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Overcoming Digital Trade Barriers with AI Agents: Opportunities, Strategies, and a Regulatory Adaptation Perspective

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Abstract

As the global digital economy becomes deeply integrated, digital trade has emerged as a core engine of international trade growth. However, differing value orientations and interests have led to the emergence of diverse regulatory frameworks with distinct emphases. This fragmentation of regional regulatory systems conflicts with the large-scale cross-border flow of digital elements, thereby hindering the globalization of digital trade. From the perspective of regulatory adaptation, this article systematically analyzes how AI agents empower technological solutions to overcome digital trade barriers. It further reveals their unique opportunities in rule interpretation, dynamic compliance, and collaborative governance, and proposes a three-stage strategic pathway: "technology adaptation rule transformation ecological collaboration." This study finds that AI agents can effectively reduce the cost of regulatory adaptation and provide precise compliance solutions for digital trade entities through semantic parsing, real-time learning, and cross-domain collaboration. It offers a theoretical framework for technological pathways to overcoming digital trade barriers and provides strategic insights for China's participation in global digital governance.

Keywords Digital trade; AI agent; Rule adaptation

1 Introduction

As a new form of trade aligned with the development of the digital economy, digital trade is becoming a key variable reshaping the pattern of international trade and a major growth driver for global economic recovery. With its unique advantages—crossing physical boundaries and reconstructing global value chains—digital trade is playing an increasingly critical role. According to authoritative data from the 2024 Global Digital Trade Development Report, the total volume of global digital trade grew steadily from USD 6.02 trillion in 2021 to USD 7.13 trillion in 2023, with an average annual compound growth rate of 8.8%. Amid mounting global economic challenges such as inflationary pressures and geopolitical conflicts, digital trade has demonstrated strong resilience. At the same time, in the process of establishing a new development paradigm, China's digital trade has shown robust vitality and has become a "new

engine" driving the high-quality development of foreign trade. In the first half of 2024, China's imports and exports of digitally deliverable services reached 1.42 trillion yuan, marking a year-on-year increase of 3.7%. This data not only indicates that digital trade has become a core component of China's service trade but also reflects the country's growing international competitiveness in cloud computing, artificial intelligence, cross-border e-commerce, and other sectors. Importantly, in the complex context of slowing global economic growth and rising trade protectionism, digital trade has served as a key stabilizing force for China's service trade to achieve growth against the broader trend.

However, with the rapid development of digital trade, it faces increasingly complex global governance challenges, and the restrictive effects of various digital trade barriers have become increasingly prominent. Among these, the fragmentation of regional digital trade rules stands out as a key structural obstacle. Depending on their respective technological advantages, industrial structures, and value orientations, different economies have developed divergent regional regulatory systems. Some countries emphasize the protection of development rights in the global rule-making process and seek to balance security with openness; others focus on data sovereignty and security, establishing protective mechanisms such as data localization requirements and cross-border data review procedures. This parallel multi-rule system not only forces enterprises to comply with multiple standards in cross-border trade—significantly increasing compliance costs and operational complexity—but also risks creating "digital islands" due to regulatory conflicts, hindering the efficient global allocation of data elements and the inclusive application of digital technologies. In this context, overcoming the barriers posed by rule fragmentation and fostering a more inclusive and interoperable global digital trade governance system have become urgent tasks to ensure the sustainable and healthy development of digital trade and to unlock its growth potential.

At present, advancements in artificial intelligence (AI) technology offer new possibilities for regulatory adaptation. As intelligent systems capable of autonomous perception, decision-making, and execution, AI agents have demonstrated the ability to analyze rules and dynamically adapt in fields such as financial compliance and cross-border logistics. For example, Amazon's intelligent compliance assistant can adapt in real time to the cross-border e-commerce regulations of multiple countries, effectively reducing the time required for product listing review. However, few scholars have taken AI agents as a primary analytical lens to explore their deeper mechanisms in addressing the fragmentation of digital trade rules. In particular, there remains a lack of systematic exploration regarding the enabling logic of such technologies, their potential practical applications, and their strategic role in regulatory adaptation. This research gap not only limits the cognitive depth of technology-enabled trade governance innovation, but also leaves enterprises and policymakers without effective theoretical support or operational models for navigating complex regulatory environments using AI agents. Therefore, starting from the key entry point of regulatory adaptation, the systematic investigation of the unique opportunities and implementation strategies offered by AI agents to address digital trade barriers can help bridge existing gaps in the literature on technological empowerment and trade regulation. Moreover, such research provides a novel theoretical perspective and an analytical framework that offers both theoretical depth and practical guidance for Chinese digital trade entities seeking to manage regulatory diversity and enhance international competitiveness.

