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THE IMPACT OF ARTIFICIAL INTELLIGENCE AND REGULATORY STRATEGIES ON THE ECONOMICS: LEARNING FROM INDONESIA, CHINA, AND EUROPE

Bella Thalia Winardi[1], Evelyne Julian Halim[2]
[1]School of Economics, Shanghai University, 99 Shangda Road, Baoshan District, Shanghai, China, 200444
emaili :bellatha@shu.edu.cn

[2]Law Department, University of Indonesia Jl. Prof. Mr. Djokosoetono, Kampus Universitas Indonesia Depok 16424, Indonesia
emaili : evelyne.julian@ui.ac.id

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ABSTRACT

This study examines the economic impact of artificial intelligence (AI) on labor markets and regulatory strategies in Indonesia, China, and Europe. Through a literature review, it assesses how AI adoption influences productivity, job creation, and displacement in these regions. Indonesia faces challenges like infrastructural and educational gaps, though targeted investments and reskilling could boost growth and mitigate job losses. Meanwhile, China and Europe benefit from AI-driven productivity but also confront labor market disruptions, requiring strong policy responses. Indonesia focuses on foundational AI integration, while China pursues aggressive technological advancement and regulation. Europe prioritizes ethical AI use, data protection, and workforce resilience through education and retraining. The study highlights the importance of region-specific regulatory frameworks and calls for continued international collaboration to address global AI-related labor issues. Cross-regional knowledge exchange is crucial for managing labor market transitions and ensuring AI's benefits are widely shared.

Keywords: *Artificial Intelligence (AI); Labor Market Disruption; Regulatory Frameworks*

ABSTRAK

Studi ini meneliti dampak ekonomi kecerdasan buatan (AI) terhadap pasar tenaga kerja dan strategi regulasi di Indonesia, Tiongkok, dan Eropa. Melalui tinjauan literatur, studi ini mengevaluasi bagaimana adopsi AI memengaruhi produktivitas, penciptaan lapangan kerja, dan pengurangan tenaga kerja di wilayah-wilayah tersebut. Indonesia menghadapi tantangan seperti kesenjangan infrastruktur dan pendidikan, meskipun investasi yang ditargetkan dan peningkatan keterampilan dapat mendorong pertumbuhan dan mengurangi kehilangan pekerjaan. Sementara itu, Tiongkok dan Eropa memperoleh manfaat dari produktivitas yang didorong oleh AI, tetapi juga menghadapi gangguan pasar tenaga kerja, yang membutuhkan respons kebijakan yang kuat. Indonesia berfokus pada integrasi AI dasar, sedangkan Tiongkok mengejar kemajuan teknologi dan regulasi secara agresif. Eropa memprioritaskan penggunaan AI yang etis, perlindungan data, serta ketahanan tenaga kerja melalui pendidikan dan pelatihan ulang. Studi ini menekankan pentingnya kerangka regulasi spesifik untuk setiap wilayah dan menyerukan kerjasama internasional yang berkelanjutan untuk mengatasi isu-isu tenaga kerja terkait AI secara global. Pertukaran pengetahuan lintas wilayah sangat penting untuk mengelola transisi pasar tenaga kerja dan memastikan manfaat AI dapat dinikmati secara luas.

Kata Kunci: *Kecerdasan Buatan; Gangguan Pasar Tenaga Kerja; Kerangka Regulasi*

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Corresponding author:
Bella Thalia Winardi
School of Economics, Shanghai University, 99 Shangda Road, Baoshan District, Shanghai, China, 200444
Email: bellatha@shu.edu.cn

INTRODUCTION

Artificial Intelligence (AI) is transforming labor markets worldwide, influencing job creation, displacement, and altering required skill sets. Its integration across industries—such as manufacturing, healthcare, finance, and logistics—has automated routine tasks, improving productivity while reducing demand for certain manual labor. In sectors like customer service, administrative support, and legal professions, AI tools like chatbots, machine learning algorithms, and robotic process automation (RPA) have minimized human involvement in routine functions (Wang, 2023). This shift has led to a dichotomy: AI displaces jobs, especially in low-skilled roles, while generating new opportunities in AI development, data science, and cybersecurity, where advanced technical skills are needed. Workers must increasingly reskill and upskill to stay relevant in an AI-driven economy(Bera et al., 2024). Governments and industries are exploring

policies and initiatives to address these challenges, such as educational programs focused on digital literacy and technical skills.

Simultaneously, concerns about inequality and the digital divide are rising, as access to technology and training varies between regions. While countries like the U.S., China, and several European nations lead in AI adoption and regulatory frameworks, developing economies in Southeast Asia and Africa face unique challenges in managing the impacts of automation and AI-driven productivity growth (Samuel-Okon & Abejide, 2024). The global labor market is at a critical juncture, where strategic policy interventions and collaboration between governments, businesses, and educational institutions are necessary to ensure inclusive economic growth in the age of AI (Korinek & Stiglitz, 2021).

