Research on the Influence Mechanism of AI Translation on Cross-border E-commerce Transactions from the Perspective of Technology Empowerment

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Abstract: *The rapid development of cross-border e-commerce continues to be hindered by profound information asymmetry and rising transaction costs stemming from language barriers. Traditional translation models struggle to meet its massive, real-time, and fragmented cross-linguistic communication demands. AI translation technology, with deep learning at its core, offers a new technological pathway to overcome this bottleneck. Based on the perspective of technology empowerment, this study aims to systematically elucidate the internal mechanisms through which AI translation influences cross-border e-commerce transactions. By constructing a theoretical analysis framework integrating technology empowerment, information processing, and transaction costs, the research reveals that AI translation primarily functions through three core mechanisms: enhancing transaction information transparency via precise language conversion; building trust by reducing cross-cultural cognitive friction through culturally adaptive conversion; and streamlining operations while fostering the dynamic capabilities of transaction entities through process-embedded integration. Further analysis indicates that this empowerment process is constrained by the technological limitations in deep semantic understanding and exhibits differentiated adaptability across various transaction models. Ultimately, a co-evolutionary trend exists between the iterative improvement of AI translation algorithms and the evolution of cross-border e-commerce transactional relationships. This study provides a systematic theoretical analysis for understanding the role and impact of intelligent language technology in cross-border commercial contexts.*

Keywords: *technology empowerment; AI translation; cross-border e-commerce; influence mechanism; information transparency*

Introduction

The deepening of global digital trade has established cross-border e-commerce as a pivotal business model. However, language barriers remain one of the core challenges hindering the smooth exchange of information and the effective building of trust. The breakthrough advancements in artificial intelligence translation technology, particularly the application of neural machine translation and large-scale pre-trained models, are fundamentally altering the methods and efficiency of processing cross-linguistic business information. Merely viewing it within the simple scope of a tool is insufficient for understanding the transformative impact it brings. Within this context, initiating a systematic investigation into how AI translation reshapes the internal logic and procedural mechanisms of cross-border e-commerce transactions from the theoretical perspective of technology empowerment holds significant theoretical necessity and practical importance. Existing research predominantly focuses on either the technology itself or transactional aspects in isolation, lacking meso-level mechanistic studies that deeply integrate the two to systematically dissect their pathways of influence. Consequently, this research is dedicated to constructing an integrative analytical framework. It aims to thoroughly reveal the specific mechanisms through which AI translation affects the informational environment, trust foundation, and process structure of transactions, while dialectically discussing its technological boundaries and application scenarios. This endeavor seeks to fill theoretical gaps in the related field and provide fundamental analytical underpinnings for subsequent academic exploration and commercial application.

1. The Theoretical Foundation of Technology Empowerment and AI Translation

1.1 The Technical Core and Capability Evolution of AI Translation

The technical core of AI translation is rooted in deep learning, particularly in the integration of sequence-to-sequence models and the attention mechanism. Its essence lies in constructing complex mapping relationships between source and target languages through deep neural networks, transforming lexical, syntactic, and even contextual information into high-dimensional vector representations, and performing cross-lingual semantic reconstruction on this basis. This process transcends traditional phrase-based statistical methods. By training on massive parallel corpora, the models can capture deeper-level semantic associations and syntactic structures within language, achieving a shift from symbolic processing to semantic understanding. The emergence of neural machine translation models signifies that translation activity has progressed from automation based on explicit rules and statistical probabilities to the stage of intelligent capability generation grounded in representation learning.

The evolution of AI translation capabilities exhibits a shift from static conversion to dynamic interaction. Early systems focused on sentence-level correspondence within closed corpora, while the current technological pathway is dedicated to enhancing context sensitivity, domain adaptability, and coverage of low-resource languages. The introduction of large-scale pre-trained language models enables systems to assimilate broader general knowledge and rapidly adapt to specific business scenarios through fine-tuning mechanisms. This evolution is not merely a pursuit of improved translation metrics. Instead, it manifests as the system's progression from rigid to flexible handling of linguistic ambiguity, culture-loaded terms, and industry terminology. It extends from processing isolated sentence segments to considering dialogue coherence and overall textual intent, thereby offering new technological possibilities for the cross-linguistic circulation of complex business texts[1].

