Journal of Computer Science and Technology Studies
ISSN: 2709-104X
DOI: 10.32996/jcsts
Journal Homepage: www.al-kindipublisher.com/index.php/jcsts

JCSTS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Artificial Intelligence and the Evolving Labor Market: A Comprehensive Review and Policy Roadmap

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| ABSTRACT

The proliferation of artificial intelligence (AI) represents a transformative inflection point for global labor markets, distinguished from previous technological revolutions by its capacity to automate complex, non-routine tasks traditionally reserved for high-skilled professionals.[1] This report synthesizes findings from a vast body of academic and industry research to provide a data-driven analysis of AI's multifaceted impact. From a macroeconomic perspective, AI's full economic benefits have yet to be realized, with current empirical data showing minimal aggregate effects on employment and wages.[6] This apparent discrepancy is largely due to the nascent stage of AI adoption, which is currently hindered by organizational and data-related bottlenecks.[8] The true impact of AI is best observed at the micro-level, where its dual nature as both an automating and an augmenting force is reshaping the fundamental composition of work. A critical finding is that AI's exposure is highest among occupations in the 80th earnings percentile, challenging the historical precedent of technology primarily displacing low-skilled labor.[4] In fact, AI assistance disproportionately benefits low-skilled and novice workers, helping to compress wage scales within a profession.[9] However, a countervailing force is at play, as workers with "AI capital" are commanding significant wage premiums, potentially widening the gap between those who adapt and those who do not.[12] Notably, the most pronounced employment declines have been observed among early-career workers in high-exposure occupations, suggesting that AI is displacing the entry-level work that serves as a training ground for new professionals.[14] This analysis concludes with a policy roadmap to ensure a worker-centric AI economy, with recommendations centered on improving data and measurement, modernizing education and workforce development, strengthening social safety nets, and implementing targeted interventions to address geographic and demographic inequalities.

| KEYWORDS

Artificial Intelligence, Labor Market, Augmentation, Automation, Skills, Wages, Inequality, Policy, Causal Inference, Workforce Development

| ARTICLE INFORMATION

ACCEPTED: 03 October 2025 **PUBLISHED:** 17 October 2025 **DOI:** 10.32996/jcsts.2025.7.10.33

Introduction

The causal impact of artificial intelligence (AI) on the labor market is not a singular, uniform force but a fundamentally heterogeneous one. This report finds that AI's primary effect within knowledge-intensive occupations is not mass automation, but rather a nuanced process of augmentation that reconfigures work at the task level. This dynamic is leading to a profound reallocation of human effort from repetitive, rules-based activities to higher-order, non-routine responsibilities.16

This reorientation of labor presents a dual effect on economic inequality. At a micro-level, AI augmentation demonstrates a clear potential for skill-leveling. Empirical evidence from a study of customer support agents shows that AI tools disproportionately boost the productivity of less-experienced and lower-skilled workers, with a minimal or even negative impact on highly skilled employees.9 This dynamic challenges historical trends where technology amplified the skill premium and could, in the long term, appreciably narrow the wage gap between high- and low-skill workers.18

Conversely, at a macro-level, the benefits of AI adoption are concentrating in already-wealthy regions, among high-skill professionals, and within large, well-resourced enterprises.8 Data reveals that high-adoption countries exhibit a more collaborative, augmented use of AI, while lower-adoption countries tend toward simpler, automated usage patterns. This uneven diffusion of AI could exacerbate global and domestic economic inequality, reversing recent trends of growth convergence.8

The ultimate outcome of this technological shift—whether it leads to widespread economic leveling or a deepening of existing inequalities—is not predetermined by the technology itself. Instead, it will be shaped by deliberate organizational and policy choices that govern its adoption and diffusion.18

AI Adoption Disparates

Data from the Anthropic and Open AI Economic Index shows a significant geographic divide in AI adoption Recent 2024–2025 survey data indicates uneven patterns of AI adoption across countries. India, UAE, and Singapore exhibit the highest deployment rates (53–59%), reflecting rapid digital transformation and favorable government initiatives. China (50%) also demonstrates strong uptake, while the United States (33%) and European countries such as Germany (32%), France (26%), and the UK (37%) display relatively lower deployment despite higher exploration levels (41–45%). South Korea (40%) balances both adoption and exploration, indicating steady progression. These trends suggest that emerging economies are leapfrogging in AI deployment, while advanced economies are taking a more measured approach due to regulatory, ethical, and integration considerations., lead in per-capita AI usage