2 Literature review

The rapid development of digital trade has made it a key topic in international trade research, while digital trade barriers—particularly regulatory fragmentation—significantly restrict its further expansion. Simultaneously, the emergence of AI agent technology has opened new possibilities for resolving these challenges, and related studies are gradually emerging.

Digital trade refers to a new mode of commerce aligned with the digital economy. It leverages digital technologies to facilitate the transmission, transaction, and consumption of goods and services, thereby

greatly expanding the range of tradable goods and services[1]. Existing research on digital trade generally falls into three categories: (1) the definition and theoretical foundations of digital trade; (2) the measurement of digital trade development; and (3) the economic, social, and environmental impacts of digital trade growth[2]. For instance, Li (2020) argued that digital trade consists of two components—digital trade proper and trade digitalization—which correspond to digital services, digital goods, digital delivery, and digital ordering[3]. Zhao (2025) measured the digital trade volume of major world economies using both narrow and broad definitions[4]. Zheng (2025), employing a multi-phase DID model, demonstrated that digital trade significantly promotes innovation in retail enterprises—particularly in business model innovation. This impact occurs primarily through three channels: transaction cost reduction, supply chain optimization, and the creation of digital demand[5].

With the vigorous development of digital trade, various trade barriers have emerged accordingly. These range from restrictions on cross-border data flows to differences in regulatory standards, from discrepancies in digital taxation rules to obstacles posed by platform monopolies. Together, these factors constitute multiple barriers that hinder the sustainable growth of digital trade. Digital trade barriers specifically refer to a variety of restrictive measures imposed by host governments in pursuit of national interests[6]. Currently, scholars have widely examined the manifestations, potential impacts, and countermeasures related to digital trade barriers, producing substantial research findings. For instance, Yang (2025) argued that in addition to traditional tariffs, digital trade barriers also encompass cross-border data restrictions, personal data protection, and intellectual property concerns[7]. Xia (2024) highlighted challenges in regulating data flows across borders, including regulatory fragmentation, misaligned governance demands, outdated taxation systems, and difficulties in data classification[8]. Sun (2025) noted the existence of discriminatory conditions for e-commerce licenses, deviations from international standards in cross-border transaction rules, and inadequacies in e-commerce-related legislation[9]. Qiang (2024) emphasized that such discriminatory licensing requirements and the lack of enforceability of electronic signatures increase both administrative and contractual costs for service enterprises engaged in export activities within the value chain[10]. Liu (2025) empirically verified that digital services trade barriers significantly hinder the export competitiveness of the manufacturing sector by weakening technological innovation, reducing human capital spillovers, and diminishing value-added effects[11]. Zhu (2025), using panel data from 72 of China's trading partners, found that digital services trade barriers negatively affect ICT exports by increasing the bilateral trade costs[12].

With the rapid evolution of generative AI technology, AI agents have gained the ability to plan, execute, and learn independently, and are gradually becoming key participants in the business world. An AI agent refers to a software program, information system, or other type of entity that can perceive the external environment and independently make decisions and execute tasks based on predefined goals or user instructions. It exhibits strong flexibility and adaptability, with significant advantages in rule analysis, task execution, and cross-border compliance[13]. At present, a growing number of scholars have begun to explore the enabling advantages of AI agents in fields such as data analysis, negotiation guidance, education and instruction, healthcare, transportation, and commercial markets. In-depth research has been conducted on their conceptual features, classification systems, practical applications, and more. For example, Zhou (2024) pointed out that the advancement of AI agents can be evaluated from four dimensions: practicality, sociality, value criteria, and the ability to evolve sustainably[14]. Yang (2024) used multi-agent systems to integrate data from different sources to accurately predict stock market volatility and enhance financial market risk assessment and forecasting[15]. Han (2024) designed an AI agent model for multimodal data processing, using the analysis of financial annual reports in smart investment scenarios as an example[16]. Zhao (2025) emphasized that with the continued expansion of AI agent application scenarios, it is important to consider how to achieve the dual legislative objectives of protecting personal information and promoting its reasonable use at the practical level[17].

