. These contrast effects - the creation of high-skilled jobs and the potential decline of routine jobs - emphasize the importance of the development of a strategic labor force which will match the needs of the future labor market. In an estimate by the World Economic Forum, in 2025, automation could eliminate 85 million jobs globally and create 97 million new opportunities

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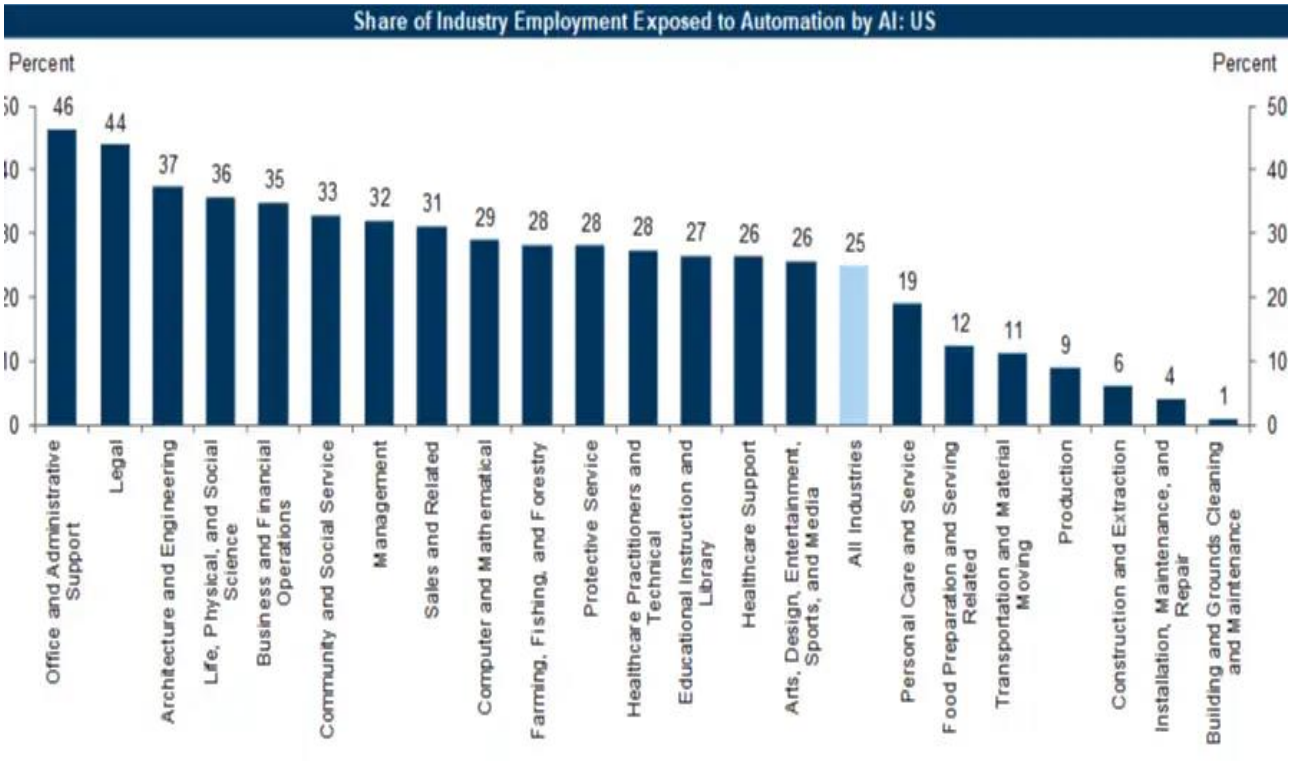
(*World Economic Forum*, 2020[7]), reflecting the destructive but transformative nature of automation.



(*credits*: *Hatzius*, 2023. *Goldman Sachs*.)

Much attention has been paid to how artificial intelligence (AI) will impact jobs and the economy. Progress has promised a boom in productivity and new jobs, but the potential for job losses and an expansion in the social division remains worrying. For example, in the recent Goldman Sachs report (*Hatzius*, 2023[8]), AI can improve global productivity and create new opportunities, but automation can also automate about 300 million jobs and pose a significant risk to the labor market. Similarly, British Telecom's plan to reduce 55,000 jobs by 2030, with AI replacing most positions (*Milanovic*, 2024[9]), highlights the potential disruption that AI can bring. Furthermore, the adoption of artificial intelligence could have a disproportionate impact on groups already facing challenges in the labour market.

Artificial intelligence must be evaluated from the perspective of gender and race (*Khan*, 2023[10]; *Gomez Herrera & Köszeg*, 2022[11]). Concerns are growing about the impact of gender, particularly in areas such as health and administration. Here, AI can improve the role of qualified persons (*Gopinath*, 2023[12]) and automate the routine tasks traditionally carried out

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by women (*Milanovic*, 2024[9]). This mirrors the previous trend that automated work replaced manual labor in industries such as car manufacturing.

However, new generation AI can handle non-routine cognitive tasks and poses even greater challenges by potentially automating the roles previously considered safe (*Hatzitz*, 2023[8]). Studies suggest that the more prevalent sectors of clergy and service work are women-dominated and are particularly vulnerable to AI-driven automation and may lead to gender inequalities (*Milanovic*, 2024[9]). Policy interventions and training programs are crucial to addressing these disparities, as well as to ensure a more equitable future for the employment market (*Collett et al.*, 2022[13]).

AI in the finance industry

The financial sector is undergoing a revolution driven by cutting-edge technology. One of the most prominent examples is algorithmic trading, where artificial intelligence (AI) plays a leading role. AI algorithms can sift through vast amounts of data, news, and market movements,, allowing them to react to changes in real time and execute transactions faster than humans. (Feng et al. (2021[14]))suggest that this approach not only improves the overall efficiency of the market, but also leads to better trading results.

Another area where AI has proven its worth is risk management. Financial firms have traditionally relied on human analysts to identify potential threats lurking in the market. Today, AI-powered systems can wade through massive data sets, spotting trends that could indicate fraud or other anomalies. According to (Peng et al. (2020[15])), these systems offer the significant advantage when providing real-time insights into portfolio and market conditions. This means better decision making, lower losses for financial institutions, and a more stable financial environment in general.

The impact of artificial intelligence extends beyond the back office AI-powered chatbots and virtual assistants are changing customer service, modifying the way people interact with banks and financial institutions. These systems can answer questions, provide personalized financial advice based on unique needs, and even complete transactions seamlessly. (*Liu et al.* (2021))[16]highlights how AI improves customer satisfaction by providing 24/7 support and customized solutions. Finally, AI can help financial institutions improve their operations and achieve significant savings. By automating repetitive tasks such as data entry and processing, AI frees up human resources to focus on more strategic roles. This means leaner operations and significant savings. In a competitive market where efficiency is key, these cost savings give financial institutions a significant advantage and improves profitability when compared to competition.

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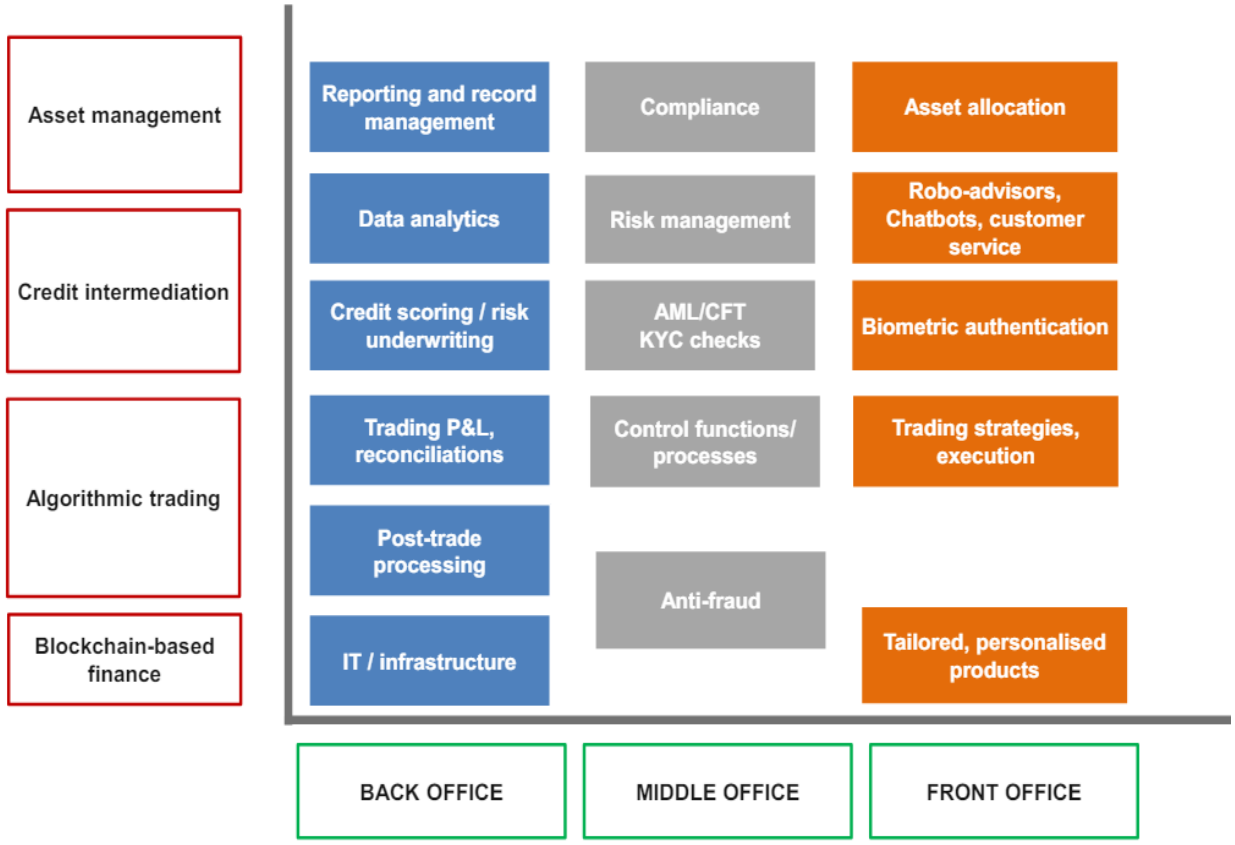
Despite these developments, integrating artificial intelligence into the field of finance remains challenging. Important factors to consider are data protection, regulatory compliance and the ethical implications of an AI decision ($Liu\ et\ al.(2021)$)[16].Identify the challenges and utilize AI to enhance accountability, transparency, and confidence in financial management. This is crucial for financial institutions. Thanks to continuous improvements in machine learning, natural language processing, and predictive analytics, the future of artificial intelligence in banking looks bright. These developments are expected to improve AI's ability to evaluate complex financial data, more accurately predict market trends, and automate increasingly complex financial processes ($Feng\ et\ al.,2021$)[14].