Furthermore, the integration of artificial intelligence (AI) into economic systems has diverse impacts, shaped largely by a country's level of technological advancement, labor market structure, and industrial focus. In developed economies like the United States and Europe, AI has revolutionized high-tech industries, driving significant productivity gains due to their well-established technological infrastructures and research ecosystems (Comunale, 2024; Trabelsi, 2024). These regions benefit from AI innovations in sectors such as healthcare, finance, and advanced manufacturing, with Europe witnessing AI-driven automation in industries like automotive manufacturing, and the U.S. leveraging AI in financial services for fraud detection and personalized customer experiences (Walter, 2024). Despite these advancements, challenges such as the displacement of low-skill jobs and the need for regulatory frameworks to ensure ethical AI use remain prevalent. As a result, developed nations are prioritizing AI-related policies and skill development programs to maintain competitiveness in the global economy.

In contrast, emerging economies like those in Southeast Asia and Latin America face different opportunities and risks. For countries like Indonesia, AI threatens to automate low-wage jobs in key sectors such as manufacturing and agriculture but also offers potential for economic diversification in areas like e-commerce, logistics, and digital services (Strusani & Houngbonon, 2019). Countries like China are navigating both paths, using AI to transition from a manufacturing-based economy to a knowledge-based one while pursuing leadership in AI research and innovation. The varied impacts of AI across regions highlight the importance of tailored policy responses, as each economy's ability to adapt and succeed in an AI-driven world depends on investments in infrastructure, fostering innovation, and reskilling the workforce (Bakovic, *et al.,* 2021).

As the novelty, this structured literature review offers a comparative analysis of Indonesia, China, and Europe, examining their distinct approaches to AI adoption, labour market disruption, and regulatory evolution. Unlike many studies, it highlights how regional disparities in economic development, industrial focus, and governance create unique challenges and opportunities. Indonesia exemplifies the struggles of emerging economies with limited resources, while China showcases rapid AI advancement balanced with regulatory control. Europe's strong regulatory frameworks and ethical considerations provide a contrasting perspective. By comparing these regions, the review delivers a comprehensive understanding of AI's global labour market impact and offers tailored policy recommendations.

Furthermore, this paper addresses key problems related to AI-induced labour market disruptions. As AI reshapes industries, developed regions like Europe have robust regulatory frameworks, but emerging economies like Indonesia face challenges due to their reliance on low-skill jobs. A primary issue is how different regions can mitigate job displacement while promoting growth. Additionally, countries vary in their ability to regulate AI's economic impacts. China's rapid AI development outpaces regulatory efforts, while Europe's stringent regulations may hinder competitiveness. Lastly, the rapid adoption of AI highlights skill gaps, with Indonesia and China struggling to prepare their labour forces for AI-driven economies. So, the objective of the articles are as follows: (i) to analyze how the adoption of artificial intelligence is transforming labor markets, productivity, and economic growth in Indonesia, China, and Europe; (ii) to investigate the regulatory frameworks and policies implemented in each region to manage the economic and social impacts of AI, and (iii) to compare and contrast the approaches taken by Indonesia, China, and Europe to derive best practices for integrating AI into the economy while mitigating potential negative effects.

METHODS

This research employs a structured literature review methodology to explore the economic impact of artificial intelligence (AI) and the regulatory strategies implemented in Indonesia, China, and Europe. The initial phase involves a comprehensive search of academic databases, industry reports, and policy documents. Key databases of Scopus will be extensively utilized to gather relevant peer-reviewed articles, research papers, and case studies published over 2000 - 2024. This selection process will ensure that the review captures the most current and relevant literature pertaining to AI's economic effects and regulatory approaches across the three regions.

Furthermore, Boolean operators are pivotal in refining searches within the Scopus database in the range of year 2000 to 2024. By using operators such as AND, OR, and NOT, researchers can effectively combine terms and phrases to narrow down or broaden their search queries. The AND operator narrows searches by including only documents that contain all specified terms, OR expands the search to include documents with any of the terms, and NOT excludes documents containing certain terms. This functionality is essential for managing the vast amount of data available and for honing in on relevant information specific to the research focus. The selection of articles for this review is based on specific inclusion and exclusion criteria with Boolean operator. Articles were included if they were published within the last 24 years, indexed in Scopus, and relevant to the keywords such as “Artificial Intelligence”, Economics Impact” and “Indonesia”, ”China” and “Europe”.

In the second phase, the collected literature will be systematically categorized and analyzed according to themes such as economic impact, labour market changes, and regulatory frameworks. A thematic analysis will be conducted to identify and compare the effects of AI on job creation and displacement, productivity, and economic growth in each region. Additionally, the review will focus on the regulatory measures adopted by Indonesia, China, and Europe, examining their effectiveness in managing the transition to an AI-driven economy and addressing associated challenges.

The final phase involves synthesizing the findings to draw comparative insights and identify best practices. The review will highlight regional differences and commonalities in AI's economic impact and regulatory strategies, providing a nuanced understanding of how each region adapts to technological advancements. Based on this synthesis, the study will offer policy recommendations aimed at optimizing AI integration while addressing potential economic and social issues. This structured approach ensures a comprehensive and comparative analysis of the economic and regulatory dimensions of AI across diverse global contexts.