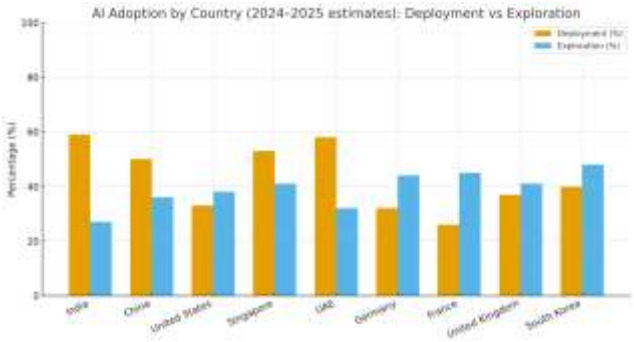


Image - AI Adoption Rates by Country (2024-2025)

1. Chapoter 1 : The Macroeconomic and Historical Context of AI's Labor Impact

1.1. AI in the Context of Technological Revolutions

The current discourse surrounding AI's impact on employment is often characterized by a palpable sense of "automation anxiety" 14, a phenomenon with deep historical roots. Such concerns echo sentiments from nearly two centuries ago, when economists used phrases like "mental steam power" and "intellectual machinery" to describe the disruptive potential of new technologies.22 To understand AI's unique position in this history, it is essential to re-examine the canonical economic framework that has long guided the analysis of technology's effect on labor: the Skill-Biased Technical Change (SBTC) hypothesis.

The SBTC hypothesis posits that a burst of new technology, such as the computerization of the 1980s, increased the relative demand for highly skilled workers, thereby raising earnings inequality.22 This framework held a "virtually unanimous agreement" among economists and was largely supported by the observation that earlier technologies, like industrial robots, primarily substituted for low-skill, routine tasks.22 However, a critical reassessment of the SBTC hypothesis reveals that it "falls short as a unicursal explanation" for the evolution of the U.S. wage structure, particularly after wage inequality stabilized in the 1990s despite continued advances in computing.22 This inadequacy suggests that the relationship between technology and the labor market is more complex than a simple, linear progression of skill-biased change.

AI represents a fundamental departure from this historical pattern. Unlike industrial robots, which predominantly substitute for low-skill labor, AI is designed to perform a wide range of non-routine, complex tasks.1 Its capabilities extend to intellectual and cognitive functions such as image classification, language understanding, and visual reasoning.2 This proficiency allows AI to

substitute for tasks performed by high-skilled workers, including medical diagnosis, legal document production, and software coding.1 By placing downward pressure on the wages of high-skill workers, AI has the theoretical potential to reduce the skill premium and narrow the wage gap, a direct counter-narrative to the central premise of the SBTC hypothesis.18 This nuanced understanding of AI's capabilities is foundational to analyzing its contemporary and future effects on the labor market.

1.2. Aggregate Economic Impacts: GDP, Productivity, and Employment

AI's disruptive potential is widely recognized, but its overall economic impact remains highly debated. Long-term projections often differ from current empirical evidence. Leading reports take an optimistic stance, suggesting that AI could add as much as $13 trillion to the global economy and boost global GDP growth by 7%. The Penn Wharton Budget Model predicts a lasting increase in economic activity, with cumulative GDP levels rising 1.5% by 2035 and nearly 3.7% by 2075. Much of this expected growth is attributed to substantial productivity gains—a Goldman Sachs report anticipates a 15% jump in labor productivity once AI is fully adopted. The PwC 2025 Global AI Jobs Barometer echoes this outlook, noting that productivity growth in AI-exposed industries has surged since 2022, climbing from 7% to 27%.