Source: OECD staff illustration.

The banking and financial services industry is undergoing a major AI-driven metamorphosis fueled by the proliferation of big data, technological advances in infrastructure, increased regulation, and increased competition..The use of AI-based analytics has become widespread among banks, which are responding to customer demands for personalized services through analyzing both structured and unstructured data. This enables a complete 360-degree view of the customer interaction, which improves decision-making and customer experience

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$(McKinsey, 2021)^{17}$. Computing capabilities have been transformed by a robust infrastructure that includes cloud computing and high-speed processors. Thanks to this infrastructure, banks can successfully implement AI solutions, increasing scalability, efficiency and reducing costs $(Gartner, 2021)^{18}$. By leveraging AI-based automation, banks can meet strict regulatory requirements faster by speeding up data collection and reporting information which would not be possible otherwise $(Deloitte)^{19}$.

In addition, due to competition in the industry, banks need to constantly innovate, especially fintech companies. Artificial intelligence is a key element that banks can use to improve existing services while also providing a personalized customer experience that is less time consuming $(Accenture\ 2021)^{20}$.

To ensure future readiness and continuous innovation, this change will require strategic investments in AI technology as well as reforms to the current legislative framework $(PwC, 2021)^{21}$.The BFSI industry is at the forefront of the digital revolution, and it is well-positioned to leverage AI to generate business value and simplify the challenges of a constantly evolving financial world.

Financial advisors are increasingly using Natural Language Generation (NLG), a subset of artificial intelligence that unifies and improves client data and reporting. By simplifying complex data sets into stories that are easy to read, this technique improves customer satisfaction and engagement (Gould, 2016). Machine learning (ML) models can improve risk management for investment managers and large institutional investors by estimating portfolio performance across various market and economic conditions, and monitoring thousands of risk factors daily.

This is particularly advantageous in 2020 $(PwC)^{21}$. The operational benefits of artificial intelligence include a significant reduction in background costs for investment managers as additional costs are greatly decreased . Artificial intelligence can automate labor-intensive matching procedures that traditionally take a long time, increasing efficiency and reducing costs, largely helping human resource management as well $(Accenture, 2020)^{21}$. Asset managers can receive smart stock selection and portfolio assignment recommendations tailored to specific AI techniques that combine big data with ML models $(McKinsey\ and\ Company, 2021)^{17}$

Data has changed the role that AI plays in investment management; traditional datasets are now viewed as commodities that are available to all investors. Data is being used by asset managers to obtain novel insights during the investment process. The financial industry is currently using enormous volumes of raw, unstructured, and semi-structured data to obtain a new edge. Historically, the financial industry has depended on information and data as the basis of investment strategies $(Deloitte, 2019)$ [22].

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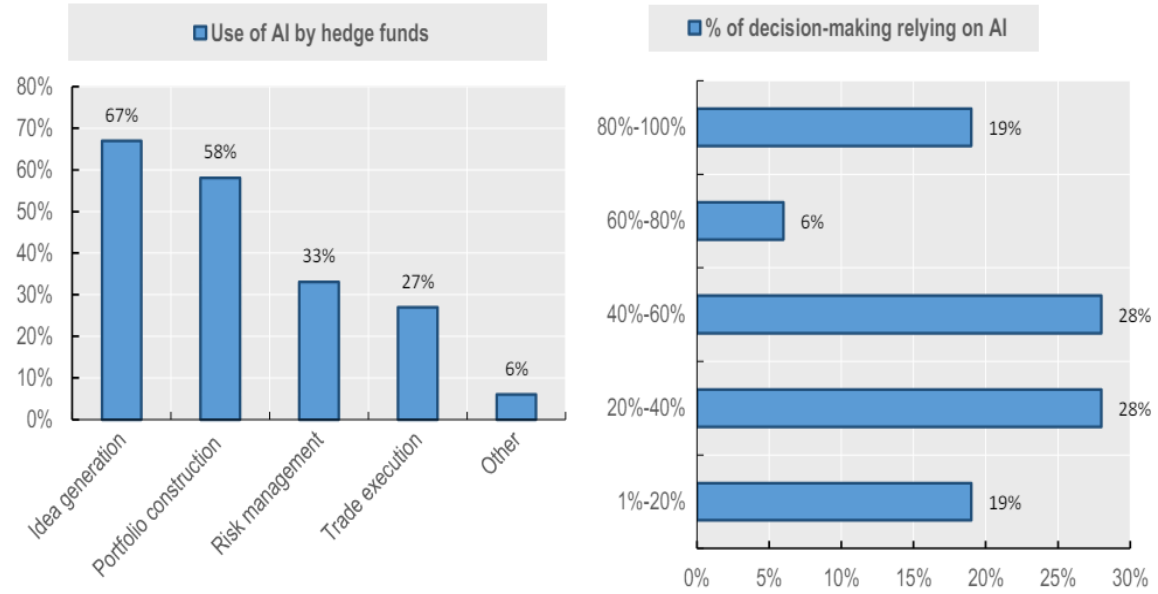

Note: Based on industrial research by Barclays, as of July 2018.
Source: (BarclayHedge, 2018[17]).

Previously, asset managers had focused on structured data and had focused on asset management techniques, but new AI tools allow them to process and evaluate data sources quickly. This function provides them with a significant competitive advantage that can quickly inform strategy $(Boston\ Consulting\ Group, 2021)^{23}$. A fast adoption of artificial intelligence and the interpretation of massive amounts of data will enable investment managers to make more timely and informed decisions on investments, including information from multiple sources, which will improve market performance.

Hedge funds are at the forefront of the FinTech Adoption Curve $(Kaal, 2019)^{24}$. Those that focus exclusively on AI and ML have recently been called "AI pure play" hedge funds. Numerai, Aidiyia Holdings, Cerebellum Capital and Taaffeite Capital Management are some notable examples $(BNY\ Mellon, 2019)^{25}$.

Trading AI-enabled solutions help traders manage orders and risk. The AI-powered program can monitor risk exposure and automatically change or delete investments in response to user requirements. These systems manage broker trade flows, regulate the allocation of fees and liquidity based on different factors (i.e. regional market preferences and currency determinations), and train autonomously, reacting to market changes with little human assistance $(Bloomberg, 2019)^{12}$. The commercialization of AI-managed instruments is different from systematic instruments, as traditional systematic techniques require extensive human intervention to change parameters. AI models reinforce learning to adapt to changes in market conditions.

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When trends change, traditional backtest techniques based on historical data often fail to provide meaningful returns in real time.

Consequences

If traders begin to use large-scale similar AI models, market stability and competitiveness may be negatively affected. If more traders use the same model, arbitrage opportunities will be reduced, resulting in lower margins. Ultimately, this phenomenon would benefit consumers by resulting in a narrow bid-ask spread. However, this similarity may also cause herd behavior and convergence, which may lead to one-way markets which are less liquid and stable, especially in times of crisis. The potential for self-reinforcing feedback loops to cause abrupt price swings is of concern $(BIS\ Market\ Committee, 2020)^{27}$. Because it is now simpler for cybercriminals to target agents with similar characteristics than autonomous individual agents, convergence also raises the risk of cyberattacks. Malicious actors may increase cyber dangers by automatically attacking other financial market participants' trading systems through artificial intelligence (AI) $(ACPR, 2018)^{28}$.

Commercial traders keep a competitive edge by using proprietary models that are difficult to replicate, resulting in deliberate transparency and unexplained machine learning models (MLs). The Surveillance Of machine learning algorithms may be complicated by users' refusal to reveal the inner functioning of models $(OECD, 2017)^{30}$. Algorithms can also lead to collusion, which makes it easier to maintain and observe collusion in the digital markets. This increases the possibility that systems driven by AI will intensify illicit activities such as "spoofing", making it more difficult for supervisors to identify whether machines are colluding $(OECD, 2017)^{30}$.

Further, machine learning models cannot explain their results. The AI-driven trading algorithms do not easily reveal which parameters affect the results, unlike the conventional linear process where the correlation of cause and effect is evident. When trading performance is poor, traders must decompose the output to identify factors influencing their decisions; they then make necessary adjustments.

The problem of " garbage in , garbage out" affects AI and ML-based risk assessment algorithms as does other financial models. This occurs when models are trained with insufficient data, including incomplete data sets, human bias data, and incorrect classification data $(S\&P, 2019)^{31}$. A neural network trained on high-quality data, but subsequently fed with inadequate data, can produce dubious results despite the strong fundamental algorithms. Even a neutral machine learning model, which is trained with insufficient data, can produce erroneous results. It is difficult to detect inappropriate data use and inadequate data in artificial intelligence applications, as many machine learning algorithms are essentially unknown. Unsuitable or low-

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quality data may lead to a distortion of decision-making. Intentional or unintended biases occur when algorithms use neutral data points as a starting point for traits such as gender or ethnicity, avoiding the application of non-discrimination laws $(Hurley, 2017)^{32}$. For example, credit officers may remove gender-based data points from models; however, models may use gender-derived transactions to determine creditworthiness and circumvent regulatory protections. In addition, prejudices within external data sources that machine learning models learn can strengthen past prejudices by integrating them into decision-making processes.

Because they cannot be explained, financial ML and artificial intelligence models also have problems of transparency, making it difficult to understand, duplicate, or follow decision-making procedures. This lack of transparency is particularly worrying in areas where justice and accountability are in question, such as credit decisions and other crucial financial desicions , and it is essential to understand the reasons for the decision.

The widespread use of artificial intelligence and machine learning systems is still under discussion, but it represents a fundamental change in the financial sector. The algorithms are carefully designed and tested to improve efficiency, facilitate risk assessment and management, ensure regulatory compliance, and provide new tools for prudential monitoring and implementation $(Financial\ Stability\ Council, 2017)^{33}$.

In addition, artificial intelligence systems have new and distinct risks due to their opaque decision-making processes, manipulation vulnerabilities, and privacy concerns $(European\ Central\ Bank, 2020)^{34}$. The dynamic nature of AI in banking implies that the benefits and disadvantages of all these technologies are still not fully understood by stakeholders, including consumers, technology suppliers, developers and regulators.

As a result, regulatory organizations need to monitor and monitor operations more closely and more prudently $(World\ Economic\ Forum, 2020)^{35}$. Due to AI being relatively new the limitations arent completely identified yet.

b). AI in the manufacturing industry

Gaining an understanding of the distinctions between artificial intelligence (AI) and machine learning (ML) in the manufacturing industry is crucial to appreciating their diverse applications and capacities. These include seeing, reasoning, solving problems, interpreting natural language, and making decisions $(European\ Commission, 2018)^{36}$. It aims to replicate cognitive functions of humans and adapt to different settings. But machine learning (ML) is concerned with algorithms that use statistical methods to analyze data, learn from it, and produce predictions or conclusions $(Goodfellow\ et\ al., 2016)^{37}$.