THEORETICAL FRAMEWORK

Defining AI and Its Economic Impacts

Artificial Intelligence (AI) in the labor market involves using machine learning, automation, and advanced algorithms to perform tasks traditionally handled by humans. Key concepts include machine learning, which trains algorithms to recognize patterns and make decisions; automation, which replaces human labor to boost efficiency; and robotics, which integrates machines with AI to perform complex tasks. These technologies reshape job roles by managing repetitive tasks, analyzing vast data, and improving decision-making (Acemoglu & Restrepo, 2018; Kao, 2024). Another critical concept is "skill displacement," where AI may make certain skills obsolete while creating demand for new ones, necessitating workforce retraining and upskilling. Additionally, "AI-driven productivity" emphasizes AI’s role in optimizing operations and reducing costs (Adhikari, 2024). Together, these concepts show AI’s transformative effects on job creation, displacement, and skill requirements, presenting both challenges and opportunities. Understanding these dynamics is crucial for developing strategies to manage AI’s integration into the workforce and fostering economic growth.

In addition, Artificial Intelligence (AI) significantly impacts automation by performing tasks that traditionally required human intervention, using algorithms and machine learning to execute repetitive

processes with greater speed and accuracy. This enhances efficiency across industries like manufacturing, logistics, and services, where AI handles tasks from data entry to complex decision-making (Faishal et al., 2023). However, the rise of AI-driven automation raises concerns about job displacement, particularly for roles involving repetitive tasks. Managing transitions for affected workers and providing pathways for reskilling are essential (Poba-Nzaou et al., 2021). On the other hand, AI fosters job creation by driving new industries and roles, such as data scientists, AI engineers, and cybersecurity experts. It could enhance productivity by optimizing workflows and providing insights that drive innovation. AI enables organizations to analyze large datasets, predict trends, and make informed decisions, contributing to economic growth. Balancing productivity gains with job displacement challenges is key to ensuring AI supports sustainable economic and workforce development.

Labor Market Theories and AI

Existing theories on labor market shifts due to technological advancements provide insights into how innovations impact employment patterns. Joseph Schumpeter's "Creative Destruction" theory suggests that while technological advancements render certain industries and job roles obsolete, they simultaneously create new industries and opportunities, underscoring the dynamic nature of labor markets (Corrocher et al., 2023). This cycle of disruption and renewal drives economic growth by fostering new economic activities. Similarly, the "Skill-Biased Technological Change" (SBTC) theory posits that technological progress benefits high-skill workers, increasing demand for advanced skills while reducing the need for low-skill labor. This shift often leads to greater wage disparities, potentially exacerbating income inequality (Tsutsulaeva, 2023). Hence, together, these theories highlight the opportunities and challenges posed by technology, illustrating how advancements shape employment patterns and economic outcomes through both job displacement and the creation of new roles.

Human capital and labor substitution models offer valuable insights into how artificial intelligence (AI) affects labor markets. The human capital model emphasizes the importance of education, skills, and experience in enhancing worker productivity and employability, particularly in an AI-driven economy. As AI systems automate routine tasks, there is increasing demand for workers skilled in managing, designing, and interpreting AI processes, highlighting the need for continuous learning and skill development (Paslar, 2024). Conversely, labor substitution models examine how AI can replace human labor in specific tasks, particularly low-skill, repetitive roles (Felten et al., 2019; Poba-Nzaou et al., 2021). While AI may displace such jobs, it also creates new opportunities in areas requiring human creativity, oversight, and problem-solving—skills where AI remains limited (Acemoglu & Restrepo, 2018). By understanding these models, policymakers and organizations can better navigate AI's labor market impacts, balancing job displacement with the creation of new, AI-enhanced roles and ensuring that workers are equipped with the skills to thrive in a rapidly evolving job landscape.

Regulatory Theories and Technological Innovation

Theoretical perspectives on regulatory frameworks in response to technological disruption focus on how governments adapt to rapidly evolving technologies. One key approach is the "Regulatory Sandbox," which allows controlled experimentation, enabling regulators to test new technologies with limited constraints, fostering innovation while developing appropriate rules (Morgan, 2023; Tsai et al., 2020). Another perspective is the "Precautionary Principle," advocating for proactive regulation to prevent potential risks from emerging technologies like AI. This principle emphasizes taking precautionary measures to safeguard public welfare, even before definitive evidence of harm (Zetzsche et al., 2017). Both approaches help balance innovation with regulatory oversight, ensuring technological advancements align with societal values and ethical standards.

Public policy is also pivotal in managing the transition to AI-driven economies by shaping the integration of technological advancements into the labor market and broader economy. Effective policies address challenges such as job displacement and skill gaps, through measures like promoting education and vocational training. Social safety nets, including unemployment benefits and job transition support, assist individuals affected by technological disruptions (Goolsbee, 2018). Additionally, public policy drives responsible AI development by establishing ethical guidelines and regulatory standards, safeguarding data privacy,

preventing algorithmic biases, and ensuring transparency (Chhatre & Singh, 2024; Goolsbee, 2018). By setting clear regulations and fostering collaboration between government, industry, and academia, public policy mitigates negative impacts, supports innovation, and ensures that technological progress benefits society equitably.