However, research on integrating AI agents with digital trade barrier resolution is still in its infancy. Existing literature mostly focuses on the application of AI technologies to specific aspects of digital trade, such as customer service and supply chain management in cross-border e-commerce, or discusses the conflicts and coordination of digital trade rules in isolation. These studies fail to fully explore the potential of AI agents in addressing the fragmentation of digital trade rules and lack systematic research on integrating the two dimensions. Therefore, based on the core perspective of rule adaptation, this paper aims to fill the gap in the current literature by systematically exploring the integration of AI agents with digital trade barrier resolution. Specifically, by constructing an analytical framework of "technology empowerment rule transformation ecological synergy," this paper investigates the mechanisms through which AI agents analyze fragmented digital trade rules, dynamically adapt to differentiated regulatory requirements, and promote rule compatibility and collaborative governance. It identifies the unique opportunities of AI agents in overcoming rule fragmentation and develops a strategic framework characterized by both theoretical innovation and practical operability. This not only provides a new theoretical explanation for the technological resolution of digital trade barriers but also offers targeted theoretical support and strategic guidance for enterprises to manage complex regulatory environments, enhance cross-border trade efficiency, and support countries' participation in global digital governance.

3 The Dilemma of Rule Adaptation of Digital Trade Barriers

The dilemma of rule adaptation in digital trade barriers is essentially a structural contradiction between the fragmentation of the global digital governance system and the large-scale development of digital trade. Specifically, it manifests in three intertwined challenges that together constitute the compliance barriers faced by enterprises engaged in cross-border operations.

First, the fragmentation and differentiation of the rule system have created a standard maze. The World Trade Organization (WTO) consists of a package of multilateral trade agreements established at the end of the 20th century, covering trade in goods, services, and intellectual property. As the core mechanism of global trade governance, the WTO should theoretically serve as a foundational framework for regulating digital trade and cross-border data flows. However, in practice, member states are often able to circumvent contractual obligations through flexible interpretations of service categories, leading to divergent demands and the adoption of restrictive measures. More importantly, when multilateral rule systems fail to keep pace with the evolving needs of digital trade, major economies increasingly resort to unilateral legislation, as well as bilateral or regional trade agreements, to seek breakthroughs. Agreements such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) and the Regional Comprehensive Economic Partnership (RCEP) have placed cross-border data flow at the core of their digital trade agendas, aiming to address new regulatory challenges. However, these regional frameworks reflect divergent value orientations and national interests: some emphasize barrier-free flow, others preserve localization exceptions, while still others focus on development-oriented governance. This multi-regulatory orientation has resulted in a high degree of rule heterogeneity. For instance, even in the domain of cross-border data flow alone, there exist over ten distinct compliance mechanisms, including "adequacy determination," "standard contractual clauses," and "security assessments." For enterprises seeking to enter multiple markets, adapting to these diverse rules and standards significantly increases compliance costs. In some cases, firms may even fall into a "compliance paradox," whereby fulfilling one jurisdiction ' s requirements results in violations in another due to rule conflicts.

Second, semantic ambiguity and regulatory volatility exacerbate compliance uncertainty. Digital trade rules involve numerous abstract concepts, whose meanings evolve alongside technological development and often lack clear definitional standards. For example, the categorization of key terms such as "personal sensitive information," "important data," and "digital services" differs significantly across jurisdictions. This

semantic ambiguity makes it difficult for enterprises to accurately determine the boundaries of compliance. As a result, they must allocate significant resources to interpret the rules—yet may still face compliance risks due to misinterpretation. To make matters more complex, the pace of regulatory change has accelerated. With the emergence of new technologies such as artificial intelligence and the metaverse, many countries have frequently revised their digital trade rules. In 2023 alone, 37 countries worldwide updated terms related to cross-border data flows. In some cases, the regulatory revision cycles are even shorter than the update cycles of enterprises' compliance systems. This widening gap between technological innovation and regulatory adjustment places enterprises in a constant state of reactive compliance.