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Artificial intelligence (AI) systems are designed to interact with humans through natural language interfaces or other methods in order to increase their usability and flexibility in complex production contexts $(Russell\ \&\ Norvig, 2022)^{38}$. Artificial intelligence (AI) development merges various subjects, such as computer science and cognitive science, whereas machine learning (ML) research concentrates on algorithmic design and data processing approaches $(Bishop, 2006)^{39}$. This distinction demonstrates how AI's wider scope enables more advanced problem-solving skills and interactive functionalities, in contrast to the more specialized approach of machine learning in manufacturing applications.

One application of artificial intelligence (AI) in the manufacturing industry is machine learning (ML). Its main goal is to develop algorithms with the ability to learn from data and render decisions or predictions. In manufacturing, machine learning is critical for roles such as demand forecasting, quality assurance, and predictive maintenance. These algorithms identify patterns and trends by analyzing previous data, which increases operational performance and reduces costs. Machine learning algorithms, for instance, can evaluate sensor data from production lines to find anomalies or predict maintenance needs in order to minimize downtime and maximize resource allocation $(Sriram\ \&\ Radhakrishnan, 2020)^{40}$.

However, artificial intelligence (AI) covers a wider variety of skills than machine learning (ML), such as computer vision, and autonomous decision-making. AI-driven manufacturing systems leverage cutting-edge technologies to boost overall production agility and have the ability to optimize supply networks, as well as automate complicated procedures. They analyze data using machine learning (ML) as well. This broader application of AI helps industrial facilities to quickly react to changes in market circumstances and demand by using real-time data and adaptive decision-making $(Varia, 2019)^{42}$.

AI and ML are critical to transforming industrial operations because they can both build smarter, more responsive production environments. Using AI and ML technology, manufacturers can obtain a competitive advantage in the global market and boost production, quality, and operational efficiency.

Artificial intelligence (AI) has emerged as a disruptive force in the industrial sector, changing everything from production and quality control to supply chain management and workforce efficiency. Artificial intelligence (AI) technology such as robotics, computer vision, and machine learning are helping manufacturers increase overall productivity, efficiency, and creativity. This essay explores the intricate implications of artificial intelligence on manufacturing, drawing evidence from a range of sources.

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AI's ability to analyze massive volumes of data in real-time, which enables automated procedures and predictive insights that enhance operational outcomes and decision-making, is what drives its integration into manufacturing operations. Predictive maintenance is one of the main uses, in which AI systems examine sensor data from equipment to identify problems before they happen. Predictive maintenance, according to McKinsey, can cut maintenance expenses by as much as 40% and equipment downtime by 50% $(McKinsey, 2021)^{43}$. By optimizing asset use and minimizing disruptions, this proactive approach results in significant cost savings and operational efficiencies.

Another crucial area where AI shines is quality control. Artificial intelligence (AI)-driven vision systems are able to identify product flaws faster and more accurately than human operators, even in terms of consistency. This competence is essential for guaranteeing product quality and cutting waste during the production process. According to McKinsey, AI-driven quality control can increase defect detection rates by up to 90%, which would boost operational effectiveness and customer satisfaction $(McKinsey, 2021)^{43}$.

Artificial Intelligence (AI) technologies facilitate supply chain optimization and predictive analytics. Deloitte notes that artificial intelligence (AI) can lower overall supply chain costs by 10% to 40% and increase demand forecasting accuracy by up to 60% $(Deloitte, 2021)^{45}$. Artificial intelligence (AI) algorithms assist firms in forecasting demand changes, optimizing inventory levels, and minimizing supply chain interruptions by assessing historical data and external factors in real-time. Proactive management increases resilience against market uncertainties and boosts efficiency.

Collaborative robots, or cobots, are working alongside human workers in a safe and effective manner thanks to the integration of AI with robotics and automation, which is changing manufacturing operations. According to Robotics Online, AI-driven automation improves manufacturing processes' flexibility and agility, enabling quick adjustments to shifting production needs while enhancing worker productivity and safety $(Robotics\ Online, 2021)^{46}$. This fusion of robotics and AI highlights how automation has the power to revolutionize contemporary industry settings.

There are many advantages of using AI in manufacturing. First of all, it increases productivity by simplifying processes and allocating resources as efficiently as possible. Second, by cutting cycle times and freeing up human workers for more strategic duties, AI-driven automation increases productivity. Thirdly, through enhanced supply chain management, predictive maintenance, and better asset usage, AI technologies help cut costs. Finally, AI stimulates innovation by allowing producers to quickly create new goods and procedures in response to consumer needs.

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The application of AI in manufacturing presents difficulties even with its advantages. Data security and privacy are major concerns because collecting and analyzing vast amounts of data creates problems with cybersecurity and regulatory compliance. There are also employment ramifications, including as the requirement for personnel to retrain and upskill in order to use AI technology for operation and collaboration. In order to fully utilize AI's potential and ensure its ethical and sustainable implementation in manufacturing environments, it is imperative that these issues be resolved.

Artificial intelligence significantly improves natural language understanding and translation capabilities, simplifying communication between employees and software systems. This feature allows software to interpret user intent more intuitively, making systems more user-friendly and reducing errors. For example, AI-enabled systems can allow users to search for information directly instead of navigating complex menus, which improves productivity and user satisfaction ($Rane\ and\ Nitin\ 2023\ )^{46}$.The impact of AI on the industry is profound, building on decades of technological advances such as drones and industrial robots. With the help of artificial intelligence integration, it is possible to achieve significant progress, especially in light inventory management and cost reduction of production processes. However, this change requires the seamless integration of supply chain management, engineering teams, production lines and quality control into intelligent systems that provide actionable insights $(Davenport\ and\ Ronanki, 2018)^{47}$. Emerging trends in artificial intelligence may transform manufacturing in unexpected ways.

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For example, AI-based computer vision technologies are revolutionizing quality assurance by detecting product defects in real time, which optimizes data flow and reduces manual data entry. It can simplify processes such as inventory management by automatically updating inventory transactions based on real-time visual data captured by cameras $(Shin\ et\ al., 2018)^{48}$.In addition, artificial intelligence combined with the Internet of Things (IoT) is transforming manufacturing with advanced connectivity and data analytics capabilities. IoT devices provide real-time telemetry data that AI systems can analyze to improve product quality and predict defects, leading to improved manufacturing processes. This synergy enables AI to optimize generative design processes, facilitating the creation of innovative product designs based on evolving market and operational data $(Autodesk)^{49}$.

Business costs include various costs incurred during the business process, excluding direct production costs. These costs include transportation costs and information-processing costs $(World\ Trade\ Organization)^{50}$. Artificial Intelligence (AI) plays a crucial role in mitigating these business costs by improving efficiency and decision-making at various business stages. Artificial intelligence significantly reduces information retrieval costs for businesses using technologies such as big data and the Internet of Things (IoT). These advances allow rapid collection and analysis of data related to the production, consumption and transportation of export goods. Unlike traditional methods that rely on timed feedback, AI allows manufacturing companies to dynamically adjust production structures based on real-time consumer behavior data. Similarly, AI enables supply chain companies to track products in transit, optimize logistics decisions and select the most appropriate upstream and downstream partners, improving overall supply chain efficiency $(McKinsey\ and\ Company)^{43}$. In addition, smart logistics systems based on artificial intelligence play a key role in reducing transportation costs. These systems use advanced algorithms to quickly identify, analyze and process logistics information. By dynamically adjusting transport routes and optimizing resource allocation, artificial intelligence can help minimize transport costs and improve overall logistics efficiency $(Deloitte)^{44}$.

Developing AI/ML [51] applications in manufacturing often involves accessing data stored on servers (historians) located within plant control rooms. However, this presents a significant cybersecurity risk, as malicious actors could exploit these access points to launch cyberattacks on industrial control systems, potentially leading to severe financial costs and safety hazards due to equipment malfunctions. In 2020^{52}, the global average cost of a data breach was reported to be $3.86 million, highlighting the financial impact of such incidents. By 2021^{52}, this average cost had risen to $4.35 million globally, with even higher costs in the United States averaging around $8.5 million. While general cybersecurity solutions are available to mitigate these risks , deploying AI-driven security solutions has shown potential to reduce data breach costs by up to

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70% . However, the evolving nature of cybersecurity threats necessitates continuous adaptation and enhancement of security measures.

Research into safety systems and human-machine interaction involves the use of human data and monitoring of employees, raising concerns about employee privacy . It is crucial that data involving employees is securely stored, anonymized, and used in a manner that respects their rights.

AI expands capabilities such as natural language interaction and autonomous decision-making, while ML focuses on data understanding and algorithmic learning, collectively driving innovation and operational excellence in industrial environments. Balancing these advances with strong cybersecurity measures and ethical considerations remains critical to maximizing the benefits of AI/ML[52] and mitigating the associated risks.

3. Analysis of AI Applications

Manufacturing industry

➔ Supply chain management

Businesses are modernizing their supply chain processes and gaining considerable efficiency, accuracy, and cost savings by utilizing artificial intelligence (AI)[54] technologies.Supply chain management with artificial intelligence may leverage predictive analytics, maximize inventory, enhance demand forecasting, and simplify logistical $processes$[53].$Walmart$,[55] the well-known retail behemoth, makes extensive use of artificial intelligence in supply chain management to boost output and customer happiness. The business uses machine learning algorithms for inventory management, demand forecasting, and analysis of past sales data. $Walmart$[56] lowers extra storage costs, lowers inventory levels, and guarantees product availability by utilizing AI-based demand forecasting. Additionally, $Walmart$[57] uses AI-driven routing algorithms to improve its logistics, offering delivery alternatives that are both faster and more affordable. The incorporation of artificial intelligence into Walmart's supply chain operations serves as an example of how cutting-edge technologies may boost overall supply chain agility, raise accountability, and improve decision-making in the fiercely competitive retail sector.

implications of labour: Automation and artificial intelligence systems eliminate the need for manual labor for repetitive tasks, freeing up workers to concentrate on more difficult and valuable jobs. This technology has also had an impact on the workplace. Workforce dynamics are the result of the increased requirement for qualified personnel who can manage, maintain, and upgrade AI systems, even though certain routine activities can be outsourced.

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➔ Management

Inventory management is an important use of artificial intelligence in manufacturing warehouses. AI algorithms, including demand forecasting and predictive analytics, can accurately predict future demand by looking at past sales data, current inventory levels and market patterns. This allows warehouses to maintain optimal inventory, which reduces transportation costs and ensures product availability when needed. Tools used to achieve these goals include Amazon's Forecast and $IBM's\ Watson\ Supply\ Chain$.[58]

BMW, for example, uses artificial intelligence automated guided vehicles (AGV) to improve internal logistics in its manufacturing warehouses. By automating the movement of raw materials and finished products along predetermined routes under the control of artificial intelligence and machine learning algorithms, these automated forklifts significantly improve inventory management and work visibility. Automated forklifts are being used to improve logistics in warehouses using technologies such as Vision-Guided Vehicles and Kiva Systems from $Seegrid$[60], now part of $Amazon\ Robotics$.[59]

Labour implication: Labor requirements might change as a result of automated technologies and artificial intelligence in inventory management. These innovations can decrease the need for manual labor to complete repetitive activities and increase the need for specialized people to oversee and maintain these cutting-edge systems. Additionally, in order for humans to properly communicate and collaborate with AI-driven technologies and systems, this transition may necessitate workforce retraining and upskilling.

