

# Artificial Intelligence and Globalized Division of Labor: Research Progress and Future Prospects

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**Abstract.** The rapid development of Artificial Intelligence (AI) Technology is profoundly refactoring the Global Industrial Layout and Labor Force Structure and promoting the transformation of the International Division of Labor System from Cost-oriented to Technology-driven. This paper systematically studies the Impact Mechanism of artificial intelligence on the Globalized Division of Labor and reveals the Structural Transformation under Technology Substitution and Data Elements Dual-wheel Drive through Literature Review and Theoretical Analysis. The study finds that AI triggers Industrial Chain Regional Clustering by reducing the Technological Marginal Cost, developed countries strengthen Governance Hegemony through Technical Standards and Data Sovereignty, while developing countries face Technology Embargo, Rule Bundling and Capital Concentration Triple Barriers. Empirical evidence shows that every 1 percentage Industrial Robot Density elevation leads to a 0.8 percentage point decrease in the Manufacturing Global Value Chain Participation Rate, and the reduction of the AI Model Performance Gap between China and the United States to single digits highlights the new trend of Technology Competition. The research proposes that China needs to optimize its Global Division of Labor Position through Foundational Innovation Breakthrough and Governance Rule Construction, providing a Differentiated Path reference for Emerging Economies to cope with Technological Nationalism. This achievement has dual significance for improving the Globalized Division of Labor Theoretical Framework and Policy Design.

**Keywords:** Artificial intelligence; global division of labor; global value chain

## 1. Introduction

Artificial Intelligence Technology is deeply refactoring the Global Industrial Layout and Labor Force Structure and promoting the transformation of the International Division of Labor System from Cost-oriented to Technology-driven. This paper systematically studies the Impact Mechanism of artificial intelligence on the Globalized Division of Labor and reveals the Structural Transformation under Technology Substitution and Data Elements Dual-wheel Drive through Literature Review and Theoretical Analysis. The study finds that AI triggers Industrial Chain Regional Clustering by reducing the Technological Marginal Cost, developed countries strengthen Governance Hegemony through Technical Standards and Data Sovereignty, while developing countries face Technology Embargo, Rule Bundling and Capital Concentration Triple Barriers. Empirical evidence shows that every 1 percentage Industrial Robot Density elevation leads to a 0.8 percentage point decrease in the Manufacturing Global Value Chain Participation Rate, and the reduction of the AI Model Performance Gap between China and the United States to single digits highlights the new trend of Technology Competition.

The research proposes that China needs to optimize its Global Division of Labor Position through Foundational Innovation Breakthrough and Governance Rule Construction, providing a Differentiated Path reference for Emerging Economies to cope with Technological Nationalism. This achievement has dual significance for improving the Globalized Division of Labor Theoretical Framework and Policy Design.

## **2. The Dynamic Mechanism of Artificial Intelligence Reshaping Global Division of Labor**

### **2.1. The Technology Substitution Effect and the Weakening of Traditional Comparative Advantage**

The composition and distribution of the global value chain (GVC) are changing due to Artificial Intelligence Technology, and its core driving force is primarily reflected in the surrogation effect on traditional production factors. Information and communication technology once promoted the deepening of process-level division of labor by reducing coordination Costs, forming a wave of hyper-globalization [1]. However, collaborative empirical research by scholars has revealed that AI's automated substitution of labor is undermining the labor cost advantage of developing countries. Their calculations show that every 1% increase in Industrial Robot Density leads to a 0.8% decrease in the Manufacturing GVC Participation Rate, triggering regional contraction of the industrial chain [2]. This technological shock exposes the limitations of traditional theories. Under this shock, deep globalization requires sacrificing domestic social goals, forming the view of an impossible triangle of national sovereignty, democratic politics, and hyper-globalization. This contradiction is amplified by Technological Nationalism in the era of AI [3].

There are fundamental differences between artificial intelligence and traditional industrial automation, mainly reflected in three aspects. First, the scope of substitution is expanding. AI not only replaces repetitive manual labor but also automates cognitive tasks. For example, TCL China Star Optoelectronics Technology (TCL CSOT)'s "Xingzhi Large Model" realizes chip design defect detection and continues to erode the traditional positioning of developing countries in value chains. Second, the prediction capability is enhanced. Traditional Information and Communications Technology (ICT) technologies mainly support ex-post coordination, while AI-driven ex-ante prediction significantly reduces the necessity of multinational collaboration. Third, the system autonomy is improved, shifting from single-point tool optimization to full-scenario self-operation. These characteristics enable multinational corporations to reintegrate dispersed global production networks into regional manufacturing centers, weakening the motivation for traditional offshore outsourcing.