Third, the hierarchical complexity and regional discrepancies in rule implementation pose significant barriers to effective compliance. Digital trade regulations span a multi-level system ranging from international agreements to local rules, forming a pyramid structure comprising global rules, regional agreements, domestic legislation, industry standards, and local-level policies. At the international level, the World Trade Organization (WTO) has made little progress in developing specific agreements on cross-border data flows and has yet to establish a dedicated framework in this domain. Regional agreements such as the Regional Comprehensive Economic Partnership (RCEP) and the United States Mexico Canada Agreement (USMCA) contain digital provisions, but differences remain across their respective digital clauses. At the national level, conflicts may arise between legislative texts and administrative practices. For instance, while national laws may permit the free flow of data, regulatory agencies may impose implicit restrictions through internal administrative guidance. At the industry level, self-regulatory standards in different sectors further refine compliance expectations—for example, data encryption protocols in the financial sector or privacy protection norms in the healthcare field. This layering of multi-level regulations requires enterprises to undertake end-to-end compliance. However, due to limited resources, small and medium-sized enterprises (SMEs) often struggle to satisfy the requirements across all regulatory levels and may be forced to exit certain international markets. Moreover, the same rule may be implemented with varying degrees of enforcement in different jurisdictions. Even when countries sign mutual recognition agreements, interpretation discrepancies and varying enforcement priorities among local agencies can lead to inconsistent compliance outcomes.

4 Opportunities for AI Agents in Addressing Rule Adaptation Dilemmas in Digital Trade

4.1 Semantic Transformation Opportunity of Rule Parsing

The most basic and core opportunity for AI agents to solve the dilemma of rule adaptation lies in their ability to accurately transform the semantics of rules, which fundamentally changes the inefficiency and fuzziness of traditional manual rule interpretation. The texts of digital trade rules are often filled with technical terms, abstract expressions, and implicit logic, and the semantic meanings of rules in different language versions may also diverge, together constituting the first obstacle for enterprises to understand and apply such rules. In the traditional model, enterprises are required to organize legal and compliance teams to interpret rules word by word, a process that is time-consuming, labor-intensive, and prone to subjective judgment. In contrast, AI agents, empowered by language models or multimodal models, can rapidly process vast quantities of regulatory texts, convert textual information into structured rule databases, and decompose them into quantifiable and comparable compliance indicators using algorithmic methods. Throughout this process, AI agents achieve in-depth semantic interpretation of unstructured rule texts by integrating natural language processing, knowledge graphs, and deep learning technologies. The value of this semantic transformation is not only to enhance the efficiency of understanding but also to construct a machine-executable rule base. For instance, when an enterprise must simultaneously comply with the General

Data Protection Regulation (GDPR) of the European Union and the Personal Information Protection Law of China, AI agents can automatically extract provisions related to the right to data deletion, compare their respective scopes, conditions of exercise, and exceptions, and generate a visualized chart highlighting points of overlap and divergence to help enterprises quickly identify both the intersections and conflicts of compliance. More importantly, this semantic transformation capability is reusable and extensible. As new rules emerge, AI agents can continuously optimize their semantic models through transfer learning, gradually constructing a comprehensive knowledge graph of digital trade rules across major economies. This allows enterprises to understand and compare multiple regulatory systems under a unified technical framework, thereby reducing compliance risks caused by semantic ambiguity at the source.