➔ Predictive maintenance

Artificial intelligence has transformed manufacturing processes through $predictive\ maintenance$[61]. By using advanced predictive analytics and artificial intelligence (AI), manufacturers may improve maintenance schedules, minimize downtime, and anticipate equipment faults.

One of the fundamental concepts of predictive maintenance is the digital twin. A $digital\ twin$[62] is an electronic copy of a real-world object that records data in real time and behaves like the genuine thing in a virtual setting. When paired with sensor data, artificial intelligence can analyze patterns, spot abnormalities, and forecast malfunctions.

$Ford$[63] is a great example of AI-based predictive maintenance using digital twin technology. Ford creates different digital twins for each vehicle model, each focusing on a different aspect of production – from concept to manufacturing to operations. These digital models also extend to manufacturing processes, manufacturing facilities and customer experiences. The digital twin of

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these production facilities accurately identifies energy efficiency and recommends energy saving targets, improving overall production line performance. Reduce the need for routine manual checks and fixes by focusing more on technical roles that involve monitoring and managing AI systems. This transition requires improving workforce skills to manage advanced $technology^{61}$ and interpret data analysis, creating opportunities for specialized training.

➔ Quality assurance

$Businesses^{43}$ are revolutionizing their quality control procedures to reach previously unheard-of levels of precision and consistency by utilizing AI in production. Manufacturers may examine photos or videos of goods and components using computer vision algorithms to find flaws, irregularities, and departures from quality standards with a remarkable level of precision that far exceeds human skills.

One of the best examples is $Foxconn^{64}$, a well-known electronics firm that has improved quality control by $integrating\ AI^{66}$ and computer vision technology into its manufacturing lines. By analyzing photos and videos, Foxconn's AI algorithms quickly and effectively detect defects in electrical components, guaranteeing that the company's goods live up to strict quality requirements. In addition to increasing manufacturing accuracy and efficiency, this use of AI in quality control helps $businesses^{65}$ such as Foxconn manufacture high-quality products at scale in the quickly changing electronics sector. Labour implications: has an effect on labor by lowering the demand for manual inspection duties, which might result in a decline in some employment categories. But it also opens up new doors for highly skilled jobs involving the creation, administration, and upkeep of AI systems. To manage these cutting-edge technology, workers will need to retrain or upskill, which will cause a shift in the manufacturing sector toward more technical and analytical employment.

There are multiple other ways in which artificial intelligence can be utilized in the manufacturing industry; these are just a few examples. The scope of AI has not completely been defined therefore the application in this industry is limitless.

Finance industry:

➔ Fraud detection and prevention

By $applying\ AI^{68}$ to finance, companies are transforming their fraud detection processes to reach previously unheard-of levels of accuracy and consistency. With the use of machine learning algorithms, financial institutions may analyze transactional data and customer behavior to detect unusual activity, suspicious activity, and departures from standard patterns with an unprecedented level of precision that surpasses human skills. The well-known online payment

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company $PayPal^{67}$ is one of the biggest examples. $PayPal^{67}$ has improved fraud detection by adding artificial intelligence and machine learning to its transaction tracking systems. $PayPal's^{67}$ AI algorithms quickly and accurately detect fraud by looking at transaction data and user behavior, ensuring compliance with the platform's strict security guidelines. In addition to improving efficiency and accuracy, the use of artificial intelligence in fraud detection helps companies like $PayPal^{67}$ prevent large-scale fraud in the rapidly changing financial industry.

Labor is impacted by AI integration in finance since it eliminates the need for jobs involving trade execution and human transaction monitoring, which might result in a reduction in some employment categories. On the other hand, it also opens up $new\ career\ paths^{69}$ for highly qualified professionals with experience in managing, developing, and maintaining $AI\ systems.^{70}$

➔ Customer service and support

In the banking sector, artificial intelligence is also revolutionizing customer service. Financial institutions may offer 24/7 service, manage client questions more effectively, and tailor consumer interactions by utilizing chatbots and virtual assistants driven by AI. $Erica^{71}$, the AI-powered virtual assistant from Bank of America, is a perfect illustration. In addition to making payments and monitoring account balances, Erica assists clients with a range of chores and offers tailored financial guidance. This AI technology improves customer satisfaction by providing personalized, accurate, and timely service.

Labour implications: With AI-powered customer care, fewer regular manual support positions are required, freeing up time for monitoring and improving AI systems. As a result of this shift, there will be more possibilities for specialized training in order to run cutting-edge technology and analyze client data.

➔ Credit scoring and risk assessment

By using machine learning algorithms to evaluate massive amounts of data, including non-traditional data sources, to assess creditworthiness and more accurately predict default risks, AI is revolutionizing credit rating and risk assessment procedures in the banking industry. One well-known example is $ZestFinance,^{72}$ a company that uses machine learning to provide more comprehensive credit scoring models. For people who may not be served by traditional credit scoring techniques, $ZestFinances,^{72}$ algorithms examine a variety of data points, including payment history, work history and even social media. This leads to more accurate credit ratings.When artificial intelligence is used for credit scoring, there is less need for manual data analysis, which is why some traditional $risk\ analysis\ stations\ fall.^{73}$

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On the other hand, it creates new opportunities for tasks that focus on managing and creating AI models. To acquire this cutting-edge technology, employees will need to retrain or upgrade their skills, leading to a shift in the banking industry to a more technical and analytical role.

➔ Personalized Financial Planning

AI will significantly enhance personal financial planning by using state-of-the-art analytics and machine learning to deliver tailored investment plans and financial advice. Large amounts of data, including market movements, financial indicators, and individual financial behavior, are analyzed by these AI-powered systems to deliver consumers individualized suggestions that align with their $financial\ objectives$[74]. Wealthfront is a robo-advisory platform that offers automated and customized investing advice with artificial intelligence. An excellent use of artificial intelligence in personal financial planning is this one. A diverse investment portfolio is created and maintained by Wealthfront's AI algorithms depending on the financial status, risk tolerance, and long-term objectives of its clients. The platform keeps an eye on the portfolio and modifies it as necessary to suit the needs of the customer and the state of the market. Personal financial planning with the integration of artificial intelligence eliminates the need for typical financial advisors who deal with simple portfolio management tasks. Rather, it opens up new opportunities for financial professionals to specialize in AI system management, advanced data analytics and AI-based strategic advisors. This shift will require workforce retraining and upskilling to handle and understand AI-driven offerings, resulting in a more technically and analytically capable $banking\ workforce$.[75]

There are multiple other ways in which artificial intelligence can be utilized in the finance industry; these are just a few examples. The scope of AI has not completely been defined therefore the application in this industry is limitless.

4. Solow Model

The original Solow Growth Model, developed by $Robert\ Solow\ in\ the\ 1950s$,[76] explains long-term economic growth by examining capital accumulation, labor growth, and technological progress. The model uses a production function to describe how output is generated from these inputs. In the $Solow\ model$[76], technology plays a crucial role as an exogenous factor that shifts the production function upward over time, leading to higher levels of output per worker. Technological progress is considered external to the model, meaning it is not influenced by the economic variables within the model but is essential for sustained growth. This progress enhances the productivity of both capital and labor, driving long-term economic growth beyond what could be achieved through capital accumulation and labor expansion alone. The $model$[76] uses a production function to describe how output is generated from these inputs. Typically, the

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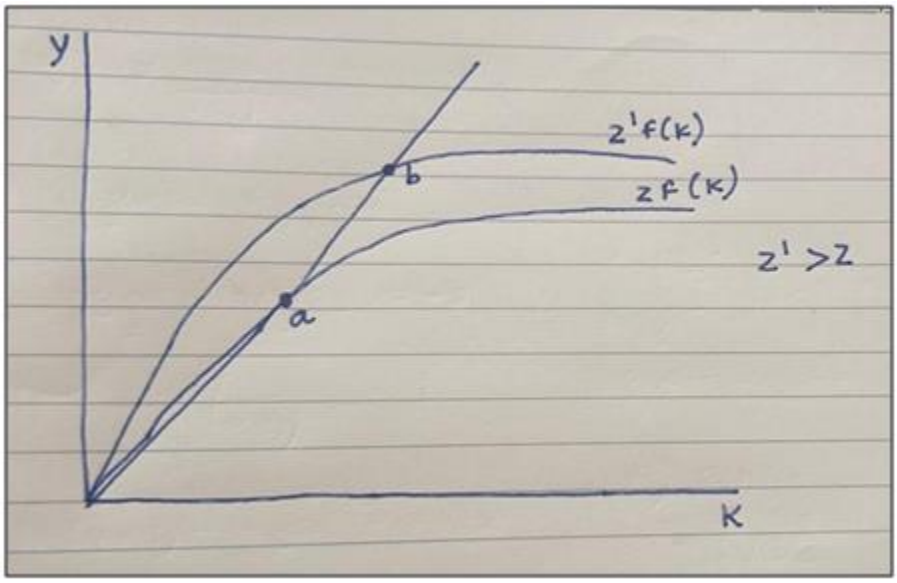
x-axis of the Solow model graph represents capital per worker (K/L), while the y-axis represents output per worker (Y/L).

Manufacturing industry

In the manufacturing industry, the implementation of AI has led to a significant increase in output levels per worker, demonstrating a complementary relationship where AI aids both worker productivity and capital utilization. This trend suggests that AI technology enhances the capabilities of workers, allowing them to perform tasks more efficiently and effectively, thereby boosting overall productivity.



However, examining this phenomenon through the lens of the original Solow Growth Model presents some limitations. The Solow model analyzes economic growth by focusing on the accumulation of capital and technological progress, with each value on the graph represented in per capita terms. This approach effectively illustrates how technological advancements, such as AI, can shift the production function upwards, indicating a more productive economy overall.

Despite this, the Solow model's representation in per capita terms does not explicitly account for the specific role of labor and how it interacts with technology and capital in the production process. While it shows that the economy is more productive on a per-worker basis, it abstracts away from the detailed dynamics of labor's contribution and the complementary role of AI. The model treats technological progress as an exogenous factor that boosts productivity uniformly, without distinguishing between the direct impact on labor and capital.