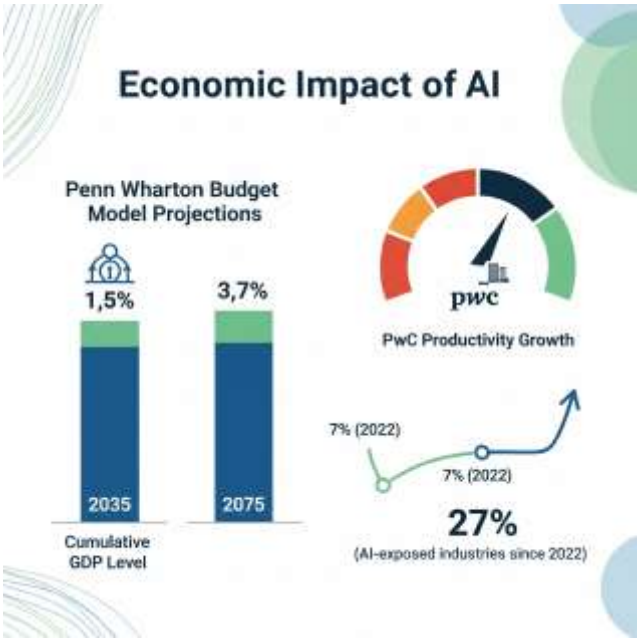
Despite these optimistic forecasts, real-world data currently paints a more subdued picture. A key NBER working paper found "no discernible relationship between AI exposure and employment or wage growth at the occupation or industry level." This conclusion is supported by the U.S. Census Bureau's 2023 Annual Business Survey, which found that technology adoption—including AI—has had "little impact on the number or skills of workers that businesses employ."

These apparently conflicting results can be reconciled by considering how technology spreads over time. The optimistic economic predictions are long term, depending on the "full" or "widespread" adoption of AI. In contrast, today's modest empirical results reflect the early stage of AI's integration into the economy. Adoption rates remain low: by mid-2025, fewer than 10% of U.S. firms reported regular AI use, while a Goldman Sachs survey placed the figure at 9.3%. The hurdle for businesses isn't just acquiring AI, but also making substantial investments in "costly data modernization and organizational" changes needed to use it effectively. As a result, AI's macroeconomic benefits may follow a "J-curve" pattern—an initial period of limited impact followed by a sharp rise in productivity and growth as adoption becomes widespread.

Concerns about job displacement persist, but the literature suggests that AI's effects on total employment will be "modest and relatively temporary." A Goldman Sachs report, for example, forecasts only a half-percentage point rise in unemployment during the transition. Meanwhile, global organizations such as the World Economic Forum predict a net gain of 69 million jobs worldwide by 2028 thanks to AI and automation.

Optimistic Projections Section:

- $13 trillion global economic contribution potential
- 7% global GDP growth projection
- 15% labor productivity increase



2. Chapter 2: Automation vs. Augmentation: A Nuanced Framework for Analysis

2.1. Conceptualizing AI's Role: Automation vs. Augmentation

A core analytical framework for understanding AI's impact on the micro-level of work is the distinction between automation and augmentation. AI as automation refers to the use of AI to replace "repetitive, rules-based tasks".29 This approach aims to eliminate manual work, reduce errors, and free up human time.29 Conversely,

AI as augmentation involves leveraging AI to enhance or amplify human capabilities, empowering individuals to work "faster, smarter, and with better insight".29 This form of AI fosters the emergence of new tasks and roles where human labor has a comparative advantage, ultimately boosting labor demand and wages.2

While some experts and organizations advocate for prioritizing augmentation for its superior long-term performance benefits 25, a deeper analysis reveals that automation and augmentation are not mutually exclusive. The two applications are "interdependent across time and space" and create a "paradoxical tension" that leaders must navigate.30 The most effective strategy involves a hybrid approach, where AI handles "what's repeatable and support[s] what's strategic".29 For example, in customer service, AI can automate routine ticket categorization and triage while simultaneously augmenting human agents by providing real-time analytics and case summaries.31

A compelling empirical demonstration of AI's augmentative effect comes from an analysis of generative AI usage in coding. The data shows a significant shift in task composition, with the share of tasks involving "creating new code" more than doubling (up 4.5 percentage points) while "debugging and error correction" tasks fell by 2.8 percentage points.8 This is more than a simple efficiency gain; it represents a fundamental redefinition of the programmer's role. By automating the tedious, routine aspects of code maintenance, AI frees human programmers to focus on the higher-order, creative tasks of system architecture and innovation, thereby elevating the human role rather than merely replacing it.

