

The Impact of Artificial Intelligence Industry Development on Service Exports: A Systematic Review Approach

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Abstract

With the rapid development of the digital economy, artificial intelligence (AI) has become an important factor influencing international service trade. As the growth of traditional merchandise trade slows, digitally deliverable services have continued to expand, supported by the increasing role of data and AI technologies. Using a systematic literature review approach and drawing on recent macro-level trade statistics and micro-level empirical studies, this paper examines the mechanisms through which AI affects the scale and structure of service exports and reviews the related empirical evidence. Recent data show that digitally deliverable services account for more than half of global service trade. Existing studies suggest that AI can improve the technological sophistication of knowledge-intensive service exports by lowering cross-border search costs, increasing total factor productivity, and enhancing service tradability. In this sense, AI contributes not only to the expansion of service trade but also to its movement toward higher value-added activities. The findings of this study help explain recent developments in digital trade and provide policy implications for narrowing the global digital divide, particularly through improvements in digital infrastructure and increased investment in research and development.

Keywords

artificial intelligence, service exports, digitally deliverable services

1. Introduction

1.1 Contemporary Context and Development Status of Digital Service Exports

Amid increasing uncertainty in the global economic recovery, the structure of international trade has continued to change. Supported by advances in artificial intelligence (AI), digitally deliverable services have become an increasingly important source of global trade growth. The impact of AI on service exports can be better understood in the context of recent macroeconomic trade data.

In 2023, while global merchandise trade contracted overall, digital service exports achieved counter-cyclical growth, expanding by 9% year-on-year to reach USD 4.25 trillion. From 2005 to 2023, global digitally deliverable service trade grew at a compound annual growth rate (CAGR) of 8.2%, significantly outpacing merchandise trade (4.6%) and overall service trade (6.2%) over the same period. By 2023, digital service

exports accounted for 13.8% of total global exports of goods and services, and more than half (54.2%) of total service exports. These figures indicate that digitally delivered services now occupy an increasingly important position in global trade.

However, significant regional disparities remain in both AI commercialization and digital service exports. In 2023, Europe maintained the largest share of digital service exports (52.4%, approximately USD 1.62 trillion), while Asia recorded the strongest growth, rising to 23.8% (approximately USD 1.15 trillion). North America accounted for 17.5%. Overall, developed economies monopolized over 80% of the global digitally deliverable service trade market. A key prerequisite for AI to effectively empower service exports is the presence of robust digital infrastructure. According to the World Bank's 2024 report [1], median internet connection speeds in high-income and upper-middle-income countries increased by 50% in 2023–2024, reaching 143 Mbps. In contrast, median speeds in low-income countries remained stagnant below 25 Mbps. Differences in computing infrastructure and network capacity continue to constrain the adoption of generative AI technologies in many developing countries, which may further widen international productivity gaps.

Despite these disparities, China has placed increasing policy emphasis on the development of digital trade. In recent years, China has hosted the China International Fair for Trade in Services (CIFTIS) at a consistently high level. This reflects both the scale of China's domestic market and the growing importance of service trade in the country's opening-up strategy.

1.2 Practical Challenges: Examining Service Industry Bottlenecks Through the Lens of Trade Deficits

In stark contrast to the persistent trade surplus in manufacturing, China's service trade has long faced a structural deficit. This deficit is closely related to the relatively limited scale, efficiency, and standardization of China's service sector.

$$NX = Y - (C + I + G) \quad (1)$$

From the perspective of the macroeconomic national income trade identity (Equation 1), net exports essentially represent the difference between China's total output (productive capacity) and total domestic demand (absorption). China's manufacturing sector maintains strong export competitiveness largely because of its high production efficiency and large-scale industrial capacity. In contrast, the service sector is more dependent on human capital and customized provision, which limits its ability to achieve large-scale output expansion and export growth [2]. Therefore, improving the productive capacity of the service sector remains important for expanding service exports.

1.3 Technological Breakthrough: AI-Empowered “capacity Revolution” in the Service Sector

The growing adoption of artificial intelligence may help alleviate some of the scale constraints traditionally associated with service industries. Unlike earlier internet technologies, in particular, generative AI (AIGC) has increased the degree of standardization in certain service activities. By automating repetitive cognitive tasks, AI enables some traditionally customized services to be delivered in more standardized and digitalized forms. Owing to its large domestic market and extensive data resources, China provides a favorable environment for the application and development of AI technologies in the service sector. With AI technological empowerment, the service sector is expected to achieve a “capacity leap” similar to that of manufacturing—substantially increasing output density and quality without proportionally increasing human capital investment. This may strengthen the sector's ability to meet domestic demand while also supporting the expansion of service exports.