### **2.2. Data Element Flows and the Formation of New Comparative Advantages**

The second driving force behind the restructuring of global division of labor stems from the increased strategic value and uneven distribution of Data Elements. As a new type of production factor, data is reshaping the underlying logic of international competition, forming a three-in-one competitive landscape centered on "algorithm-computing power-scenario." Within this framework, the United States and China dominate due to their significant first-mover advantages. The United States possesses a technological ecosystem spanning the entire AI industrial chain, while China is rapidly narrowing the technology gap through breakthroughs in innovative models such as DeepSeek and the cluster effect of over 4,500 AI enterprises. According to the Stanford Report, the Performance Gap between top US and Chinese AI Models on key benchmarks such as MMLU and Human Eval has narrowed from double digits in 2023 to single digits or even a fraction of a digit in 2024.

The contest for Data Sovereignty has intensified the fragmentation of global production networks. The EU's Digital Act mandates local data storage, leading to a 30% increase in the costs of cross-border cloud services. While this policy protects regional Data Sovereignty, it objectively hinders the free flow of global Data Elements. In contrast, China is exploring new models of cross-border data cooperation through the innovative path of "R&D in Beijing, Shanghai, and Guangzhou + Integration in Guangxi + Application in ASEAN," providing institutional experiments for regional digital collaboration. This path divergence reflects the differences in value orientations of different economies in data governance: the United States advocates industry self-regulation and open innovation, China emphasizes government-led full-process review, and the European Union seeks a balance between regulatory protection and technological autonomy [4].

The uneven distribution of Data Elements also fosters the risk of new digital colonialism. Currently, 40% of global AI R&D investment is concentrated in 100 companies in China and the United States, while 118 Southern countries are excluded from core discussions on AI governance. This asymmetrical pattern puts developing countries in a double bind: on the one hand, they lack the key resources to build autonomous AI capabilities, namely computing power, algorithms, data, and talent; on the other hand, they have to rely on the technological systems of dominant countries, resulting in their industrial upgrade being subject to external technological path dependence in the long term.

### **3. Adaptability Challenges of the Global Governance System**

#### **3.1. Institutional Lags and Technological Disparities**

Existing governance frameworks struggle to adapt to the characteristics of AI technology. The WTO dispute settlement mechanism, hampered by a lack of rules, saw a case enforcement rate of only 32% in 2024, reflecting the multilateral system's failure to regulate digital trade. This institutional lag is evident not only in the absence of rules but is also deeply rooted in the imbalanced distribution of power [5]. A deeper contradiction lies in the fact that developed countries, through a "small yard with high fences" strategy, are cornering the market in standards setting. The power to formulate critical rules, such as chip manufacturing standards and algorithm ethical norms, is concentrated within closed alliances, excluding 118 developing countries from the core mechanisms of AI governance. This institutional exclusion exacerbates the global digital divide.

According to a quantitative analysis of global value chains networks, the share of developing countries in the global artificial intelligence patent pool decreased from 18.7% to 12.3% between 2015 and 2023, revealing that institutional disparities are accelerating the polarization of technology dividend distribution [4].

Acemoglu and Restrepo's theoretical model further reveals the chain reaction of governance deficits. Their research indicates that when the rate of Technology Substitution exceeds the carrying capacity of labor transition buffer mechanisms, medium-skilled workers will face the risk of permanent job loss. In developing countries with weak institutional foundations, the absence of a social security system and vocational training networks amplifies this risk. For example, in the manufacturing sector of Southeast Asian countries, for every 1 percentage point increase in the penetration rate of industrial robots, there is a corresponding increase of 0.5 percentage points in the youth unemployment rate [5].

Such social costs have not been fully assessed under the existing governance framework, nor are there effective transnational compensation mechanisms.

#### **3.2. Diverse Paths to Order Reconstruction**

Decentralized governance is bridging institutional gaps. Three types of emerging mechanisms are observed: self-governance by technology communities, such as the open-source ethical charter established by the Hugging Face platform, which dynamically updates algorithm transparency standards through a developer community voting mechanism; urban laboratory mechanisms, such as Shanghai's pilot artificial intelligence regulatory sandbox, which allows companies to test high-risk technologies such as autonomous driving algorithms in a closed environment, providing empirical calibration basis for regulatory rules; and transnational public-private partnerships promoting technology-neutral standards setting [5]. These practices embody the core of "resilient globalization," which allows room for policy experimentation while maintaining core rules [6].