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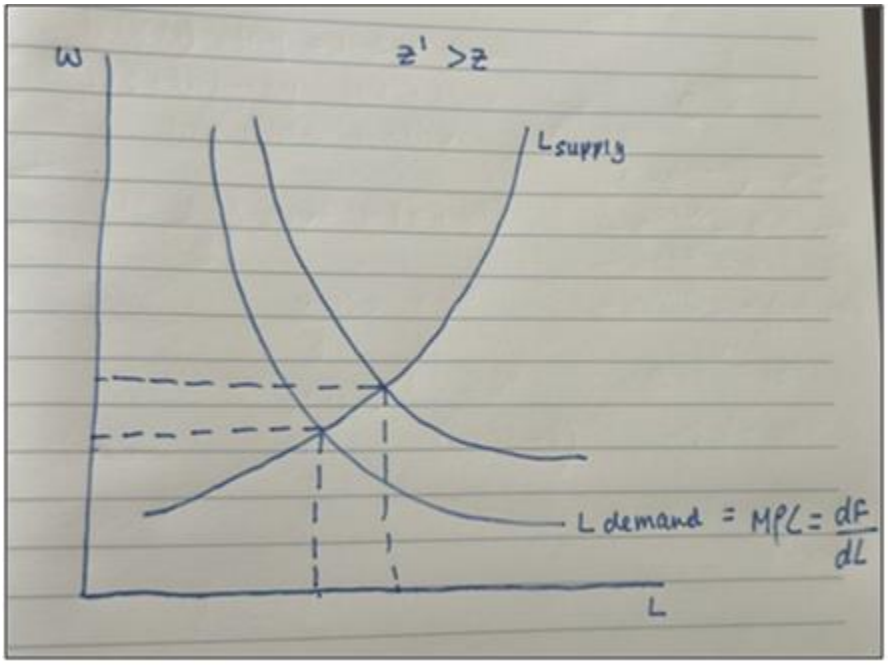
In reality, AI in the manufacturing industry does not just enhance capital but also fundamentally changes the nature of labor itself. Workers are not merely passive recipients of productivity gains; instead, they actively interact with AI systems, learning to use them and adapting their skills accordingly. This dynamic interplay between labor and AI is crucial for understanding the full impact of technological progress on the economy.

In the original Solow curve, as shown in fig 1.1, the x axis represents the capital and the y axis represents the output. This technological progress is represented by a shift from the initial production function f(K/L) to a new, higher production function z'f(K/L), where z' indicates the enhanced productivity level due to Al. Consequently, the economy moves from an initial equilibrium point, point A, to a new equilibrium point, point B, on the z'f(K/L) curve. This shift signifies higher output levels per worker for any given level of capital per worker, reflecting the productivity gains brought about by AI.

Therefore, while the Solow model provides valuable insights into the aggregate. effects of technological progress, it does not fully capture the nuanced role of labor in the context of AI implementation to address this gap, it may be necessary to incorporate additional models or frameworks that explicitly consider the interactions between labor, capital, and technology. For instance in Fig 1.2 the x



Axis represents the labour quantity and the y axis represents the wage rate. From the basic solow model we can derive this model as if we differentiate the original capital by worker (K/L) in

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terms of labour with the addition of Z (which represents technology and more specifically AI) we then get the marginal product of labour which shows the downward sloping labour demand curve with regards to wage.

$$F(K, L) = ZK^{\alpha}L^{1-\alpha}$$

$$Y = total\ output$$

$$Z = \ technology$$

$$K = capital\ stock$$

$$L = quantity\ of\ labour$$

$$F = \ production\ function$$

$$\alpha = \ output\ elasticity\ of\ capital$$

The MPL is the additional output produced by an additional unit of labor, holding capital constant.

$$MPL = \frac{\partial F(K, L)}{\partial L}$$

$$F(K, L) = ZK^{\alpha}L^{1-\alpha}$$

$$MPL = \frac{\partial ZK^{\alpha}L^{1-\alpha}}{\partial L}$$

$$MPL = \frac{\partial}{\partial L}(ZK^{\alpha}L^{1-\alpha}\ \ )$$

We take the partial derivative with respect to L

$$MPL = ZK^{\alpha} \cdot \frac{\partial}{\partial L}(L^{1-\alpha})$$

$$\frac{\partial}{\partial L}(L^{1-\alpha}) = (1-\alpha)L^{(1-\alpha)-1} = (1-\alpha)L^{-\alpha}$$

$$MPL = ZK^{\alpha} \cdot (1-\alpha)L^{-\alpha}$$

Based on the power rule

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$$MPL = (1-\alpha)ZK^{\alpha}L^{-\alpha}$$

The labor demand curve is derived from the MPL. Since firms hire labor up to the point where the wage rate (W) equals the MPL, the labor demand curve is downward-sloping, indicating that higher wages lead to lower quantities of labor demanded.

This derivation can further be simplified to

$$W = MPL = (1-\alpha) * Z * (\frac{K}{Z})^{\alpha}$$

In the basic Solow model, an increase in technology leads to higher GDP per capita, higher wages, and greater labor participation. When considering the manufacturing industry, the implementation of AI follows this principle but adds specific dynamics that further illustrate the model's predictions.

➔ **Higher GDP per $Capita^4$**

- In the manufacturing industry, AI enhances various processes, from production planning and supply chain management to quality control and maintenance. For instance:
  - Production Planning: AI optimizes production schedules and resource allocation, reducing downtime and increasing throughput.
  - Supply Chain Management: AI improves logistics, predicts demand, and manages inventory more efficiently, leading to cost savings and higher output.

These improvements collectively boost the overall productivity of the manufacturing sector, leading to higher GDP per $Capita^4$

***Higher Wages*[77]**

- As AI technology boosts productivity in the manufacturing industry, the marginal product of labor (MPL) increases. Workers can produce more output per unit of input, making their labor more valuable. Consequently, firms are willing to pay higher wages to attract and retain skilled workers who can effectively collaborate with AI systems. Examples include:
  - Skilled Machine Operators: Workers who can operate and manage AI-enhanced machinery are in higher demand and command higher wages.

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- AI Maintenance Technicians: Specialists who can maintain and troubleshoot AI systems are critical, leading to higher compensation for these roles.

➔ ***Increased Labor Demand***[78]:

◆ Contrary to fears that AI might reduce the need for human labor, in the manufacturing industry, AI is viewed as a complement to human workers rather than a substitute. This complementary relationship results in several positive outcomes:

- Enhanced Worker Productivity: AI systems take over repetitive and dangerous tasks, allowing human workers to focus on more complex and creative aspects of manufacturing. This leads to increased job satisfaction and productivity.
- New Job Creation: The integration of AI creates new job categories, such as data analysts, AI system integrators, and automation supervisors. These roles require new skills and typically offer higher wages.

➔ ***Job Creation and Transformation***[79]

◆ The introduction of AI in manufacturing leads to the creation of new roles and the transformation of existing ones:

- AI System Integrators: Professionals who integrate AI solutions into existing manufacturing processes, ensuring seamless operation and efficiency.
- Data Analysts: Specialists who analyze data generated by AI systems to optimize production processes and predict maintenance needs.
- Automation Supervisors: Managers who oversee AI-driven automated systems, ensuring they operate correctly and intervene when necessary.

These new roles often come with higher wages due to the specialized skills required, reflecting the increased productivity and value added by *AI technology*[79].

Wages?

The reality is more complex, even while the Solow model and related economic theories frequently suggest that productivity gains brought about by technology developments can result

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in greater pay. For a variety of reasons, salaries may not rise at all or may even fall in certain $situations$.[80]

Theoretical Anticipations

According to the Solow model, advancements in technology should raise GDP per person, which will raise salaries. This is due to the fact that technical developments like artificial intelligence (AI) increase productivity, which raises the value of labor and raises pay.

- $Enhanced\ Productivity$[81]: AI increases productivity by streamlining manufacturing processes and automating monotonous jobs. As a result, businesses may be able to pay greater wages because of the higher production.
- $Complementarity$[81]: AI frequently works in tandem with human labor to enhance workers' abilities and provide new, better-paying jobs.

Real-World Difficulties

$Real-world\ results$[82], however, may deviate from these theoretical predictions for a number of reasons.

- Skill Displacement: AI has the potential to increase demand for certain abilities while making others obsolete. If their abilities become obsolete, workers may lose their jobs or see their pay stagnate. Higher salaries may be advantageous for those who can move into other roles, although this shift might be difficult.
- $Labor\ Market\ Frictions$[82]: The labor market's imperfections, such as the mismatch between workers' skill sets and the requirements of newly created AI-driven roles, can impede a consistent increase in salaries. Wage adjustments may lag if training and education institutions are unable to keep up with technological advancements.
- Bargaining Power: An important factor is workers' ability to bargain. Even increases in productivity might not result in better pay if employees have little negotiating leverage. Factors like labor market monopsony—in which a few employers control the majority of the market and can stifle wage growth—may make this worse.
- $Short-Term\ Adjustments$[82]: As businesses adapt to new technologies and employees experience temporary displacement, the use of AI may result in wage suppression in the near term. Wages may rise when the labor market adjusts over time, although this adjustment phase may take a while.

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Finance industry

The same model, however, behaves differently owing to a change in industry completely. In the finance industry, the implementation of artificial intelligence can be seen as a substitute rather than a complement to labor in general and labor demand. The finance sector, in contrast to the manufacturing sector, frequently views artificial intelligence (AI) as a replacement for labor rather than as an addition to It. This difference results from the way that jobs and processes are carried out in the banking industry, where AI technologies are mainly used for automation and efficiency benefits that potentially take the place of human labor. The Solow model, however, behaves differently as compared to the manufacturing sector because the two factors are inversely correlated such that as one increases the other decreases. The equation changes such that it becomes a multivariable function.

$$F(K, L) = Z(\Psi * K + L)^{\alpha}$$

F represents the output (GDP) of the financial industry,

K represents capital,

L represents labor,

represents the level of technology,

Ψ represents the capital-augmenting productivity parameter related to AI.

This has the property that as psi increases, $F(GDP)$ This shows that as AI increases in the financial industry the productivity of the industry also increases even with the decrease in labor unlike in the manufacturing industry. Ψ is entering in a capital augmenting manner.

Capital augmenting role of AI

- ➔ The term Ψ*K indicates that AI enhances the productivity of capital. As Ψ increases, the effective capital in the production process increases.
- ➔ This means that AI boosts the output generated by each unit of capital, reflecting its role in automating and optimizing financial processes.

Output Growth with Reduced Labor

- ➔ Even if the labor input decreases, the overall output F can still increase due to the augmented capital productivity brought by AI. This highlights AI's ability to drive productivity gains independently of labor input.

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Economic implications

Labour displacement

- ➔ In the financial industry, AI substitutes labor by automating tasks such as data processing, trading, risk assessment, and customer service.
- ➔ This can lead to job displacement for roles that involve routine, repetitive tasks, as these can be more efficiently performed by AI systems.