1.4 Research Focus and Logical Framework of This Paper

Although the academic community has reached a preliminary consensus on the trade-promoting effects of artificial intelligence, existing literature predominantly focuses on macro-level effects. However, existing studies have paid relatively limited attention to the mechanisms through which AI affects service sector capacity and trade patterns [3]. In light of this, this study combines recent trade data with existing literature to examine the mechanisms by which AI influences service exports. The logical structure of this paper is as follows: First, it systematically reviews and evaluates representative literature on the trade effects of AI.

Second, it focuses on constructing a theoretical mechanism framework for AI's role in enhancing service capacity and reducing transaction costs. Finally, it summarizes the research conclusions and puts forward targeted policy recommendations grounded in China's reality as a super-large market.

2. Literature Review

2.1 International Research: Digital Economy Theoretical Frameworks and Global Macro Effects

Early international studies examined the effects of digital technologies on trade from both theoretical and empirical perspectives. Goldfarb and Tucker [3] discussed how algorithms and digital technologies influence global economic activities by reducing information processing costs. At the empirical level, Aghion et al. [4] examined the potential long-term growth-driving effects of artificial intelligence, finding that AI adoption increases the degree of automation in service production processes in high-income countries. Recent studies have increasingly focused on trade barriers associated with digital technologies. Reports from the Organisation for Economic Co-operation and Development (OECD) indicate that between 2014 and 2023, global trade barriers on digitally enabled services increased by 25%, primarily due to intensified government regulation of cross-border data flows and artificial intelligence algorithms [5].

2.2 Chinese Research: Improvements in Export Technological Complexity and Domestic Empirical Evidence

In recent years, Chinese scholars have increasingly examined the role of artificial intelligence in improving China's position in global value chains through service trade, providing robust support from micro-level panel data. Regarding the enhancement of technological complexity, Yao Tingting and Bao Yanan [6], using the artificial intelligence development index published by Stanford University and panel data from 29 major economies, conducted empirical tests. Their results indicate that AI contributes to improvements in the technological complexity of service exports, primarily through two channels: improving service production efficiency and optimizing the human capital structure of the service industry. Further, in exploring the moderating role of R&D and innovation, Tao Mengyao [7], based on cross-country panel data, demonstrated that the positive effect of AI on the technological complexity of service exports is highly robust. Moreover, a country's overall "innovation level" exerts a significant positive moderating effect in this process. This finding suggests that the adoption of AI technology alone may not be sufficient to generate competitive advantages; it must be accompanied by high-intensity R&D investment to translate AI capabilities into stronger competitiveness in knowledge-intensive service exports.

3. Theoretical Mechanisms of Ai-Empowered Service Exports From the Perspective of the Macroeconomic Trade Identity

Existing studies have mainly examined the trade effects of digital technologies from the perspective of firm-level transaction costs. However, this perspective provides limited explanation for China's persistent service trade deficit at the macro level and the growing role of artificial intelligence in addressing this issue [3]. Accordingly, this paper employs the national income trade identity $NX=Y-(C+I+G)$ as the analytical framework, where NX represents net exports, Y denotes China's total output (i.e., productive capacity), and $(C+I+G)$ represents total domestic absorption (i.e., domestic demand). From a macroeconomic perspective, AI may promote service exports by changing the production structure of the service sector. This may increase domestic service capacity and support the expansion of service exports into international markets. The specific theoretical mechanisms can be decomposed into the following three dimensions:

3.1 Overcoming "Baumol's Cost Disease": AI-Driven Standardization and Reshaping of Service Sector Capacity

Within the framework of the macroeconomic trade identity, the absolute scale of total service output (Y) constitutes the cornerstone of export potential. The deep-rooted logic behind China's long-term service trade deficit lies in the rigid physical constraints on traditional service sector capacity expansion — a phenomenon

known in economics as “Baumol’s cost disease.” The production function of traditional knowledge-intensive services (including legal consulting, medical diagnosis, language translation, etc.) typically exhibits strict linear characteristics: $Y=f(L)$, where output scale is highly dependent on the time and effort invested by professional service personnel (L). Since service delivery often requires “co-location and simultaneous presence of producer and consumer in time and space” (e.g., face-to-face consultations), production efficiency is extremely difficult to improve significantly through capital equipment investment alone. This characteristic prevents traditional services from adopting the assembly-line production models common in manufacturing, resulting in limited capacity scale, high marginal costs, and an inability to effectively meet the increasingly diverse service consumption demands of China’s super-large market. As a result, domestic service supply has often been insufficient to meet demand, contributing to continued reliance on imported services.