However, fragmented governance also poses new risks. The lack of coordination mechanisms among over 500 artificial intelligence ethics guidelines worldwide, coupled with the ambiguous attribution of responsibility when open-source algorithms cause social harm, are causes for concern. More critically, developing countries hold less than 30% of the seats in standard-setting bodies, leading to the systemic neglect of their demands. This fragmentation of governance, under the wave of Technological Nationalism, is accelerating into regulatory fragmentation. For example, the EU's

Artificial Intelligence Act requires companies from third countries to establish legal entities within its territory in order to file complaints, which constitutes a de facto institutional exclusion of small and medium-sized technology providers.

## **4. Asymmetric Game for Developing Countries**

### **4.1. Institutional Obstacles to Value Chain Climbing**

The traditional theory of comparative advantage partially fails in the era of artificial intelligence. Developing countries face a compound lock-in effect formed by Triple Barriers. The first is the technology barrier. Sovereign AI Model relies on computing power and data. However, the United States' export control on semiconductor equipment with manufacturing processes below 14 nanometers not only covers high-end GPU chips but also extends to basic materials such as photoresist [7]. This blockade directly hinders African countries from building the hardware foundation for sovereign AI Model. The medical diagnosis platform planned in Nigeria's national artificial intelligence strategy has been stagnant for a long time due to the inability to obtain A100-level computing power. Second, the rules barrier. The EU Artificial Intelligence Act binds the "trustworthy AI" standard to access in the marketplace, raising compliance costs and constituting a substantial barrier to small and medium-sized enterprises.

Empirical calculations indicate that meeting the full life cycle monitoring requirements for high-risk AI systems will increase corporate operating costs by 15%-20%, directly leading to the withdrawal of Indonesian digital healthcare startups, MedAI, from the European market. Thirdly, there are capital barriers, with 85% of global AI venture capital concentrated in the US, China, and Europe, forcing Southeast Asian countries to accept technological vassalage clauses [5]. Empirical studies by scholars have shown that this oppression leads to an average annual decrease of 0.6 percentage points in the export value-added rate of developing countries [8]. This structural dilemma has been further identified as potentially leading to a "permanent division of labor fault line" [5].

### **4.2. Catching-Up Leverage Path**

Successful breakthrough cases show that a differentiated strategy relying on local factor endowments to reconstruct comparative advantage is a feasible path.

Leveraging its mega-sized market, China is fostering domestic AI enterprises. Huawei's Ascend chips, through architectural innovation, have achieved a 40% increase in computing density under the constraints of the 7nm process, significantly reducing reliance on advanced lithography technology [9]. India, on the other hand, focuses on modular service exports. Tata Consultancy disassembles AI diagnostic systems into labor-intensive segments such as core model training, data annotation, equipment deployment, and feedback collection, creating new service outsourcing positions.

Of greater strategic value is the dimension of regulatory innovation. The "governance wedge" strategy has achieved substantial breakthroughs in Sino-African digital cooperation [10]. Addressing the systemic biases of Western-dominated algorithms in facial recognition within Africa, the two sides are jointly developing a culturally inclusive computer vision framework that requires training data to cover the physiological characteristics of at least 18 major African ethnic groups.

This standard has been incorporated into the mandatory provisions of the African Union's Convention on the Ethics of AI, successfully breaking the Technological Nationalism of technology cornering the market. In the field of green computing, Ghana has leveraged its tropical climate to develop naturally cooled data centers, reducing their Power Usage Effectiveness (PUE) value by 0.3 compared to traditional data centers. Consequently, the "Low-Carbon AI Infrastructure Certification Standard" formulated by Ghana is gaining acceptance from an increasing number of developing countries.

However, technological nationalism is narrowing the policy window of opportunity. Taking the U.S. restrictions on AI chips to China as an example, its controls have extended to civilian fields such

as biometric identification. Therefore, developing resilience mechanisms has become an effective strategy. ASEAN is advancing a regional AI chip substitution plan, and Sino-African cooperation is using a "governance wedge" strategy to create alternative rules in areas such as AI ethics (e.g., algorithms inclusive of African culture) and green computing.

This technology-market hedging strategy, based on independence and control, challenges the cornering the market of technology and provides Southern countries with a strategic buffer against systemic risks.