2.2. Methodologies for Measuring AI Exposure and Impact

Accurate analysis of AI's labor market consequences relies on robust and dynamic methodologies that move beyond mere correlation to establish causal links. The most widely used approach involves constructing **task-based AI exposure scores**.9 This methodology leverages databases like the US Bureau of Labor Statistics' O*NET system, which provides detailed descriptions of tasks for thousands of occupations.9 Researchers now use state-of-the-art Large Language Models (LLMs) such as OpenAI's ChatGPT 4o and Anthropos's Claude 3.5 Sonnet to assess the percentage of each task that can be performed by an AI at various stages of capability.33 This approach enables the creation of a "dynamic Occupational AI Exposure Score" that evolves with technological advancements, offering a scalable and near real-time alternative to traditional, slower survey-based methods.33

To establish causal relationships, researchers are increasingly employing sophisticated econometric methods. One key framework is the use of Structural Causal Models (SCMs), which represent variables as nodes in a directed acyclic graph (DAG) to map causal mechanisms.35 This allows researchers to isolate the direct effect of a policy or technology change by adjusting for potential confounding variables.35

A powerful example of a causal inference study is the analysis of a generative AI tool's staggered introduction to a large firm's customer service agents.9 The staggered rollout allowed researchers to use a **difference-in-differences (Did)** approach, comparing the productivity changes of agents who received the tool to those who did not.9 Furthermore, the study took advantage of "software outages" as a "natural experiment" to provide evidence of durable learning among workers.9 This methodological rigor provides a solid foundation for the empirical findings presented in this report, offering a more precise understanding of AI's effects than correlational studies alone.

2.3. The Empirical Evidence on Task Composition

Data-driven analyses confirm that AI's impact is far from uniform, challenging traditional assumptions about which jobs are most vulnerable. The Penn Wharton Budget Model found that occupations around the 80th percentile of earnings are the most exposed to AI automation, with approximately half of their work susceptible to automation on average.4 This finding directly contradicts the conventional notion that AI primarily affects blue-collar jobs, highlighting the potential for significant disruption across various skill levels.3

The following table, drawing on data from the Penn Wharton Budget Model, illustrates the wide variance in AI exposure across different occupational groups 4:

Aggregated Occupation Group	Percent of Work Susceptible to AI Automation
Office and Administrative Support Occupations	75.5% 4
Business and Financial Operations Occupations	68.4% 4
Computer and Mathematical Occupations	62.6% 4
Sales and Related Occupations	60.1% 4
Management Occupations	49.9% 4
Legal Occupations	47.5% 4
Arts, Design, Entertainment, Sports, and Media Occupations	45.8% 4
Architecture and Engineering Occupations	40.7% 4
Life, Physical, and Social Science Occupations	31.0% 4
Educational Instruction and Library Occupations	29.5% 4
Community and Social Service Occupations	27.5% 4
Healthcare Practitioners and Technical Occupations	23.1% 4
Protective Service Occupations	20.7% 4
Transportation and Material Moving Occupations	20.0% 4
Food Preparation and Serving Related Occupations	18.1% 4
Personal Care and Service Occupations	17.5% 4
Healthcare Support	15.5% 4

Occupations	
Production Occupations	14.4% 4
Installation, Maintenance, and Repair Occupations	13.1% 4
Farming, Fishing, and Forestry Occupations	9.7% 4
Construction and Extraction Occupations	8.9% 4
Building and Grounds Cleaning and Maintenance Occupations	2.6% 4

Specific high-exposure, high-skill roles include computer programmers, accountants, and legal and administrative assistants.5 Conversely, occupations at the bottom of the wage distribution, which often involve manual labor or personal services, are the least exposed.4 An NBER study also found that occupations relying on "complex reasoning and problem-solving tend to experience larger declines in full-time work and overall employment in association with rising AI exposure".33

A seminal study on customer service agents provides a critical counterpoint, revealing that AI assistance increased average productivity by 14%.9 Most notably, the productivity gains were highly uneven, accruing disproportionately to novice and low-skilled workers, who saw a 34% increase in their issues-resolved-per-hour rate, while experienced workers saw "minimal impacts".9 This finding suggests that AI acts as a skill disseminator, implicitly learning the best practices of top performers and disseminating them to less-skilled workers, thereby helping newer employees move more quickly down the experience curve.9

3. Chapter 3: The Social Dimensions of AI's Impact on Work

3.1. Skill Polarization and the Evolving Skill Premium

The impact of AI on wage inequality is multifaceted and often defies a straightforward narrative of polarization. One view posits that AI has the potential to reduce the wage premium for college-educated workers by disrupting their roles more than those of low-wage, manual laborers. This perspective is supported by evidence showing that early AI tools tend to benefit lower-skilled workers more than top performers, a trend that could eventually lead to a “compression” of wage scales.