Productivity gains

- ➔ The increase in Ψ leads to substantial productivity gains. Financial institutions can manage more transactions, perform complex analyses, and offer enhanced services with fewer human workers.
- ➔ This results in higher overall output (GDP) for the financial sector, despite a reduction in labor input.

Wage dynamics

- ➔ While routine jobs may be displaced, there is an increased demand for highly skilled roles involving the development, implementation, and management of AI systems.
- ➔ These roles typically command higher wages due to their specialized nature. However, wages for lower-skilled, routine jobs may stagnate or decrease due to reduced demand.

The derivative with respect to L (marginal product of labor which is equal to wages in competitive equilibrium)

$$MPL = \frac{\partial L}{\partial F}$$

$$F(K, L) = Z(\Psi K + L)$$

$$MPL = \frac{\partial Z(\Psi K + L)}{\partial L}$$

$$MPL = \frac{Z * \partial(\Psi K + L)}{\partial L}$$

Since Z is a constant multiplier and the derivative of $(\Psi K + L)$ with respect to L is 1:

$$MPL = Z \cdot 1$$

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$$MPL = Z$$

$However$,[4] if we consider a more complex form where the output is influenced by the marginal increase in L, and rewrite the expression taking into account the form provided

If the production function is more generally written as:

$$F(K, L) = Z(\Psi K + L)^{\alpha}$$

Where α is a positive constant, we proceed as follows:

$$MPL = \frac{\partial F}{\partial L} = \frac{\partial}{\partial L}(Z(\Psi K + L)^{\alpha})$$

Using the power rule of differentiation:

$$MPL: \alpha * Z * (\Psi * K + L)^{\alpha - 1}$$

Which can be rewritten as

$$MPL = \frac{\alpha * Z}{(\Psi * (K) + L))^{1-\alpha}}$$

$$note: all\ variables\ are\ positive$$

In a competitive equilibrium, the wage rate (w) is equal to the MPL:

$$MPL = w$$

$$w = \frac{\alpha * Z}{(\Psi * (K) + L)^{1-\alpha}}$$

the MPL, which determines the wage rate in a competitive equilibrium, depends on the productivity parameter Z, the capital-augmenting parameter Ψ, and the combination of capital K and labor L. The presence of AI (through Ψ) enhances the effective capital, thereby influencing the MPL and, consequently, the wage rate. The specific form of the production function and the value of determine the exact relationship, highlighting the impact of AI on labor dynamics in the financial industry.

Capital-Augmenting Role of AI:

➔ In this model, AI augments the productivity of capital through the parameter Ψ.

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- ➔ As Ψ increases, the effective capital in the production process increases, making each unit of capital more productive.
- ➔ This augmentation implies that AI allows capital to generate more output without a proportional increase in labor.

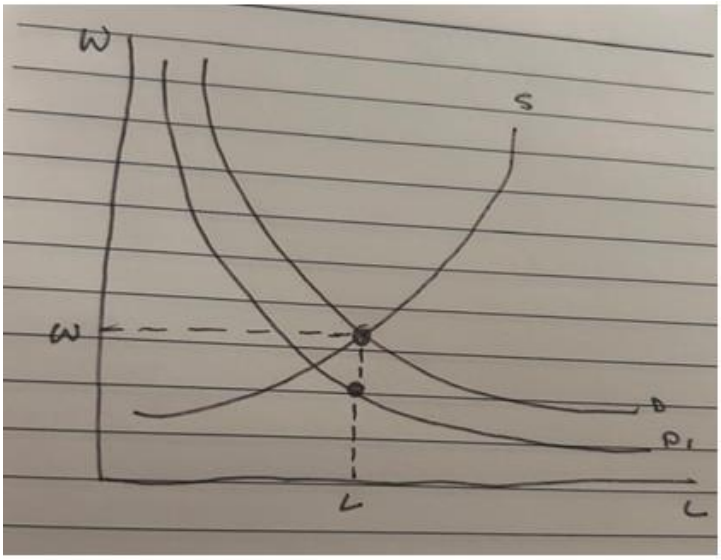
Output and Labor Dynamics:

- ➔ The output F increases with higher values of Ψ, reflecting AI's positive impact on productivity.
- ➔ Even with a reduction in labor L the output can increase if Ψ is sufficiently large, highlighting AI's ability to compensate for reduced labor input by enhancing capital productivity.

Wages and Employment:

- ➔ In a competitive labor market, the wage rate (w) is equal to the MPL
- ➔ $w = Z\alpha(\Psi K + L)^{\alpha-1}$
- ➔ As AI (Ψ) increases, the MPL may increase, leading to higher wages for remaining labor.
- ➔ However, since AI substitutes for labor in many routine tasks, overall employment in the sector may decrease, especially for jobs that are easily automated.

Skill shift:



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- ➔ AI-driven productivity gains require a shift in the labor force toward more complex, non-routine tasks that cannot be easily automated.
- ➔ This shift necessitates higher-skilled workers who can develop, manage, and work alongside AI systems, potentially leading to higher wages for these specialized roles.

Economic Efficiency:

- ➔ The financial industry can achieve higher economic efficiency with AI, as tasks are completed faster and more accurately than human labor alone.
- ➔ This efficiency translates to higher profitability and potentially lower costs for consumers due to streamlined operations.

AI as a substitute in the finance industry

The banking sector benefits greatly from the automation and efficiency gains brought about by AI integration. Artificial Intelligence is particularly good at automating repetitive jobs that were previously completed by human workers, like data entry, transaction processing, and simple customer support queries. AI systems may now perform these jobs more correctly and effectively, negating the need for human interaction $(Brynjolfsson\ \&\ McAfee, 2014)^4$. Financial institutions use artificial intelligence (AI) to cut labor-related operating costs since AI systems are more cost-efficient because they can operate continuously without needing breaks or vacation time. In highly competitive financial markets with narrow margins, this cost-effectiveness is especially alluring $(Acemoglu\ \&\ Restrepo, 2020)^6$. Furthermore, risk assessment, fraud detection, and compliance monitoring are duties that necessitate real-time complicated decision-making and massive data processing. These activities are handled by AI algorithms. AI improves financial organizations' total risk management skills by mitigating hazards more successfully than human workers alone because of its rapid and precise data analysis $(Solow, 1956)^{76}$.

AI deployment in finance may result in job displacement for positions requiring rule-based and repetitive work. According to $Brynjolfsson\ and\ McAfee\ (2014)^4$, administrative jobs like data entry clerks and customer service agents are especially vulnerable to automation. Although artificial intelligence (AI) replaces some regular activities, it also increases the need for expertise in data analytics, machine learning, and AI system administration. These abilities are increasingly necessary for finance professionals to design, execute, and manage AI systems $(Acemoglu\ \&\ Restrepo, 2020)^6$. For jobs that AI replaces, the banking sector may see salary stagnation or even decrease, in contrast to the manufacturing sector where AI is a complement that could result in increased salaries. However, because of their specialized nature, higher-

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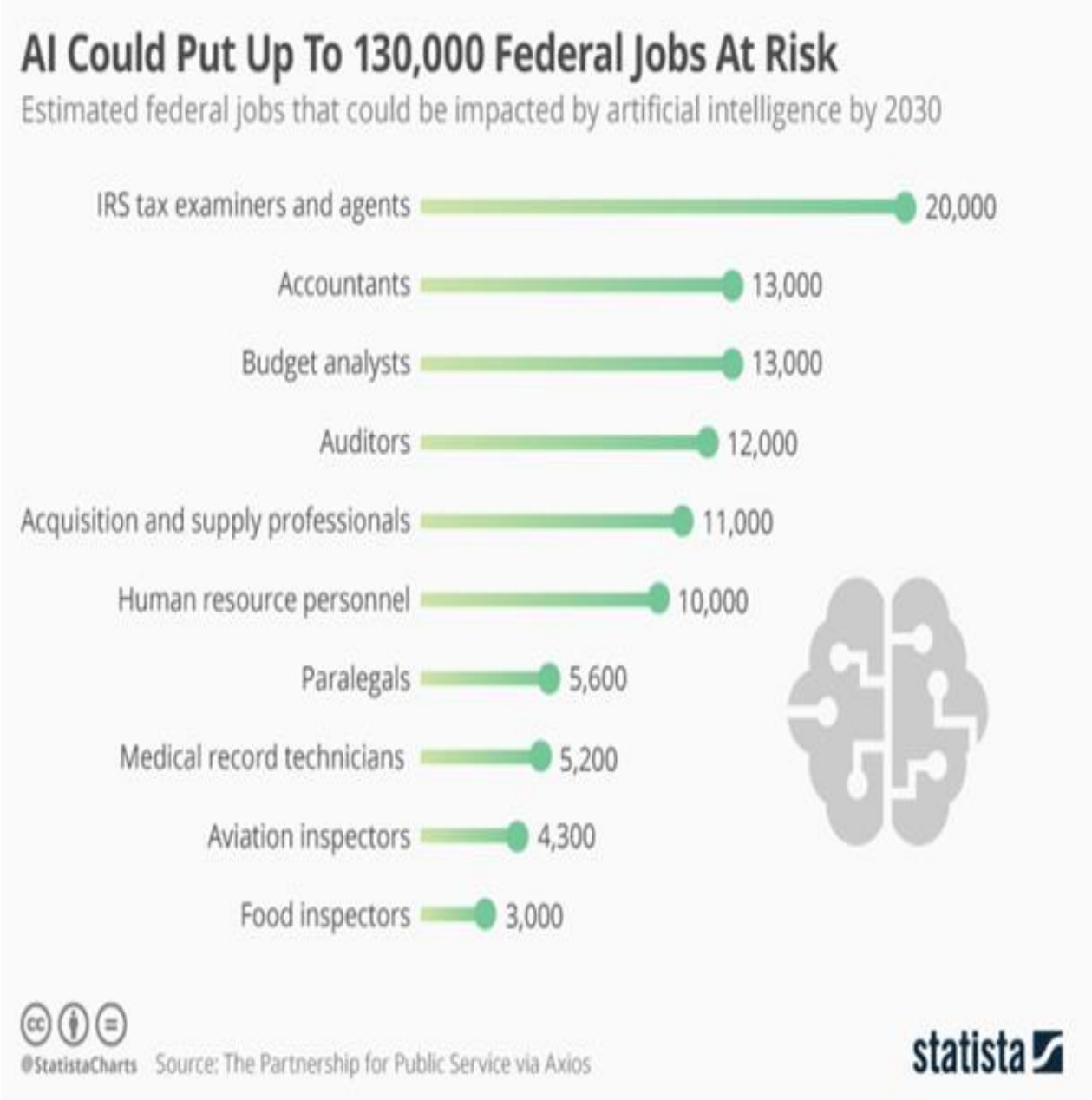
skilled professions in AI development and implementation might experience wage rises $(Solow, 1956)$[76].