DATABASE FINDINGS

Database analysis

The data presents the number of search results for various keyword combinations related to artificial intelligence (AI) and economic impact across different regions and are presented in Table 1. The break down and the analysis for the data statistically are discussed as follows.

The general search for "Artificial" AND "Intelligence" AND "Economic" yields 18,148 results, indicating a broad interest in the intersection of AI and economics. By adding the keyword "Impact" reduces the results to 3,969, showing that a more focused search on the economic impact of AI significantly narrows the scope. Furthermore, by adding country-specific keywords further narrows down the results, i.e "China" has 329 results, "Europe" has 66 results and "Indonesia" has 22 results. By adding "Impact" to the search, it results in a decrease from 18,148 to 3,969, a reduction of approximately 78.1%. Furthermore, China-related results (329) account for about 8.3% of the total "Impact" results, whereare Europe-related results (66) account for roughly 1.7%, and Indonesia-related results (22) account for about 0.6%.

Moreover, China has the most results among the specified regions, indicating a significant interest or volume of work related to AI's economic impact there, meanwhile Europe has fewer results than China, indicating relatively lesser but still notable interest or research activity. Indonesia has the fewest results, which could suggest a lesser focus or emerging interest in this area. In addition, searching for "Artificial" AND "Intelligence" AND "Economic" AND "Impact" AND "Indonesia" AND "China" AND "Europe" results in 0 hits, suggesting that there is little to no research that simultaneously considers the economic impact of AI across these three regions in a single study.

In the context of keywords, the most frequent keyword is "Artificial Intelligence" with 12,387 occurrences, followed by "Economic And Social Effects" (3,981), "Machine Learning" (1,963), "Decision Making" (1,887), "Decision Support Systems" (1,805). Furthermore, "Artificial Intelligence" is dominant, appearing in roughly 68.3% of the total results for this query (12,387 out of 18,148 from the previous data). For the search with "Artificial" AND "Intelligence" AND "Economic" AND "Impact", "Artificial Intelligence" remains the top keyword with 2,619 occurrences. The second most common term is "Economic And Social Effects" (858), suggesting a narrower focus on the societal implications of AI's economic impact. Furthermore, "Decision Support Systems" (497) and "Decision Making" (484) indicate a focus on how AI affects decision-making processes in economics. In addition, the query "artificial" AND "Intelligence" AND "Economic" AND "Impact" AND "Indonesia" AND "China" AND "Europe" results in 0 occurrences, highlighting a lack of comprehensive cross regional studies involving all three regions simultaneously.

Statistical Insights, "Artificial Intelligence" is consistently the most frequent keyword across all queries, indicating that it is the primary focus in research involving economics and AI. Furthermore, the keyword "Economic And Social Effects" suggests a significant emphasis on the broader implications of AI on society and the economy. In addition, China appears to have the most research activity compared to Europe and Indonesia when the focus is on the economic impact of AI. The terms "Decision Making" and "Decision Support Systems" indicate a cross-regional interest in how AI assists in economic decision-making processes.

From Table 1, it is also concluded that conference papers and articles are the dominant forms of dissemination, indicating a preference for sharing findings in academic settings and journals. Reviews and book chapters are less frequent, suggesting fewer comprehensive overviews or in-depth explorations in book formats. The presence of retracted papers in the China-focused search highlights a need for quality control in research dissemination. Furthermore, China's higher volume of articles and conference papers reflects more extensive research activity in AI's economic impact. Europe's and Indonesia's lower numbers suggest more limited but possibly emerging interest in this area. The absence of integrated studies across Indonesia, China, and Europe suggests an opportunity for more comprehensive cross-regional research.

Table 1. The Results of Boolean Operator for Selected Keywords

No	Keywords	Results	Top-Five Keywords	Document Type	Top-Five Subject area
1	"Artificial" AND "Intelligence" AND "Economic"	18,148	Artificial Intelligence: 12,387 Economic And Social Effects: 3,981 Machine Learning: 1,963 Decision Making: 1,887 Decision Support Systems: 1,805	Conference paper: 7,641 Article: 7,445 Review: 1,130 Book chapter: 1,115 Book: 242	Computer Science: 9,664 Engineering: 5,957 Mathematics: 2,915 Social Sciences: 2,498 Business, Management and Accounting: 1,937
2	"artificial" AND "Intelligence" AND "Economic" AND "Impact"	3,969	Artificial Intelligence: 2,619 Economic And Social Effects: 858 Decision Support Systems: 497 Decision Making: 484 Machine Learning: 427	Article: 1,846 Conference paper: 1,338 Review: 314 Book chapter: 288 Book: 76	Computer Science: 1,778 Engineering: 1,233 Social Sciences: 706 Environmental Science: 606 Business, Management and Accounting: 588
3	"artificial" AND "Intelligence" AND "Economic" AND "Impact" AND "China"	329	Artificial Intelligence: 220 China: 110 Economic And Social Effects: 61 Economic Development: 49 Article: 36	Article: 209 Conference paper: 61 Review: 22 Book chapter: 18 Retracted: 13	Computer Science: 112 Environmental Science: 83 Social Sciences: 78 Engineering: 67 Economics, Econometrics and Finance: 59
4	"artificial" AND "Intelligence" AND "Economic" AND "Impact" AND "Europe"	66	Artificial Intelligence: 38 Europe: 14 Decision Making: 11 Decision Support Systems: 9 Economic And Social Effects: 9	Article: 38 Conference paper: 16 Review: 4 Book chapter: 3 Conference review: 2	Computer Science: 19 Social Sciences: 19 Engineering: 15 Environmental Science: 13 Agricultural and Biological Sciences: 9
5	"artificial" AND "Intelligence" AND "Economic" AND "Impact" AND "Indonesia"	22	Artificial Intelligence: 17 Economics: 5 Indonesia: 5 Decision Support Systems: 4 Computers: 3	Conference paper: 14 Article: 5 Conference review: 2 Book chapter: 1	Computer Science: 14 Engineering: 7 Decision Sciences: 5 Mathematics: 4 Social Sciences: 3
6	"artificial" AND "Intelligence" AND "Economic" AND "Impact" AND "Indonesia" AND "China" AND "Europe"	0	0	0	0