At the same time, an opposing trend is gaining momentum. Recent research indicates that AI is driving a new form of skill-based inequality due to its rapid integration into the workforce. According to the PwC 2025 Global AI Jobs Barometer, which examined nearly a billion job postings, positions requiring AI expertise now command a substantial wage premium—reaching 56% in 2024, more than double the 25% premium observed the previous year. This data suggests that while AI can help level the playing field within specific occupations by elevating lower-skilled workers, it also widens the gap between workers who possess valuable “AI capital” and those who do not.

The future trajectory of the labor market depends on which of these forces becomes dominant. If AI primarily serves as an augmenter, it could narrow wage disparities within professions. However, as demand for highly paid, AI-centric skills rises, it may also heighten overall income inequality. This dual dynamic underscores the inadequacy of a simplistic model of AI’s impact and highlights the urgent need for robust workforce development and education policies.

3.2. Differential Impacts by Demographics and Experience

The influence of AI is not uniformly distributed across various demographic groups, with certain populations experiencing disproportionate effects. A notable and significant discovery pertains to the particular vulnerability of early-career professionals. A Stanford research paper, which analyzed high-frequency administrative data, revealed that since late 2022, "early-career workers (ages 22-25) in occupations most exposed to AI have experienced a 13 percent relative decline in employment." This trend contrasts sharply with the stable or increasing employment rates of more seasoned workers in the identical occupations. This observation aligns with other reports noting a recent increase in unemployment among university graduates and a deceleration in job creation within AI-intensive tech industries.

The disproportionate impact on young professionals suggests a fundamental alteration in the labor market. AI is effectively automating the "entry-level" tasks that have historically served as foundational training for new professionals. As AI undertakes routine duties such as documentation and test generation, new hires are anticipated to contribute at a higher level from their

initial day of employment, leading to a "prolonged readiness gap at the entry level" as companies encounter a growing disparity between academic instruction and the demands of AI-enabled roles. The AI tool is essentially becoming a competitor for the role of a junior employee, who traditionally acquires skills by performing the very tasks now subject to automation.

Beyond age, AI also exerts differential impacts across other demographic cohorts. A United Nations report cautions that women's employment is disproportionately at risk, with 28% of their roles globally threatened compared to 21% of men's jobs. The International Labor Organization's (ILO) report further refines this, indicating that women hold over three times the share of jobs susceptible to automation due to generative AI (5.3%) compared to men (1.6%), reflecting women's concentration in routine clerical positions. However, women also stand to gain the most from augmentation, with 22.7% of female-held jobs potentially enhanced by AI technologies, in contrast to 13% for men. These findings underscore the potential for AI to exacerbate existing inequalities if not proactively managed.

3.3. The Shifting Demand for Skills

The adoption of AI is rapidly and fundamentally reshaping the skills needed to succeed at work. According to the PwC 2025 Global AI Jobs Barometer, the skills employers seek are evolving "66% faster in jobs 'most exposed' to AI." Instead of prioritizing traditional technical skills, employers are now looking for abilities that enhance, rather than compete with, AI.

Today's key skills include AI fluency, systems thinking, problem framing, and contextual judgment. Companies are assessing candidates not just on their basic coding abilities, but on how effectively they use AI tools to solve problems. The importance of uniquely human traits is also growing; as AI takes over more execution tasks, ethics, empathy, and creativity have become vital—allowing people to focus on strategic oversight and design.

Interestingly, some studies indicate a drop in demand for skills once considered central to high-skill jobs. For example, an OECD report notes that while "management and business skills" were initially in higher demand for roles most exposed to AI, that demand is now declining. This shift likely reflects how AI is automating significant elements of project management, finance, and clerical work, pushing employers to reassess which skills are most valuable.

4. Chapter 4: A Policy Roadmap for a Worker-Centric AI Economy

The findings of this indicate that the impact of AI is not a foregone conclusion but a complex process shaped by strategic decisions. To mitigate risks and harness AI's potential for broad-based prosperity, policymakers must adopt a proactive, worker-centric approach. This requires a comprehensive policy roadmap focused on data, education, social safety nets, and targeted interventions.

4.1. The Critical Need for Better Data and Measurement

A foundational challenge in formulating effective AI policy is the lack of timely, high-quality data. The slow pace of traditional labor market research, which often relies on outdated surveys, is ill-suited to track the "hyper-fast pace of AI innovation".34 Experts agree on the urgent need for a new data infrastructure that enables policymakers to monitor changes in the labor market in near real-time.21 The solution lies in making existing data collection systems more flexible and coordinating information sharing across government agencies and private organizations.21

This suggests a new model for data collection. The use of LLMs to generate "dynamic" exposure scores from real-time data on job tasks 9 provides a blueprint for government agencies. By leveraging AI as a tool for analysis, public institutions can create

dynamic labor market indices that offer granular, up-to-the-minute insights into skill shortages and workforce shifts, enabling a more agile policy response.