4.2 Real-Time Response Opportunities for Dynamic Compliance

The dynamic adjustment of digital trade rules and regional differences make enterprises constantly face a passive situation in which their internal compliance strategies cannot keep pace with regulatory changes. AI agents, with their real-time monitoring and adaptive decision-making capabilities, provide a key opportunity to solve this dilemma. In the traditional compliance model, enterprises often track rule changes by regularly consulting official announcements, hiring external consultants, and conducting periodic internal assessments. However, such lagging mechanisms may cause enterprises to continue applying outdated compliance strategies after rules have already been updated, thus exposing themselves to potential regulatory risks. Meanwhile, differences in the implementation of the same rule across regions make it difficult for enterprises to grasp local enforcement intensity in real time. AI agents can rely on algorithm-driven reinforcement learning to continuously optimize decision-making models by dynamically adjusting the weight parameters of rule interpretation. This enables the construction of a closed-loop compliance system, encompassing monitoring, analysis, and responsive decision-making, thereby achieving dynamic and accurate compliance management. In the rule monitoring phase, AI agents can capture revised draft rules, effective regulatory announcements, and law enforcement cases in real time by interfacing with open data platforms from national legislatures and regulatory authorities. Furthermore, they can predict the direction and scope of rule adjustments by analyzing sources such as news archives, policy interpretation briefings, and official consultations. In the analysis phase, AI agents can compare enforcement cases across different regions and extract key similarities and differences. In the strategy response phase, they can automatically generate adjustment schemes tailored to enterprise-specific compliance goals and business characteristics. For example, when a country tightens tax regulations for cross-border e-commerce, the AI agent can immediately calculate the changes in tax burden under various pricing strategies and recommend the most suitable compliance response.

4.3 Consensus-Building Opportunities for Cross-Domain Collaboration

The fragmentation of digital trade rules is, at its core, a reflection of divergent interests among various stakeholders. AI agents offer a technological opportunity to break this deadlock by facilitating consensus-building through their cross-domain collaboration capabilities. Whether in intergovernmental rule negotiations, inter-enterprise compliance coordination, or regulatory-market interactions, all parties face persistent challenges of information asymmetry. AI agents can act as neutral technological intermediaries that promote consensus through enhanced data sharing and balanced interest alignment. At the international rule coordination level, AI agents can leverage big data analysis to identify the "maximum common denominator" among regulatory systems of different economies, thereby assisting negotiators in formulating more inclusive proposals. This approach to consensus-building does not aim to impose uniform standards, but rather to enhance rule compatibility while respecting existing differences. By quantifying the implementation costs and benefits associated with different regulatory regimes, AI agents enable

stakeholders to recognize the mutual value of rule recognition and its contribution to shared objectives. This technology-driven approach to consensus-building can not only help resolve the current dilemma of rule fragmentation but also offer an innovative, win-win pathway for the future of global digital trade governance.

4.4 Technology Adaptation: Building an AI Agent Rule Parsing System

The construction of an AI agent-based rule parsing system should prioritize enterprise usability as its core objective. To achieve this, the system must reduce technical barriers through modular design, allowing the rule parsing capabilities of AI agents to be integrated seamlessly into daily business operations. This system primarily consists of two components: a multimodal rule knowledge base and a scenario-based compliance engine. For the construction of the multimodal rule knowledge base, digital trade regulation texts from major trading countries—such as laws, administrative regulations, departmental rules, and official interpretations—can be batch-collected from authoritative legal databases to form a foundational corpus. Next, the technical team should develop a lightweight annotation tool and collaborate with legal experts to annotate key terms, such as "cross-border data" and "personal information," across multiple languages. For example, the term "controller" under the GDPR is mapped to "personal information processor" in China's Personal Information Protection Law. Automated term alignment and cross-lingual semantic matching can then be achieved through large language model training, ensuring that more than 95% of frequently used terms are accurately identified by AI agents. Finally, the system connects to official regulatory announcement channels and includes a keyword-based monitoring feature. Upon detecting a rule revision, the knowledge base triggers an automatic update process, completes iteration within 24 hours, and pushes change notifications to enterprise clients. For the scenario-based compliance engine, the system must provide a plug-and-play toolkit tailored to specific digital trade use cases. In the context of cross-border e-commerce, a compliance checking plug-in can be embedded within an enterprise's internal ERP system. When product information is entered, the plug-in automatically matches relevant import regulations based on the HS code. For instance, upon entry of a "children's smartwatch," the system can immediately display CE certification requirements for the EU, FCC standards for the U.S., and national privacy restrictions concerning the product's built-in camera. A comprehensive compliance checklist is then generated, including testing agencies, procedural steps, and cost estimates. In the domain of cross-border data, a "data flow sandbox" tool allows enterprises to upload sample datasets. The tool automatically identifies the data type and simulates the compliance pathway for transmission to the destination country.