In summary, the bulk of research on AI and economics is presented in conferences and journal articles, indicating an active and diverse scholarly discussion. There is considerable research activity on AI's economic impact in China, with fewer studies in Europe and Indonesia. The lack of integrated regional studies across Indonesia, China, and Europe presents a gap that future research could address to provide a more global perspective on AI's economic impact.

Furthermore, the data provides an overview of the top-five subject areas for research involving artificial intelligence (AI), economics, and impact across different keyword combinations. Computer Science is the leading subject area in all queries, suggesting that the majority of research on AI's economic impact is grounded in computational methods and technologies. The prominence of Engineering and Mathematics further emphasizes the technical nature of this research field. In the context of Interdisciplinary Focus, the inclusion of Social Sciences, Business, Management and Accounting, and Environmental Science across different queries indicates a multidisciplinary approach to studying AI's economic impact. The varying prominence of subject areas across regions reflects regional research interests and priorities, such as the notable presence of Environmental Science in China.

In the context of Regional Variation, China shows a relatively higher focus on Environmental Science and

Economics compared to other regions, suggesting specific national interests in these areas. Europe displays a balanced interest between technical and societal impacts, including unique attention to Agricultural and Biological Sciences. Indonesia's research appears more nascent, with a strong emphasis on Computer Science and less on other disciplines. In Summary, research on AI and economics is primarily rooted in Computer Science, indicating a strong focus on computational methods and technologies. There is an interdisciplinary trend with contributions from Engineering, Mathematics, Social Sciences, and Business studies, showing that AI's economic impact is a multifaceted topic. Regional variations suggest different research priorities, with China focusing more on Environmental Science and Economics, Europe on a balanced range including Agricultural Sciences, and Indonesia primarily on Computer Science. The absence of integrated research across Indonesia, China, and Europe suggests an opportunity for comprehensive cross-regional studies on AI's economic impact.

RESULTS AND DISCUSSION

Regional Contexts and AI Adoption

Indonesia

Indonesia's economy, as a developing country in Southeast Asia, is characterized by its diverse sectors, with significant contributions from agriculture, manufacturing, and services. The labor market is similarly varied, featuring a large informal sector alongside formal employment. The economy has experienced robust growth in recent years, driven by its young population and expanding middle class (Tambunan, 2020). However, Indonesia faces structural challenges, including income inequality and uneven regional development (Hapsari et al., 2023). On the other hand, the labor market structure reflects these challenges, with a substantial proportion of the workforce engaged in low-wage, informal jobs, and a growing need for skilled labor to support economic advancement and industrialization.

AI adoption in Indonesia has been gradually increasing, with the technology being integrated into key sectors such as manufacturing and services. In manufacturing, AI-driven automation is enhancing productivity and efficiency, while in services, AI is improving customer interactions and operational processes (Yusriadi et al., 2023). Key sectors affected by AI include the automotive and electronics industries, which are leveraging AI for production and quality control, and the financial services sector, which is adopting AI for risk assessment and customer service. Despite these advancements, Indonesia faces challenges related to AI-driven automation, such as potential job displacement and the need for workforce upskilling (Augustin et al., 2023). As a developing economy, addressing these challenges involves balancing technological growth with the development of supportive policies and educational programs to ensure a smooth transition and equitable benefits from AI advancements.

China

China's AI strategy is characterized by its ambitious goals to become a global leader in artificial intelligence by 2030. The country has invested heavily in AI research and development, focusing on integrating AI technologies across various sectors to drive economic growth and technological advancement (Roberts et al., 2020). China's strategy includes fostering innovation through substantial government funding, creating AI research hubs, and encouraging collaboration between academia and industry. The government's commitment is reflected in its long-term plans, such as the "Next Generation Artificial Intelligence Development Plan," which outlines strategic priorities and targets for AI development (Roberts et al., 2021). China's leadership in AI is evident in its rapid advancements in areas such as facial recognition, natural language processing, and autonomous systems.