1.2 The Nature of Language Barriers and Information in Cross-border E-commerce Transactions

The essence of language barriers in cross-border e-commerce transactions lies in multidimensional information asymmetry and cognitive gaps. Superficial barriers manifest as the inability of trading parties to directly understand explicit texts such as product descriptions, specification parameters, user reviews, and contract terms. Deeper-level barriers involve cultural metaphors within brand narratives, the emotional appeals of marketing rhetoric, and the pragmatic rules governing customer service interactions. These elements collectively constitute the implicit informational environment that influences consumer trust and purchasing decisions. Language barriers not only increase the costs of information search and verification but also lead to misunderstandings and uncertainty at critical transactional junctures. Consequently, they distort price discovery mechanisms and may hinder the ongoing maintenance of post-sales relationships.

From the perspective of information economics, the cross-border e-commerce transaction process can be deconstructed as a series of cycles involving information encoding, transmission, decoding, and feedback. Information about goods and services must be encoded from the seller's context into specific linguistic symbols, transmitted across intercultural channels, and then decoded by the buyer based on their own cognitive framework. Throughout this process, the integrity, accuracy, and timeliness of the information face the risk of degradation. Constrained by efficiency and cost, traditional human translation or basic machine translation often struggles to balance the demands of the massive, fragmented, and real-time fluctuating information in e-commerce. Therefore, the key to overcoming language barriers lies in constructing a technological intermediary capable of efficiently and accurately processing non-standardized, multimodal business information. This is essential to preserve the fidelity and utility of core transactional information during its flow across contextual boundaries.

1.3 Theoretical Analytical Framework for the Influence of Technology Empowerment on Transaction Processes

To systematically analyze the impact of AI translation on cross-border e-commerce transactions, it is necessary to construct a theoretical analytical framework that integrates technology empowerment, information processing, and transaction costs. Technology empowerment is not merely a simple tool replacement; it refers to the process by which advanced technologies reshape the logic of activities within a specific field by enhancing the capabilities of actors, reconfiguring resource combinations, and altering interaction patterns. Placing AI translation within this perspective, its subjects of empowerment

encompass both buyers and sellers as well as platforms in cross-border e-commerce. The dimensions of empowerment include information processing capability, communication and negotiation capability, and relationship governance capability. This framework views the transaction process as a value exchange system driven by information flows, where technology functions by intervening in and optimizing key information nodes within the system[2].

This theoretical framework emphasizes that the influence mechanism of AI translation originates from its fundamental intervention in the flow of transactional information. By enhancing the quality, speed, and economies of scale in generating and parsing multilingual business texts, the technology directly acts to reduce information asymmetry. Furthermore, this alteration in the information environment leads to a reconfiguration of costs across various transaction stages, including costs for information search, evaluation, negotiation, and monitoring. The change in cost structure subsequently incentivizes the formation of new patterns of transactional behavior and interactive strategies. Ultimately, at the macro level, this may give rise to outcomes such as enhanced transaction efficiency, expanded market scope, and the evolution of trust-building models. This framework provides a logically coherent analytical pathway for the subsequent chapters to dissect the specific influence mechanisms layer by layer.

2. Core Mechanisms of AI Translation's Impact on Cross-border E-commerce Transactions

2.1 The Mechanism of Precise Language Conversion and Transaction Information Transparency Enhancement

AI translation optimizes the cross-linguistic presentation quality of key information such as goods, services, and regulations in cross-border e-commerce scenarios through its capabilities in deep semantic parsing and contextually coherent generation. Compared to traditional translation methods, neural network-based translation models can better handle specialized terminology, idiomatic expressions, and complex sentence structures, reducing semantic deviations or information loss caused by literal correspondence. This precise conversion directly applies to high-information-density texts such as product descriptions, technical specifications, and user agreements. It enables consumers in the target market to access information content that is more complete and closer to that of the source language context, thereby lowering the risk of misinterpreting key attributes due to language barriers.

The mechanism for enhancing information transparency originates from the technology's systematic intervention in the structure of information asymmetry. When dynamic information flows-such as product reviews, service terms, and logistics status-can achieve multilingual synchronization with low latency and high fidelity, the information environments of buyers and sellers tend toward parity. This parity exists not only at the level of information accessibility but extends deeper into the levels of information comprehensibility and comparability. Potential consumers are able to conduct cross-verification and make rational decisions based on more sufficient and accurate multilingual information, while sellers can more clearly convey their product value propositions to diverse markets. Consequently, the authenticity of market signals is enhanced, and the connection between price and value becomes more direct, forming the foundation for optimizing the efficiency of resource allocation.