5. Workforce transitions

a) Jobs at the risk of AI



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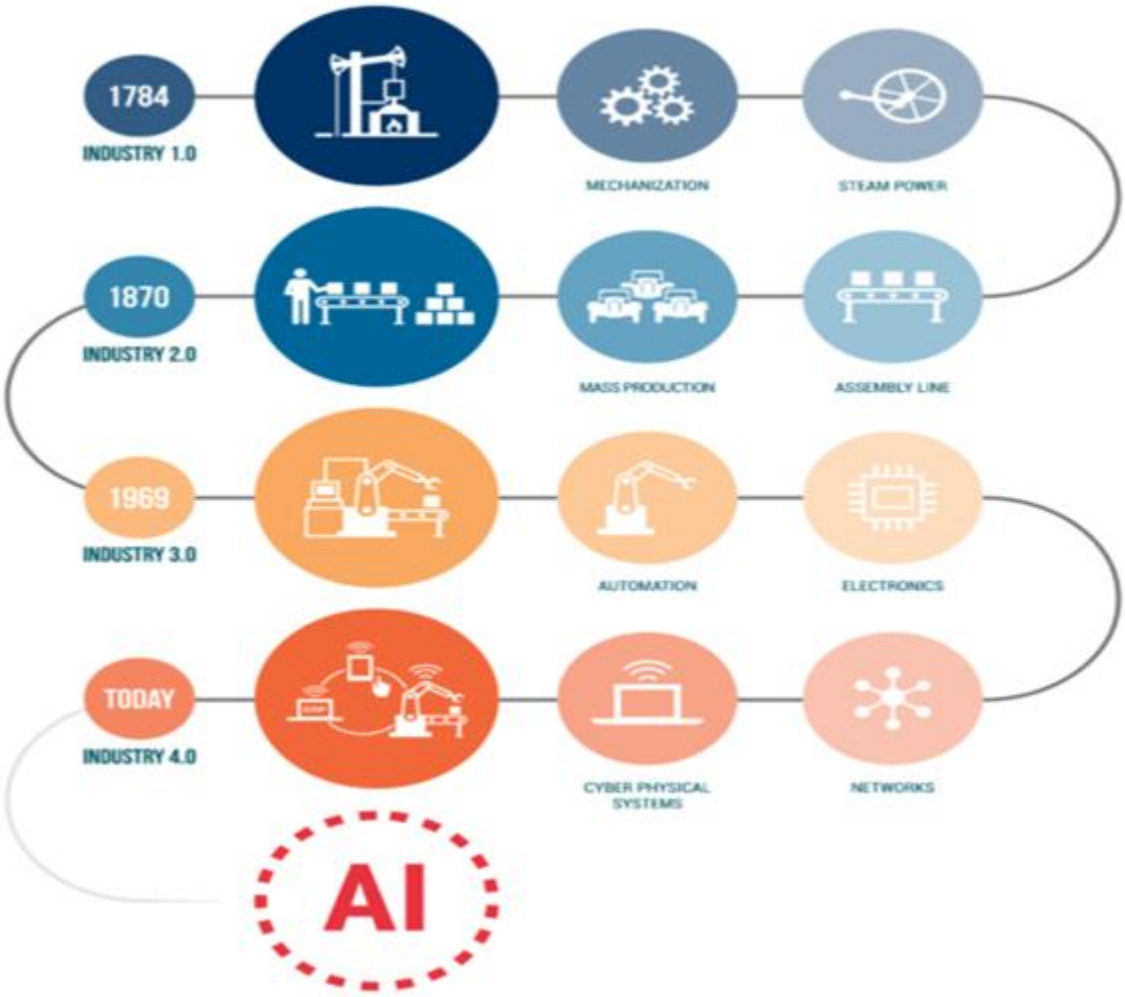

The predominant concern with the emergence of AI is that of job loss and an inability to manage extreme levels of unemployment that may occur as a result of AI. The job market is extremely volatile and constantly changing with the emergence of technology. Companies are laying off millions of workers because jobs that once were required have now become redundant. The rise of artificial intelligence (AI) has had a major impact on various jobs, especially repetitive or data-intensive tasks. Automated systems and robotics pose a serious threat to manufacturing and assembly chains, as they efficiently perform tasks such as painting and assembly. AI-based high-performance computing is threatening the role of data entry and business management. Customer service is increasingly handled by chatbots and AI-based virtual assistants, reducing the need for automated cash in retail, AI-based register systems and inventory management. a similar challenge with the advent of self-driving cars and delivery drones.

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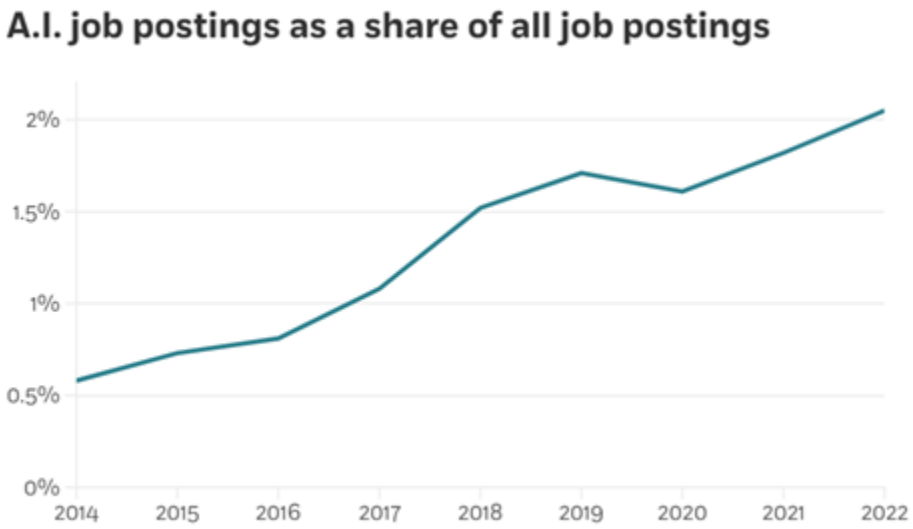
One unique aspect of generative AI is how it affects work done by educated, white-collar people, as opposed to automation technology that concentrates on repetitive activities like robots on factory assembly lines. The professions most vulnerable to AI disruption include accountants, tax preparers, legal assistants, financial analysts, journalists, web designers, mathematicians, court reporters, translators, and public relations specialists, according to a study by *Tyna Eloundou, Sam Manning, and Pamela Mishkin*[83] from OpenAI and the University of Pennsylvania's Rock Center.

Holzer[84] draws attention to the parallels between the consequences of automation and globalization, noting that both have historically resulted in the importation or outsourcing of excellent employment, which have been replaced by less educated individuals. He proposes that the way AI affects higher-skill occupations and continuously tests human work performance might be different. However, according to a *July McKinsey* [85]analysis, AI is more likely to replace lower-paying office support, customer service, and food-service occupations than it is to replace those in the creative, STEM, business, and legal professions. Notably, the research highlights the disproportionate representation of women and people of color in the professions most at danger from automation.

The main effect of generative AI is anticipated to be a major shift in the tasks that knowledge workers perform on the job. *Holzer*[84] points out that although automating less skilled labor was simpler in the past, AI's capacity to carry out complex tasks implies that its effects would be felt more widely in the future. He stresses considering AI's effects at the task level as opposed to the job level since people will need to shift to jobs that AI is not yet capable of performing. Workers with more education and skill levels will probably adjust to this change more easily.



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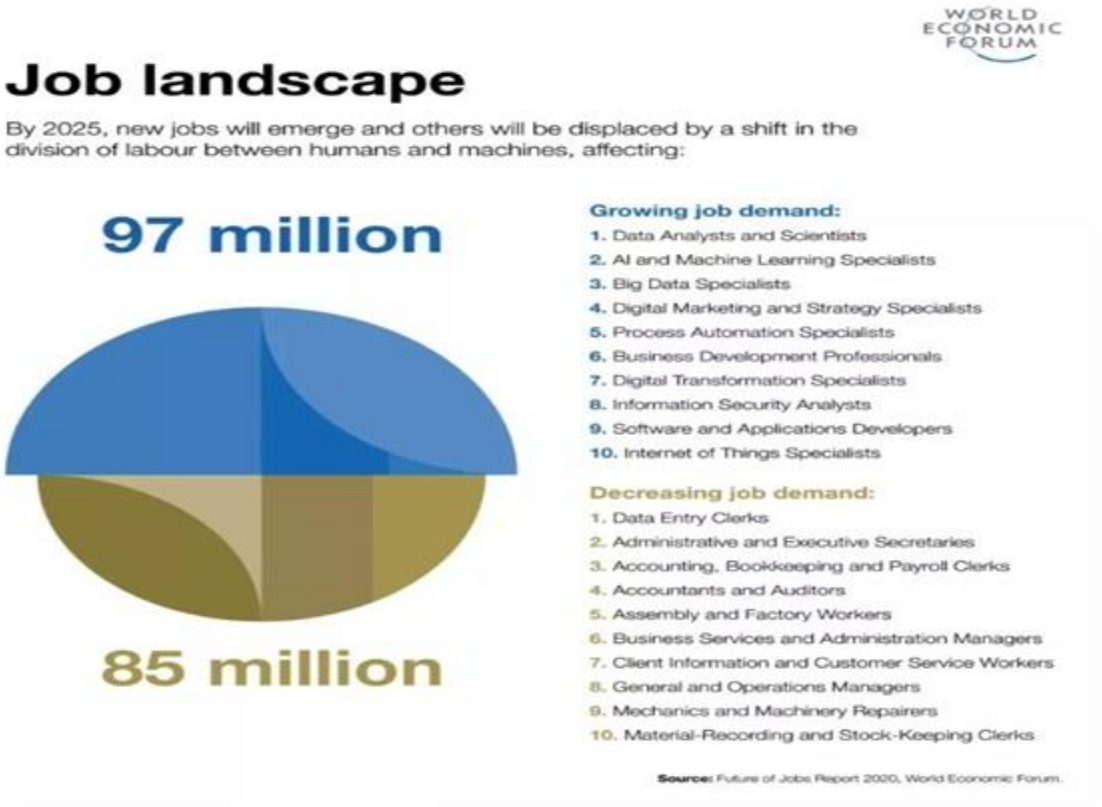
According to research by Lindsey R. Raymond, a PhD candidate at MIT, Danielle Li of Stanford, and *Erik Brynjolfsson*[86] of Stanford, there are some advantages of AI for less skilled workers. The introduction of a generative AI-based conversational tool increased productivity by 14% on average among over 5,000 customer support agents at a software company. Novice or lower-skilled workers benefited the most from this tool, as it helped them communicate more like high-skilled workers.