Furthermore, the impact of AI on China's labor market and industries is profound, with significant changes observed in manufacturing and technology sectors. In manufacturing, AI-driven automation has increased productivity and efficiency, while also displacing some lower-skilled jobs (Zhou et al., 2020). However, it has created opportunities for highly skilled roles related to AI development and system maintenance. The tech industry, in particular, has benefited from AI advancements, with companies leveraging

AI for innovation in software development, data analytics, and smart technologies (Furman & Seamans, 2019). To manage these transformations, the Chinese government has implemented policies and initiatives like "Made in China 2025," which aims to upgrade the manufacturing sector through advanced technologies, including AI (Glebova et al., 2024). Additionally, China is developing AI regulatory frameworks to address ethical concerns, data privacy, and the socio-economic impacts of AI. These policies are designed to balance rapid technological growth with regulatory oversight, ensuring that the benefits of AI advancements are harnessed effectively while mitigating potential risks.

Europe

AI adoption in European countries is diverse and sector-specific, reflecting the continent's varied industrial landscape. In industries such as automotive, European countries are leveraging AI for advancements in autonomous driving, predictive maintenance, and manufacturing efficiency (Luise, 2024). For instance, Germany and France are leading in integrating AI technologies into vehicle design and production processes. The tech sector across Europe is also seeing significant AI integration, with companies focusing on AI for data analytics, cybersecurity, and software development (Jan et al., 2023). In healthcare, AI is being used for diagnostics, personalized medicine, and administrative efficiency, with countries like the UK and the Netherlands pioneering AI applications to improve patient care and streamline operations. This widespread adoption demonstrates Europe's commitment to harnessing AI's potential to drive innovation and economic growth.

The impact of AI on labor markets in developed European economies includes both opportunities and challenges. While AI enhances productivity and creates new job roles in high-tech sectors, it also poses risks of job displacement, particularly in routine and manual occupations. The shift towards AI-driven processes necessitates a focus on reskilling and upskilling the workforce to adapt to new job requirements and technologies (Cabral, 2018; Jan et al., 2023). To address these challenges, the European Union has introduced regulatory approaches aimed at balancing innovation with ethical considerations. The General Data Protection Regulation (GDPR) sets standards for data privacy and protection, influencing how AI systems handle personal data. (Comunale, 2024). Additionally, the EU's proposed AI Act seeks to regulate the deployment of AI technologies by categorizing them based on risk and establishing requirements for transparency, accountability, and fairness. These regulatory frameworks aim to ensure that AI advancements contribute positively to society while safeguarding individual rights and fostering trust in AI technologies.

Economic Impact of AI on Labor Markets

Job Creation and Displacement

The impact of AI on job creation and displacement varies across Indonesia, China, and Europe, influenced by their economic structures and technological development. In Indonesia, AI has caused job losses mainly in low-skilled roles in manufacturing and agriculture. However, new opportunities are emerging in tech-related fields such as digital services, e-commerce, and AI-driven sectors, creating roles in data analysis and software development (Georgieff & Hyee, 2022). In China, rapid AI adoption has displaced many traditional manufacturing jobs but has also generated high-skilled positions in tech and AI development, aligning with the country’s ambition to lead globally in AI. Europe's advanced economies face a more nuanced situation(Glebova et al., 2024). While automation affects routine jobs in manufacturing and retail, there’s strong job growth in AI-driven industries. European labor markets also benefit from retraining and upskilling programs aimed at minimizing job losses.

Skill gaps and labor transitions present challenges in all regions. Indonesia’s workforce needs more advanced technical skills, highlighting the need for comprehensive training programs. China faces a growing demand for highly skilled AI professionals, prompting targeted educational initiatives. Europe adopts proactive workforce policies and educational reforms to address skill mismatches, ensuring smoother transitions (Olaniyi et al., 2024). Hence, tailored strategies are vital for maximizing AI’s benefits while minimizing employment disruptions.

Productivity and Economic Growth

AI's impact on productivity growth and economic output varies across regions based on technological adoption and economic development. In developed economies like Europe, AI boosts productivity by enhancing efficiency in sectors such as manufacturing, services, and technology. Automation and data analytics reduce costs and improve decision-making, leading to higher economic output (Maghfirah & Eni, 2024). For instance, AI in automotive and healthcare industries has increased efficiency and improved outcomes. Furthermore, in emerging economies like Indonesia and China, the effects are mixed. Indonesia is in the early stages of AI adoption, with potential gains in agriculture and manufacturing, though challenges like infrastructure and skill shortages remain (Huang, 2024). China's aggressive AI strategy has significantly improved productivity in manufacturing and tech, thanks to automation and advanced AI applications.