2.2 The Mechanism of Reducing Cross-cultural Cognitive Friction and Building Trust

The lack of trust in cross-cultural transactions partly stems from cognitive friction caused by differences in cultural norms, values, and consumption habits implicitly embedded within linguistic symbols. Through its advanced applications that incorporate the recognition and adaptive conversion of culture-specific expressions, politeness levels, and emotional tones, AI translation partially assumes the function of a cultural intermediary. This technology can, during the language conversion process, appropriately moderate or annotate culture-loaded terms that may cause misunderstanding or offense. Thereby, it softens the rigidity in communication arising from different cultural backgrounds and fosters a more amicable initial atmosphere for transactional interactions.

The trust-building mechanism manifests in this process as a generative pathway based on the consistency and predictability of the symbol system. When AI translation ensures that brand narratives, marketing communications, and customer service interactions maintain consistent core intent and emotional tone across different language versions, it gradually establishes an image of brand reliability and professionalism in the consumer's perception. Continuous, accurate, and culturally appropriate cross-linguistic communication reduces perceived uncertainty and itself becomes a signal of credible

commitment. This instrumental trust, derived from precise and stable information interaction, serves as a crucial prerequisite for the formation of affective trust and institutional trust. It contributes to the establishment of sustainable transactional relationships that transcend geographical and cultural boundaries[3].

2.3 The Mechanism of Transaction Process Simplification and Dynamic Capability Formation

AI translation, in the form of embedded services, seamlessly integrates into the entire process of cross-border e-commerce, including product listing upload, customer inquiry, order processing, and post-sales support. This deep integration automates and instantizes multilingual information processing, transforming translation tasks that previously required specialized human intervention or external coordination into standardized operations performed in real-time by the system backend. From the seller's perspective, this reduces the complexity of multi-market operations and compresses the time cycle from product preparation to market reach. From the buyer's perspective, it removes language-switching barriers, enabling them to directly complete information retrieval, need communication, and issue resolution in their native language, significantly lowering the operational threshold for participating in cross-border transactions.

The efficiency gains brought about by process simplification further empower transaction entities to cultivate their dynamic capabilities for responding to the volatile international market. Enterprises can engage in trial and error at lower costs and iterate at faster speeds, thereby nimbly responding to preference changes and competitive dynamics in different markets. The capacity for real-time, large-scale multilingual data processing also provides the data foundation for precise optimization based on market feedback, personalized recommendations, and risk warning. This dynamic capability manifests in the enhancement of organizational learning speed, resource allocation flexibility, and strategic adjustment sensitivity. It enables transaction entities to no longer perceive language differences as static, fixed obstacles, but rather to internalize them as variables that can be continuously managed and optimized through technological capabilities, thereby strengthening their long-term adaptability in the global digital marketplace.

3. Discussion on the Application Pathways and Boundaries of AI Translation Technology

3.1 Technical Limitations in Semantic Depth Understanding and Multilingual Interactive Interfaces

Current AI translation systems remain limited in their depth of semantic understanding, constrained by their capacity to handle context dependency, domain knowledge, and implied meanings. Although neural machine translation excels at syntactic structure conversion, its interpretation can still be prone to deviations when processing presuppositions, cultural allusions, subtle terminological differences within specialized fields, as well as ellipses and ambiguous expressions in colloquial communication. These limitations stem from inherent patterns and biases in the model training data, coupled with the algorithms' current shortcomings in genuine situational awareness and commonsense reasoning. In cross-border e-commerce scenarios, the accurate translation of texts involving nuanced product characteristics, the delineation of post-sales responsibilities, or the emotional conveyance of marketing highly depends on grasping deep semantics and pragmatic contexts. The performance of existing technologies in handling such complex tasks remains uncertain. This uncertainty may lead to semantic degradation or distortion of critical business information, thereby harboring potential risks at key transactional stages such as confirmation, execution, and dispute resolution[4].

The construction of multilingual interactive interfaces also faces challenges in technical integration and real-time performance. Ideal seamless multilingual interaction requires the translation module to achieve millisecond-level data synchronization and context sharing with the front-end display, search algorithms, customer service bots, and recommendation systems of the e-commerce platform. However, existing architectures exhibit performance bottlenecks in maintaining cross-session state consistency, processing multimodal information (such as associated image-text translation), and handling high-concurrency real-time interactions. A trade-off often exists between the immediacy and accuracy of interface translation. Excessively pursuing speed may lead to fluctuations in translation quality, while ensuring high quality may introduce perceptible latency, adversely affecting user experience and the smoothness of the transaction process.