Emerging job roles

On the other hand, AI advocates argue that it is not only a destroyer but also a creator of jobs. AI has the potential to increase industrial productivity and efficiency, which will lead to the creation of new roles requiring human intelligence, creativity, and emotional intelligence—the areas where machines are currently lacking. For example, the development and maintenance of artificial intelligence systems requires qualified professionals in the fields of data science, machine learning, and artificial intelligence. With the adoption of artificial intelligence by the industry, demand for experts in these fields continues to increase. In addition, artificial intelligence can increase human capabilities, allowing workers to focus on more complex and strategic tasks, while leaving regular tasks to the machine.



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New skills: The integration of artificial intelligence requires a workforce with new skills. Jobs will be created in the fields of informatics, machine learning and artificial intelligence development, which reflects the need for expertise in managing, maintaining and developing artificial intelligence. AI is a powerful multiplier that allows humans to focus on more advanced tasks that require creativity, critical thinking and emotional intelligence. I.A. promote the development of human skills that lead to a more dynamic and productive level, not replace them.

Changes in the dynamics of the industry: Traditional industries are experiencing changes in their dynamics as AI becomes more common. For example, with the introduction of intelligent factories, manufacturing evolves and creates jobs in production and maintenance driven by AI.

Artificial intelligence-driven enterprises: democratizing artificial intelligence technology allows entrepreneurs to explore new business opportunities. Startups are emerging in areas such as AI consulting, personalized niche market AI solutions, and AI-driven innovation that promotes economic growth and employment creation. The quality and quantity of jobs: the focus shifts from the number of jobs to the quality of jobs. Artificial intelligence can improve the quality of work by automating mundane tasks and enabling employees to do meaningful and productive work.

Skills in demand

Programming skills, especially coding, are required in today's world. People looking for AI need to understand sound programming languages like $Python, Java, R, C++$[88] and JavaScript. Each programming language has its own specifications for understanding and using artificial intelligence and machine learning. Critical thinking and problem solving may be the most in-demand skills in AI. Knowing coding languages and programming is not enough. People involved in artificial intelligence have to look at problems and break them down into individual components to solve smaller problems. Once these minor issues are resolved, the goals are achieved.

Mathematics and statistics are deeply needed today. To create machines that can learn from experience, they need to be programmed with the ability to understand and reason. In this respect, mathematics and statistics $come\ into\ play$[87]. Mathematics studies patterns and relationships in numbers, while statistics studies collecting, analyzing, and explaining data. Together, mathematics and statistics provide the tools needed to analyze and understand data. Carlos Anchia, co-founder and CEO of Plainsight, also said: "An AI specialist must apply extensive knowledge in various mathematical fields to create algorithms and solve problems for companies, industries and around the world. The most popular candidates and professionals may have been excellent in fields such as statistics and linear algebra.

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Data science and data analysis is integral to understanding the changing world. Data is today the heart of companies. Data science and data analysis are essential tools to understand the world around us. They help us make better decisions, understand our customers' needs and monitor our progress and performance. They are important for all sizes of companies and organizations and for anyone who wants to make the most of the data available. Organizations deal with a huge amount of data every day. Many people are beginning to realise the powerful insights and business gains that data can provide when used and examined appropriately. Due to the potential for game-changing data, demand for data analysts, data architects, database administrators, business analysts, data directors and other related professions is rising. Each year, the number of vacancies for data scientists increases by nearly 50%.

Natural Language Processing and Computer Vision is currently a very in-demand skill. Natural Language Processing (NLP) is the study of how computers understand and process human languages. It involves tasks such as understanding the meaning of words, analyzing sentences into their components, and understanding the relationship between words. NLP can be used for various tasks, such as automatic translation, text summary, and machine understanding. Computer vision is the study of how computers interpret and understand digital images. It includes tasks such as identifying images, recognizing facial features, and estimating 3D geometry of images. NLP and computer vision are important subsectors of AI with a variety of applications.

Libraries and frameworks are imperative skills. When developing artificial intelligence applications, you can choose from a variety of libraries and frameworks. Popular libraries and frameworks include NumPy, Keras, TensorFlow, Matplotlib, Seaborn, and many others. They are used to explore large data sets, scientific calculations, numerical operations, etc. One of the most demanding AI skills is to have a detailed knowledge of different AI libraries and frameworks, such as NumPy, Apache Spark and TensorFlow. Understanding these platforms allows you to write code faster and more accurately for AI application.

6. Discussion

a) Key findings

Impact of AI on Finance and Manufacturing Industries is one of the key findings. AI has significantly transformed the finance and manufacturing industries by enhancing productivity and efficiency. In finance, AI improves customer service, risk management, and operational efficiency. In manufacturing, AI optimizes supply chain management, quality control, and overall production processes.

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Workforce Transition and Skills Demand is another integral aspect. AI-driven automation poses a risk to routine jobs but creates new roles that require advanced skills. There is a growing demand for high-skilled workers who can manage, develop, and collaborate with AI systems. This transition necessitates workforce development and strategic planning to ensure a smooth shift towards an AI-driven economy.

Economic Models and AI's Influence. Utilizing the Solow growth model, the paper predicts that AI can enhance capital productivity, leading to higher economic efficiency. AI's capital-augmenting role allows for increased output even with reduced labor input, highlighting the need for labor to transition towards non-routine, complex tasks. Ethical and Regulatory Considerations are also at the forefront of artificial intelligence and policy. Integrating AI into finance and manufacturing brings challenges such as data protection, regulatory compliance, and ethical implications. Financial institutions must enhance accountability and transparency to build confidence in AI-driven financial management.

Potential Risks and Market Stability is another key finding. The widespread use of similar AI models in trading could reduce market stability and competitiveness. There is a risk of herd behavior, convergence, and increased vulnerability to cyberattacks, especially during financial crises. Ensuring diverse and proprietary models can mitigate some of these risks

b) Ethical implications

The surging integration of artificial intelligence (AI) and machine learning (ML) into the workforce presents a complex ethical landscape with far-reaching implications for employees, employers, policymakers, and society as a whole. Navigating the disruptions and opportunities these technologies bring requires prioritizing ethical considerations.

A significant concern for employees lies in potential job displacement, particularly in sectors like manufacturing and finance where repetitive tasks are commonplace. This automation could disproportionately impact lower-skilled workers, exacerbating existing inequalities. The ethical responsibility falls on both employers and policymakers to prioritize retraining and reskilling programs. Equipping workers with new skills relevant to the AI-powered workplace is crucial for a smooth transition. Financial support, career counseling, and educational opportunities are essential to ensure fairness for displaced workers. Additionally, the use of AI for performance monitoring and productivity analysis raises significant privacy concerns. Transparency is key – employers must be upfront about how AI systems are used to monitor employees and ensure such practices don't infringe on personal privacy. Employees should have a voice in the implementation of workplace AI and be informed about how their data is used.

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Ethical considerations for employers focus heavily on bias and fairness. AI systems can perpetuate and amplify existing biases in crucial decisions like hiring and promotion. Employers have an ethical responsibility to ensure AI systems are rigorously audited for biases and implement measures to mitigate them. Involving diverse teams in the development and deployment of AI systems can significantly reduce bias and lead to fairer outcomes. Furthermore, employers must ensure transparency and accountability in their AI use. Designing AI systems to provide clear explanations for their decisions allows for human oversight and intervention when necessary. Adhering to relevant regulations and established standards for AI deployment is crucial to maintaining ethical practices and avoiding legal repercussions.

Policymakers have a vital role to play in shaping the ethical landscape of AI in the workforce by establishing regulations and standards. Developing ethical guidelines for AI deployment can ensure the technology is used responsibly and for the benefit of all stakeholders. Strengthening data protection laws to safeguard employee privacy and personal data is essential in the AI-driven workplace. Ensuring equitable distribution of AI's benefits across society presents a significant ethical challenge. Enhancing social safety nets like unemployment benefits and healthcare can support workers displaced by AI. Policies promoting economic inclusivity and preventing the concentration of AI benefits in the hands of a few are crucial for social stability.

Building public trust in AI technologies is critical for their successful integration. Engaging the public in discussions about AI and its implications can foster trust and ensure societal values are reflected in AI development. Promoting education and awareness about AI empowers individuals to understand and navigate the changes brought about by these technologies. The long-term societal impact of AI, including potential changes to the nature of work and the social contract, requires proactive planning and ethical foresight. Ensuring AI technologies are designed and deployed in a manner that prioritizes human well-being and societal good is paramount.

In conclusion, the ethical implications of AI and ML in the workforce are multifaceted and necessitate a concerted effort from all stakeholders. By addressing issues of job displacement, bias, transparency, regulation, and public trust, we can navigate the challenges and opportunities presented by AI in a way that promotes fairness, inclusivity, and human dignity. This collaborative approach will pave the way for a future where AI and humans coexist for the betterment of society.

c) Limitations of research

The definition of AI itself is ambiguous. The definition of AI is inherently difficult to pin down due to its ambiguous boundaries and broad scope. While this paper frames AI in a specific

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context, the evolving nature of AI technologies and their applications means that our understanding and categorization of AI might change significantly in the coming years. Therefore, the results presented in this study should be interpreted within the specific framing and context provided, keeping in mind that the scope of AI is not definitively established and may evolve.

Rapid Evolution of AI Technologies is another factor. AI technology is developing at a breakneck pace, and new advancements can lead to significant changes in how AI impacts various industries. The scope of AI applications and their implications are not static; they are likely to change dramatically over the next few years. This rapid evolution means that the findings and conclusions of this paper might become outdated as new AI technologies and methodologies emerge. Stakeholders should be aware of the dynamic nature of AI and continuously seek updated information and insights.

Industry-Specific Impacts are relatively important because it varies for different figures. AI's impact varies across different industries, and this paper primarily focuses on the finance and manufacturing sectors. While the findings provide valuable insights into these industries, they might not be directly applicable to other sectors. AI's influence on industries such as healthcare, education, and retail could differ significantly from what is observed in finance and manufacturing. Therefore, caution should be exercised when generalizing the results of this study to other industries, and further research is needed to explore AI's effects in diverse contexts.

Discontinuous Developments is a limitation as the development of AI technologies does not follow a smooth, linear trajectory. Instead, it is characterized by discontinuous jumps and breakthroughs that can rapidly alter the landscape of AI applications. These sudden advancements can lead to unforeseen changes in AI's impact on industries and labor markets. As a result, predictive models and analyses based on current trends may not fully capture the potential for abrupt shifts in AI capabilities and their implications.

Exogeneity of AI in the Model is a key limitation. In the models used in this paper, AI is treated as an exogenous factor, meaning it is considered as an external input to the system. However, in the real world, AI is likely to be endogenous, meaning it interacts with and is influenced by other variables within the system. For example, the development and deployment of AI can be driven by economic, social, and regulatory factors, which in turn are affected by AI. This limitation highlights the complexity of accurately modeling AI's impact and suggests that more sophisticated, dynamic models are needed to capture the endogenous nature of AI in real-world scenarios.

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