Sectoral Impact

AI's impact on industries varies across Indonesia, China, and Europe, shaped by each region's economic focus and technological readiness. In Indonesia, AI affects manufacturing, agriculture, and retail, with automation optimizing production and crop management, while e-commerce and customer service technologies transform retail. In China, AI is significantly reshaping manufacturing through automation and boosting the tech sector with investments in electronics and AI research (Annoni *et al.,* 2018). Europe sees AI-driven changes in automotive, healthcare, and financial services, with automation improving manufacturing, patient care, and financial analytics. Sectors most vulnerable to AI disruption vary. In Indonesia, manufacturing and agriculture, reliant on manual labor, face risks of job displacement, though new advanced roles are emerging. In China, manufacturing experiences automation challenges, while the tech sector grows. In Europe, automotive and manufacturing are susceptible to automation, but regulatory frameworks and upskilling programs ease the transition (Mou, 2019). Healthcare and finance undergo AI-enhanced transformation rather than displacement.

Regulatory Responses to AI

Indonesia

The Indonesian government is addressing AI's labor market impact through policies like the "100 Smart Cities" program and "Making Indonesia 4.0" roadmap. These initiatives focus on integrating AI into sectors, developing digital infrastructure, fostering innovation, and enhancing skills through education and vocational training. The government aims to mitigate AI's negative effects on traditional jobs while promoting growth in tech (Santoso et al., 2024). The National Strategy for Artificial Intelligence emphasizes a supportive environment for AI development through regulatory frameworks.

However, challenges remain. Regulatory frameworks lag behind AI advancements, leaving gaps in areas like data privacy and algorithmic bias. The digital divide between urban and rural areas complicates comprehensive AI implementation. To manage AI's impact, Indonesia needs robust, forward-looking policies that ensure equitable access to AI benefits and support workers transitioning to new roles (Aryanto et al., 2023).

China

China's government has implemented initiatives to regulate AI, balancing rapid technological advancements with economic growth and labor market disruptions. The 2017 "Next Generation Artificial Intelligence Development Plan" outlines China's vision to become a global AI leader by fostering innovation and industrial application (Roberts et al., 2021). Complementary policies focus on managing labor changes, promoting AI skills, and creating jobs in emerging tech sectors. Through investments in AI research, infrastructure, and collaboration between government, industry, and academia, China seeks to leverage AI for economic growth while addressing job displacement.

China also emphasizes AI ethics, data security, and long-term planning. Regulatory frameworks, like the

Personal Information Protection Law (PIPL), address concerns over fairness, transparency, and data protection, ensuring responsible AI use. Comprehensive guidelines aim to balance innovation with societal well-being and sustainable growth (Everett et al., 2015).

Europe

The European Union has introduced comprehensive regulations to guide AI development and address labor market impacts. The proposed AI Act categorizes AI applications by risk and sets stringent requirements for high-risk systems, emphasizing safety, accountability, and transparency. Alongside this, the General Data Protection Regulation (GDPR) ensures robust data protection, vital for managing personal data processed by AI. These frameworks foster a secure, ethical environment for AI innovation (Kullmann & Cefaliello, 2021). The EU also focuses on ethical AI, requiring transparency in decision-making and offering recourse for individuals if rights are violated. Worker protections are prioritized, with reskilling and upskilling initiatives helping workers transition to AI-driven roles. This approach balances innovation with individual rights and labor market stability.

COMPARATIVE ANALYSIS

Key Differences in AI Adoption and Economic Impact

The economic impact of AI varies significantly between emerging economies like Indonesia and advanced economies such as China and Europe. In Indonesia, AI adoption focuses on addressing developmental challenges and boosting productivity in sectors like agriculture and manufacturing. AI is used to optimize supply chains and improve efficiency in traditional industries, but its impact is slowed by limited infrastructure and skill shortages (Somjai et al., 2020). As a result, AI's economic influence is more gradual, with efforts centered on meeting basic needs and promoting economic inclusivity.

In contrast, advanced economies like China and Europe experience faster and more pronounced economic effects due to stronger technological infrastructure and investment. China leverages AI to drive growth in manufacturing and technology, supported by government investments and innovation. Europe, focusing on ethical AI and data protection, sees AI's impact in industries such as automotive, healthcare, and finance (Goode & Kim, 2021). These regions benefit from advanced regulatory frameworks and quicker labor market adaptations, resulting in greater economic gains.

Divergences in Regulatory Approaches

Government responses to AI's labor market impact vary across Indonesia, China, and Europe, reflecting regional priorities and regulatory approaches. In Indonesia, the focus is on fostering AI adoption to drive economic growth through initiatives like the "100 Smart Cities" program and "Making Indonesia 4.0." While these policies emphasize skill development and infrastructure improvements, they lack targeted regulations addressing AI's direct impact on the labor market (Silitonga & Isbah, 2023). The approach is gradual, aiming to integrate AI while adjusting labor policies over time.

China, on the other hand, has implemented a more proactive strategy. The "Next Generation Artificial Intelligence Development Plan" and other regulations focus on managing AI's effects on employment, with substantial investments in tech-driven sectors and workforce transitions. Europe has developed advanced frameworks like the AI Act and GDPR, emphasizing transparency, ethical AI use, and worker protections (Dixon, 2023). These tailored approaches reflect the need for emerging economies to focus on broad policies, while advanced economies require more specific regulations to balance innovation, ethics, and labor market stability.