4.5 Rule Transformation: Promoting the Connection Between Technology Adaptation Results and Institutional Rules

AI agents analyze regulatory requirements in digital trade and generate solutions that answer the question of "how to meet those requirements." However, the compliance outcomes produced by AI agents must be recognized by multiple stakeholders. It is crucial not only to give enterprises confidence in following system recommendations, but also to ensure that regulatory authorities approve the compliance results generated by AI systems. This dual recognition is key to facilitating broader adoption and application of AI agents in regulatory contexts. Accordingly, this stage requires the gradual institutionalization of the adaptation outputs generated by AI agents—such as specific compliance solutions, operational guidelines, and quantitative indicators—into industry norms and formalized regulatory frameworks. Through practical implementation and mechanism design, these outputs can gain legitimacy at the enterprise, industry, and regulatory levels, eventually serving as a basis for standardized or referenceable compliance practices.

First, technical outputs should be applied to real-world problems to generate replicable cases. When

enterprises engage in cross-border digital trade, they can utilize AI agents to analyze the digital trade rules of their target markets. Based on the enterprise's operational characteristics, the AI agent produces tailored compliance recommendations. After executing the business plan and completing regulatory inspection, the enterprise compiles key aspects—such as the use case, implementation details, and compliance performance—into a standardized case record. Second, mature technical solutions should be translated into industry standards. Under the leadership of national cross-border e-commerce pilot zones and industry associations, case studies of AI agent use in compliance can be collected and analyzed. Quantifiable compliance indicators can be extracted—such as the mandatory data fields identified by the AI agent for cross-border payments, or prohibited data categories. These indicators can then be compiled into technical specifications, for example, a "Group Standard for Cross-Border Payment Data Compliance." Once implemented, this standard can allow enterprises to access a compliance fast-track during reviews by customs, taxation, and other regulatory agencies, thereby reducing the frequency of repetitive on-site verifications. Finally, efforts should be made to align technical standards with formal regulatory frameworks. Pilot programs for mutual recognition of AI-generated compliance results can be conducted within free trade zones. In these pilots, compliance reports generated by designated AI systems can serve as the basis for applications for cross-border data transfer licenses. Regulatory authorities would then only need to verify the format and completeness of such reports, reducing the burden of manual review. Once proven effective, the mutual recognition mechanism can be expanded to bilateral or regional governance frameworks.

4.6 Ecological Collaboration: Building a Collaborative Network for Breaking Down Barriers through Multi-Agent Participation

The removal of digital trade barriers is not the responsibility of any single entity; it requires coordinated efforts among governments, enterprises, industrial chains, and international institutions. AI agents can serve as critical technological links that enable multi-party collaboration across these domains. Government-enterprise collaboration aims to address the resource limitations of small and medium-sized enterprises (SMEs) by establishing public service platforms for rule adaptation. These platforms can be government-led, co-developed by universities and tech enterprises, and provide open access to rule knowledge bases and AI-powered compliance tools for SMEs at no cost. The platform should provide three core functions:

First, rule query and interpretation—SMEs can input keywords such as export destinations and business types to receive AI-generated compliance checklists. Second, compliance diagnosis and optimization—by interfacing with enterprise ERP systems, AI agents can automatically scan business workflows to detect compliance risks. Third, dispute resolution support—when enterprises face cross-border compliance disputes, the platform can utilize historical case databases and legal knowledge bases to offer intelligent assistance for issue identification, legal argumentation, and response strategies.

International collaboration should leverage a digital rule adaptation alliance to enhance the compatibility of cross-regional regulations. Countries along the Belt and Road Initiative and RCEP member states can jointly build transnational rule knowledge bases and shared AI adaptation tools. This effort involves solving three key challenges: First, the visual presentation of regulatory differences—by comparing key terms across national regulations using AI agents, a heatmap of regulatory divergence can be generated, such as showing the strictness of data localization rules across ASEAN countries. Second, simulation and forecasting of compatible schemes—based on game-theoretical models, AI agents can predict how different regulatory alignment strategies will affect trade flows and industry structures in each country, providing empirical support for negotiations. Finally, rule update synchronization—rule revisions from alliance members can be shared in real time through encrypted channels, enabling agents to update the multilateral rule base within 24 hours and reduce compliance risks caused by information lag.