To explain it, the following equation is introduced.

$$Y = A \cdot f(K_{Data}, L_{Expert}) \quad (2)$$

The rapid development of artificial intelligence — particularly generative AI and large language models — has altered traditional service production processes, driving its evolution toward a nonlinear structure (Equation 2), where A represents the level of technological progress and K_{Data} denotes computing power and data capital inputs.

This transformation operates through three core mechanisms.

First, structural substitution of production factors has enabled a transition from “human-driven” to “algorithm-driven” modes. Relying on natural language processing and machine learning algorithms, AI achieves large-scale replacement of high-density, repetitive mental labor in traditional service sectors. As highlighted by Acemoglu and Restrepo’s (2018) “race between man and machine” theory [8], automation technologies not only substitute for humans in routine tasks but also reconstruct the composition of production factors. Recent empirical research by Brynjolfsson et al. (2023) on generative AI further confirms [9] that AI significantly boosts labor productivity in the service sector, particularly by accelerating the standardization of tacit knowledge. This evolutionary process, in which “computing capital” offsets and substitutes for “human capital,” liberates professional service personnel from tedious routine tasks, allowing them to focus on high-value-added creative strategy work. As a result, service providers may improve productivity and expand output beyond the limits imposed by purely labor-intensive production.

Second, declining marginal costs allow some services to be delivered on a much larger scale. The core competitive advantage of modern manufacturing lies in economies of scale and increasing returns. AI enables the digitalization and standardization of professional knowledge, industry experience, and certain reasoning processes. Taking generative AI (AIGC) as an example, once a specific model is initially trained, the marginal cost difference between serving 10 clients and 100,000 clients is nearly zero. This “high fixed-cost and low marginal-cost” characteristic allows some knowledge-intensive services to achieve greater scalability similar to that observed in manufacturing industries.

Third, AI reduces geographical and time-related constraints on service delivery, thereby increasing the tradability of services. As articulated in Baldwin and Forslid’s (2020) “global robot” theory [2], the integration of AI and big data reduces the dependence of many services on physical delivery channels, allowing services to be delivered more efficiently across borders. AI-driven intelligent systems achieve precise matching of cross-border supply and demand, substantially reducing overseas market search costs and information frictions arising from cross-language communication [4]. This may improve total factor productivity in the service sector and reduce some transaction costs associated with international market participation.

In summary, AI may alleviate some of the scalability constraints traditionally associated with service industries and support the expansion of digital service production at lower marginal costs, laying the most critical material foundation for subsequent large-scale capacity spillover into international markets.

3.2 Evolution of Export Necessity Under the Trade Identity: From “domestic Demand Fulfillment” to “capacity Spillover”

In open macroeconomic models, fluctuations in net exports (NX) are not only constrained by exchange rate volatility or external trade barriers; their endogenous root lies in the structural gap between China’s total output

(Y) and total absorption ($C+I+G$). For a long time, China has exhibited significant trade deficits in many core service sectors. This essentially reflects the fact that the actual supply capacity of domestic services (Y) has lagged behind the rapidly expanding demand (C) from consumption upgrading and industrial upgrading investment (I). Under traditional industrial models, the growth curve of service capacity exhibits typical linear and modest characteristics, making it difficult to respond quickly to rapid increases in demand. As a result, China has relied more heavily on imported services in certain sectors.

The introduction of artificial intelligence technology, by changing service production processes, may accelerate the growth of service capacity and improve production efficiency. In the initial stage, AI first enhances the total factor productivity of local service enterprises through automation and intelligent tools, effectively reduces service delivery costs, and enables Chinese firms to close the gap in meeting domestic consumption and investment needs [9]. As productivity continues to improve, leveraging the marginal cost reduction effect unleashed by AI, the growth of service capacity (Y) may gradually exceed the growth of domestic absorption. Within the dynamic evolution path of the trade identity framework, when capacity (Y) surpasses the threshold of domestic absorption, net exports (NX) will inevitably exhibit a convergence trend from negative to positive. Under such conditions, excess service capacity may support the expansion of exports into international markets [10].

However, it is important to distinguish between simple overcapacity and internationally competitive production capacity. Within the trade identity framework, a simple increase in output scale (i.e., traditional overcapacity) is not sufficient to automatically convert into effective exports in international markets. According to classic heterogeneous firm trade theory [10], firms entering international markets usually face substantial fixed and sunk costs. Only enterprises with significant “technological advantage” and high productivity can remain internationally competitive and profitable after bearing these additional costs. Therefore, service exports depend not only on output scale but also on competitiveness and productivity, but rather the active spillover of advanced productive forces. In other words, exports can only be achieved when a clear technological advantage is attained; this is an important condition for successful participation in international markets. The core strategic value of artificial intelligence lies not only in expanding the scale of service output (Y), but more importantly in endowing domestic enterprises with stronger technological capabilities in international markets through advanced algorithms, data-processing capabilities, and large AI models. Only when “capacity surplus” is combined with absolute “technological innovation advantage” can it truly translate into stronger competitiveness in digital service exports.