Lessons Learned and Best Practices

Successful regulatory strategies for mitigating AI-related labor disruptions include proactive reskilling and upskilling programs, essential for transitioning workers from AI-affected roles to emerging fields. Europe's focus on education and vocational training, alongside regulatory sandboxes for controlled AI experimentation,

demonstrates effective approaches for managing labor market shifts (Soueidan & Shoghari, 2024). These strategies balance technological advancement with workforce stability, maximizing AI benefits while minimizing negative employment impacts.

Cross-regional learning offers significant potential, with emerging economies like Indonesia benefiting from Europe's and China's advanced frameworks and proactive skill development. Conversely, advanced economies can adopt the flexible, innovation-driven approaches of emerging regions (Fenwick et al., 2018). By sharing best practices and adapting strategies to fit regional contexts, countries can better manage AI's impact on labor markets, ensuring policies are both forward-looking and responsive.

Future Directions and Policy Recommendations

Future AI developments are set to reshape global labor markets through advancements in machine learning, robotics, and automation. As AI systems become more sophisticated and autonomous, they are likely to automate routine jobs, potentially displacing traditional roles. However, this evolution will also create new opportunities, such as roles in AI system design, maintenance, and ethical oversight, necessitating shifts in workforce skills and education. While AI promises increased productivity and economic growth, it will require strategic planning to manage workforce transitions effectively.

Economic trends suggest that advanced economies like Europe and China will see AI drive innovation and productivity, though they may face challenges such as job displacement and skill mismatches, necessitating robust reskilling and adaptable policies. Emerging economies like Indonesia may experience slower AI adoption and more significant disruptions due to existing gaps in infrastructure and education. These regions will need to address immediate labor market challenges while fostering sustainable growth. Cross-regional comparisons indicate that while AI's impact is universal, responses should be tailored to specific contexts. Advanced economies should focus on regulatory frameworks and skill development, while emerging economies should prioritize infrastructure and education investments for gradual AI integration.

Policy Recommendations for Indonesia, China, and Europe

To foster inclusive economic growth and address AI-related labor market disruptions, policy adjustments should be tailored to the specific needs of Indonesia, China, and Europe. For Indonesia, the emphasis should be on building robust digital infrastructure and enhancing educational opportunities. Expanding access to technology and vocational training, especially in underserved regions, is crucial for preparing the workforce for new roles created by AI. Additionally, targeted support for industries such as agriculture and manufacturing, which are heavily impacted by automation, can help mitigate the negative effects on employment.

In China, policies should support high-tech and AI-driven sectors while addressing potential job displacement in traditional industries. Strengthening reskilling programs is essential to prepare the workforce for emerging opportunities. The development of regulatory frameworks that balance innovation with worker protections, including ethical considerations and data privacy, is also important. By focusing on lifelong learning and adaptive skill development, China can better manage labor market transitions and sustain economic growth driven by AI advancements.

For Europe, policy adjustments should refine existing frameworks to address AI's impact on labor markets and promote economic inclusivity. This includes enhancing education and retraining programs to meet the evolving demands of AI and automation. Strengthening labor market resilience through social safety nets and transition support for displaced workers is also vital. Additionally, Europe should continue leading in establishing international standards for ethical AI use and data protection, ensuring technological advancements contribute to fair and equitable growth. By integrating these strategies, Europe can maintain its technological leadership while addressing AI-related challenges in a balanced manner.

CONCLUSIONS

The literature review highlights several key findings regarding the impact of AI on labour markets across different regions. Emerging economies, such as Indonesia, face significant challenges related to AI adoption

due to infrastructural limitations and skill gaps, though there are opportunities for growth through targeted investments in technology and education. In contrast, advanced economies like China and Europe benefit from more sophisticated technological infrastructures and regulatory frameworks, which facilitate faster integration of AI and greater economic benefits. However, these regions also experience considerable labour market disruptions, necessitating robust strategies for workforce adaptation and skill development. The comparative analysis underscores that while AI drives productivity and economic growth, its effects on employment are complex and require tailored approaches to mitigate job displacement and leverage new opportunities.

The importance of regulatory frameworks in shaping the future of work with AI cannot be overstated. Effective regulations are crucial in managing the dual challenges of fostering innovation while protecting workers and ensuring ethical practices. In Indonesia, China, and Europe, tailored regulatory approaches are necessary to address the specific needs and conditions of each region. These frameworks should focus on promoting transparency, ethical AI use, and balanced economic growth while mitigating adverse labor market impacts. The successful implementation of such regulations will play a pivotal role in determining how well regions can adapt to AI's transformative effects and ensure that the benefits of technological advancements are broadly shared.

Continued research and international collaboration are essential to addressing global AI-related labor challenges. As AI technologies evolve and their impacts on labor markets become more pronounced, ongoing investigation into their economic and social effects will provide valuable insights for policymakers and stakeholders. Collaborative efforts across borders will facilitate the sharing of best practices, regulatory strategies, and technological advancements, helping to create a more resilient and equitable global labor market. By fostering international dialogue and research, countries can better navigate the complexities of AI integration and work together to develop solutions that address the challenges and opportunities presented by this rapidly advancing technology.

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