## 5. Conclusion

This paper employs Literature Review and Theoretical Analysis methods to systematically analyze the driving mechanisms and governance challenges of artificial intelligence refactoring the Globalized Division of Labor. It summarizes the structural transformation of the global division of labor system under Technology Substitution and Data Elements Dual-wheel Drive, and further elaborates on the asymmetric pattern of the coexistence of the technological hegemony reinforcement in developed countries and the "division of labor fault" risk in developing countries. Specifically, artificial intelligence is triggering a deep restructuring of the global division of labor system, and its structural impact presents three characteristics. In the spatial dimensionality, the industrial chain layout is accelerating from global dispersion to regional agglomeration, and the traditional offshore outsourcing operational mode is gradually shrinking due to the Technology Substitution effect. In the power dimensionality, developed countries are building new technological barriers by controlling chip Manufacturing and algorithm standards, and the global value chain governance presents a trend of unipolar reinforcement.

In terms of development dimensionality, differences in labor surrogation elasticity led to increased differentiation between countries. Emerging Economies face the dual challenges of technological dependence and breakthrough innovation, while low-skilled countries risk falling into a division of labor fault line.

This transformation marks a shift in the core logic of Globalized Division of Labor from efficiency precedence to security and controllability dominance. The impact of Technology Substitution presents significant asymmetry. Developed countries consolidate their advantages with hardware-layer technologies such as chip Manufacturing, while Emerging Economies seek breakthroughs in the application layer but are constrained by computing power constraint, and low-skilled labor-intensive countries face the dilemma of accelerating the disintegration of traditional Comparative advantages. This variation reflects the differentiated impact of AI on the global division of labor, while countries with weak institutional foundations bear Bigger systemic risk.

China should optimize its Dual-wheel Drive global value chain positioning, strengthen independent innovation and scene application, and rely on the hyperscale Marketplace to cultivate an artificial intelligence native industrial ecosystem. It should focus on breaking through the shortcomings of the basic layer such as chip architecture Design, reduce its dependence on advanced processes through technology paths such as heterogeneous computation, and avoid being controlled by others in key links. It should construct the right to speak on rule line and actively participate in the global artificial intelligence governance, and propose Chinese solutions in fields such as cross-border data flow and algorithm ethics. Establish a key Technology Substitution check list by industry, and develop a diversified vendor network. Explore "technology-Marketplace" hedging Policies, deepen digital cooperative Manufacturing with ASEAN, and balance the risk of technological blockade in Europe and the United States.

## References

- [1] Franzi S. The Great Convergence: Information Technology and the New Globalization. *The Journal of Politics*, 2018, 80.

- [2] Huang Liangxiong, Lin Ziyue, Wang Xianbin. Application of Industrial Robots and Reconstruction of Global Value Chain: From the Perspective of Bargaining Power of Export Products. *China Industrial Economy*, 2023, (02): 74-92.
- [3] Shi Dan, Nie Xinwei, Qi Fei. Globalization of Digital Economy: Technological Competition, Rule Game and China's Choice. *Management World*, 2023, 39(09): 1-15.
- [4] Han Yonghui, Zhang Fan, Peng Jiacheng. Order Reconstruction: Global Economic Governance under the Impact of Artificial Intelligence. *World Economics and Politics*, 2023, (01): 121-149.
- [5] Acemoglu D, Restrepo P. The Race Between Machine and Man: Implications of Technology for Growth, Factor Shares and Employment. NBER Working Papers, 2016.
- [6] Farrell H, Newman A L. Weaponized Interdependence: How Global Economic Networks Shape State Coercion. *International Security*, 2019, 44(1): 42-79.
- [7] Acemoglu D, Restrepo P. Automation and New Tasks: How Technology Displaces and Reinstates Labor. *Journal of Economic Perspectives*, 2019, 33(2): 3-30.
- [8] Mackintosh P M. Dani Rodrik: Straight Talk on Trade-Ideas for a Sane World Economy. *Business Economics*, 2018, 53(4): 232-233.
- [9] Korinek A, Stiglitz J E. Artificial Intelligence, Globalization, and Strategies for Economic Development. National Bureau of Economic Research Working Paper, 2021, No. w28453.
- [10] Lu Yue, Gu Wei, Wei Yanan, et al. Artificial Intelligence and the Deepening of Global Value Chain Network. *Quantitative Economics and Technical Economics Research*, 2023, 40(01): 128-151.