China’s manufacturing development experience suggests that the establishment of export competitiveness generally follows the development path of “capacity expansion → domestic market saturation → export expansion.” At present, artificial intelligence is increasing the scalability and standardization of some service activities, similar to those in manufacturing. Expanding service capacity through AI aims not only to better satisfy domestic market demand, but also to follow the endogenous logic of macroeconomic identities by pushing digitally enabled service capacity—with absolute technological advantage and efficient operation—into the global trade system, thereby improving China’s position in international service trade.

3.3 Amplification Effect of Super-Large Economies: From Domestic Application Scenarios to Global Competitive Barriers

If the trade identity constitutes the theoretical cornerstone of service export expansion, then the scale of the domestic economy may help translate these theoretical advantages into international competitiveness. Because AI development depends heavily on data resources and application scenarios, this acceleration and amplification effect is primarily manifested in the following three strategic dimensions:

First, large-scale data resources and continuous model iteration may generate economies of scale. As the world’s largest single consumer market, China continuously generates massive volumes of interaction data across a wide range of service formats. These large-scale data resources provide favorable conditions for AI model training by domestic firms, improving model performance while reducing unit costs over time. This economic characteristic enables China’s domestically incubated AI systems to rapidly establish asymmetric competitive advantages.

Second, a highly complex demand ecosystem provides favorable conditions for the testing and improvement of digital services. The demand structure of China’s super-large market is exceptionally deep,

spanning from high-end knowledge-intensive services to basic digital services, thereby providing extensive early-stage application scenarios for AI technologies. In the process of meeting China's massive and rapidly evolving demands, enterprises continuously optimize the robustness of their algorithms. When these digital service products, having undergone full trial-and-error and rigorous iteration, are introduced to international markets, they inherently establish significant technological advantages and barriers to entry relative to similar services from other countries.

Third, the super-large market helps spread sunk costs across a larger market, which may help reduce aspects of the global digital divide. The construction of AI's underlying infrastructure involves extremely high fixed investments. The core advantage of a super-large economy lies in its vast domestic consumer market, which can rapidly absorb and amortize the aforementioned R&D and infrastructure costs. Once underlying general large models achieve break-even in the Chinese market, the additional marginal delivery costs of deploying their cloud capabilities overseas approach zero. This industrial economic structure of "high fixed costs, extremely low marginal costs" may strengthen the pricing power of Chinese enterprises in international markets, thereby improving the price competitiveness of service exports and increasing barriers to entry.

4. Policy Recommendations

Based on the findings of the above analysis, this paper offers the following targeted policy recommendations for government decision-making bodies and micro-level enterprises:

First, further improve digital infrastructure development. Given that network transmission speed and underlying computing power directly constrain the practical effectiveness of AI empowerment, reducing the digital divide is important for improving the inclusiveness of international digital trade. The government should systematically increase strategic investment in 5G/6G communication networks, large-scale intelligent computing centers, and other facilities, reduce enterprises' network factor usage costs, and provide infrastructure support for the development of service exports.

Second, increase the effectiveness of R&D investment. In line with the empirical findings on the moderating effect of innovation levels, micro-level enterprises should not limit themselves to the external procurement of basic application tools. Instead, they should actively pursue "intelligent empowerment" strategies, continuously increase resource allocation to core underlying algorithms, and effectively strengthen the role of innovation in improving long-term competitiveness.

Third, actively participate in the development of international digital trade rules. Facing increasingly intensified global barriers to digital service trade and regulatory restrictions on cross-border data flows [5], China should further align with high-standard international trade rules, work to eliminate unreasonable regulatory constraints, and create a freer and more secure institutional environment for cross-border data flows to support the international expansion of domestic enterprises.

5. Conclusion

Integrating macroeconomic trade statistics with micro-level empirical findings, this study demonstrates that artificial intelligence technology has a significant positive effect on the expansion of global service exports through three core mechanisms: reducing transaction costs, enhancing production efficiency, and promoting service innovation. The 2023 macroeconomic data showing that digitally deliverable service exports accounted for 54.2% of total global service exports is consistent with this trend. More importantly, artificial intelligence contributes not only to the expansion of service trade; it is also a core engine for elevating the technological complexity of service exports. It is also contributing to structural changes in international service trade—from labor-intensive activities toward more knowledge- and technology-intensive activities.

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Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgment

This paper is an output of the science project.

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