Industrial chain collaboration requires the creation of cross-border compliance communities to facil-

itate coordinated compliance among enterprises within the supply chain. Leading enterprises can open access to their proprietary AI agent systems, sharing rule interpretation models and compliance tools with upstream and downstream partners, thereby forming a chain-leader-driven model guiding SME compliance. For instance, in the manufacturing sector, a lead manufacturer could integrate AI agents into its supply chain management system to disseminate regulatory requirements—such as EU carbon emission standards or U.S. autonomous driving data regulations—to its component suppliers and monitor their compliance status in real time. This form of industrial collaboration not only improves overall compliance efficiency but also enhances the international competitiveness of the entire supply chain through collective capacity building.

5 Challenges of AI Agent Applications

Although AI agents can facilitate enterprises' digital trade activities to some extent, their widespread application is accompanied by a series of challenges and potential risks.

The heavy reliance of AI agents on data makes them high-risk vectors for privacy breaches. Relying on AI agents to overcome the fragmentation of digital trade rules often requires access to large volumes of international trade regulatory data, including national tariff policies, import and export restrictions, and cross-border data flow regulations. Such data contain a certain degree of sensitivity, involving national regulatory details and corporate strategic planning. At the same time, the operation of AI agents frequently necessitates real-time access to sensitive enterprise information, such as transaction records, customer data, and supply chain documentation. Such high-frequency, dynamic interactions between regulatory data and business data significantly increase the risk of disclosure. To mitigate this risk, enterprises should adopt strict security measures, including access control, encrypted transmission, and real-time monitoring, when deploying AI agents. In addition, enterprises can also implement role-based permission management systems to assign differentiated data access rights to personnel at different organizational levels.

Some countries question the reliability of AI-generated compliance results and continue to mandate manual reviews, thereby limiting the broader implementation of such technologies. This skepticism arises largely because, when AI agents generate compliance results, the relationship between input data and output outcomes is often difficult to understand or explain. The underlying algorithmic logic remains opaque—a typical black-box problem. As a result, managers often find it impossible to trace the basis for decision-making, and when deviations or errors occur, responsibility becomes difficult to define. To address this issue, it is essential to advance the standardization of AI compliance systems by introducing internationally recognized technical certifications and ensuring algorithmic transparency, thereby enhancing the trust of regulatory authorities in AI-generated results. At the same time, a flexible mechanism that combines AI audits with manual spot checks can be established to improve approval efficiency while safeguarding compliance integrity.

6 Conclusion

The contradiction between the vigorous development of digital trade and the fragmentation of the global rule system has become a key bottleneck restricting the further promotion of global economic integration. From the core perspective of rule adaptation, this paper systematically explains the technical logic and practical path of AI agents in breaking digital trade barriers, reveals their unique value in rule analysis, dynamic compliance, and cross-domain collaboration, and constructs a three-level strategic framework of "technology adaptation, rule transformation, and ecological collaboration." This study combines AI agents with the adaptation of digital trade rules, fills the systematic research gap in the field of technology-enabled trade governance, expands the theoretical perspective on breaking digital trade barriers, and provides a new

analytical framework for understanding the interaction between technology and regulatory systems. At the same time, the proposed technical solutions, such as the multimodal rule knowledge base and the scenario-based compliance engine, along with ecological strategies including government-enterprise collaboration and international alliances, offer practical reference pathways for enterprises to navigate complex regulatory environments and enhance cross-border trade efficiency.

In addition, AI agents in the application of breaking digital trade barriers continue to face significant challenges, including data security risks, algorithmic black-box issues, and limited international mutual recognition. Their technical maturity and institutional adaptability still require continuous optimization in practice. Future research can further focus on three aspects: First, improving the rule-parsing accuracy of AI agents in multilingual and multi-scenario contexts, particularly their adaptability to fuzzy semantics and dynamically adjusted rules; Second, validating the practical effectiveness of the strategic framework through specific industry case studies and refining the implementation schemes; Finally, building on the synergy of technological innovation and institutional innovation to promote a more equitable and efficient global digital trade order, thereby injecting sustained momentum into the recovery and growth of the world economy.

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