4.2. Investing in Workforce Development and Education

The shift in skill demand and the specific vulnerability of early-career workers underscore the urgent need to modernize education and training systems. The Notre Dame "AI Policy Roadmap" report offers several actionable recommendations 21:

- **Modernizing Education Systems:** The report recommends teaching AI literacy from kindergarten through higher education, ensuring that students are not just consumers of AI but knowledgeable users.21
- **Fostering Complementary Skills:** Policymakers must move beyond a focus on technical skills and promote the development of broader, human-centric capabilities like critical thinking, creativity, and social skills that complement AI.21
- **Creating Lifelong Learning Pathways:** Investing in infrastructure to support continuous, lifelong learning is crucial.21 This includes exploring new financing models for training and reskilling, such as income-share agreements or outcome-based loans.21

4.3. Modernizing Social Safety Nets and Worker Protections

AI-driven job displacement, even if temporary, will require a robust social safety net to support workers during transition periods. The Notre Dame report suggests modernizing social safety nets through the use of "automatic stabilizers".21 This approach would automatically trigger social support measures in response to changing labor market conditions, providing a more responsive system than traditional programs.21

Additionally, a significant social dynamic is emerging in the form of white-collar unionization. Generative AI presents a clear and present threat of displacement for knowledge workers, a traditionally non-unionized demographic.10 The need for protections against AI is a "workplace collective good" that could motivate these workers to seek union representation.10 Given that unions tend to reduce income disparities and standardize pay scales, this could be a paradoxical catalyst for a more equitable distribution of the economic gains from AI, providing a powerful counterbalance to the polarizing effects of the AI wage premium.10

4.4. Place-Based and Industry-Specific Interventions

The economic benefits of AI are at risk of being highly concentrated in "already-rich regions" and larger cities where talent and resources tend to cluster.8 To prevent a deepening of geographic inequality, the report recommends targeted, place-based interventions.21 In regions with strong growth but a talent shortage, policies could focus on workforce training and matching workers with firms.21 For economically depressed areas, interventions should focus on broader economic development to attract new industries and investment.21 The U.S. Tech Hubs program, designed to direct technological innovation and job growth to different geographic areas, is cited as a potential model.21

Conclusion: A Path Tolard Shared Prosperity

The impact of AI on the labor market is a complex and evolving narrative that defies simple classification as either utopian or dystopian. This analysis has demonstrated that AI challenges historical economic models, presenting a new set of puzzles and problems for researchers and policymakers. The findings reveal a landscape where AI's aggregate effects are currently modest, masking significant and accelerating changes at the micro-level. The key lies in understanding AI's dual capacity for automation and augmentation. While AI is poised to automate a substantial portion of tasks for high-skilled professionals, it simultaneously provides a powerful set of tools to augment human capabilities, particularly for low-skilled and novice workers.

This report's central message is that the future of work is not predetermined; it is a choice. The path to a shared prosperity requires proactive, evidence-based policy grounded in a worker-centric philosophy. This includes a fundamental re-imagining of how labor market data is collected, how education systems prepare the workforce, and how social safety nets are structured to support individuals through periods of transition. By focusing on data, education, social protection, and targeted interventions, society can move beyond the anxieties of displacement and toward a future where AI serves as a partner in human flourishing. The challenges are significant, but so too is the opportunity for a more productive, innovative, and equitable economy.

Remaining Research Questions

To guide policymakers and business leaders in this transition, several key areas require further research:

- A deeper causal analysis of how AI adoption influences wage structures and the skill premium, using longitudinal data from firms that have fully reconfigured their workflows.
- Further research on the long-term impact of AI on the psychological well-being of workers, including the relationship between AI usage, work engagement, and work alienation.[48]
- Expanded granular data on AI adoption across a wider range of occupations, industries, and countries to inform more equitable policy design and interventions.

Funding: N/A
Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
ORCID : https://orcid.org/my-orcid?orcid=0009-0009-1669-4450
Publisher's Note: All statements and opinions in this article reflect the authors' perspectives alone and do not necessarily correspond to the views of their affiliated organizations, the publisher, the editors, or the reviewers..

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