3.2 Adaptability Analysis of Cross-border E-commerce Transaction Models under Technology Empowerment

Different cross-border e-commerce transaction models exhibit significant variations in their requirements for and adaptability to AI translation technology. The standardized, high-frequency B2C retail model, with its relatively high degree of structured product information and concentrated consumer inquiries, is more readily positioned to benefit from the scalable, standardized language services currently offered by AI translation, achieving an overall reduction in transaction costs. Conversely, in highly customized, long-negotiation-cycle B2B bulk trade, transactional communication involves a substantial volume of non-standardized technical documents, contract clauses, and in-depth business negotiations. These place extremely high demands on translation accuracy, professionalism, and confidentiality. Existing AI translation technology often serves as an auxiliary tool rather than a complete replacement in such contexts, with its adaptability more evident in the preliminary stages of the process[5].

The effectiveness of technology empowerment is also moderated by the existing resources and digital infrastructure of the transaction entities. Large multinational corporations can leverage their data resources and technological integration capabilities to deeply customize and perform domain-specific fine-tuning on general AI translation models, thereby achieving better alignment with their specific business lines and market strategies. In contrast, small and medium-sized sellers rely more on standardized translation tools provided by platforms. While they possess relatively greater flexibility in adjusting their transaction models and stronger tolerance for technological limitations, they are simultaneously constrained by the uncontrollable risks potentially arising from the technology's black-box nature. Therefore, technology empowerment is not a homogeneous process. Instead, it interacts complexly with the inherent complexity of the transaction model, information density, and the entity's technological absorptive capacity, collectively shaping the final application effectiveness profile. Different technology adoption strategies-such as in-house development, purchasing API services, or relying on platform-embedded tools-further contribute to the heterogeneity in empowerment pathways and outcomes.

3.3 Outlook on the Co-evolution of Algorithm Iteration and Transactional Relationships

The future iteration direction of AI translation algorithms is anticipated to shift from pursuing the translation quality of static texts towards constructing dynamic, proactive cross-linguistic communication agents. This includes enhancing semantic understanding by integrating more powerful world models and domain knowledge graphs, rapidly assimilating emerging business vocabulary and expressions through continuous learning and online adaptation mechanisms, and developing conversational translation systems endowed with certain negotiation and explanatory capabilities. Such evolution will transform translation activity from being confined to passive information conversion to, to a certain extent, anticipating communication barriers and proactively clarifying ambiguities. Consequently, it will enable deeper integration into complex transactional negotiation processes[6].

The evolution of such algorithmic capabilities will produce a co-evolutionary effect alongside changes in the form of cross-border e-commerce transactional relationships. More precise and context-aware translation services are expected to support the establishment of more complex supply chain collaborations and long-term partnerships that rely on high-frequency, in-depth communication. In turn, the feedback data and new communication needs generated by the transactional relationships themselves will continuously provide domain-specific training scenarios and evaluation criteria for algorithmic optimization. From a long-term perspective, a mutually shaping, co-evolving relationship is likely to form between AI translation technology and the cross-border transactional ecosystem it serves. Technological breakthroughs create possibilities for innovation in transaction models, while increasingly complex transactional relationships continuously raise new demands for the technology, driving it toward more advanced capabilities for interaction and understanding. This co-evolution will blur the boundaries between technological tools and business processes, potentially ultimately giving rise to entirely new cross-border business paradigms with intelligent language capability at their core.

Conclusion

From the perspective of technology empowerment, this study systematically demonstrates the influence mechanisms of AI translation on cross-border e-commerce transactions. The research

elucidates that its impact is not a singular, linear enhancement of tool efficiency. Instead, it involves three interrelated mechanisms that progressively reconstruct the informational foundation and interactive patterns of transactions: enhancing information transparency through precise conversion; laying the groundwork for trust by reducing cognitive friction through adaptive conversion; and empowering dynamic capabilities by simplifying processes through seamless integration.

Simultaneously, the study reveals the non-homogeneous and conditional nature of this empowerment process: its effectiveness is constrained by the current technological limitations in deep semantic understanding and complex interactive interfaces, and it demonstrates differentiated adaptability across various transaction models such as standardized B2C and complex B2B. Looking ahead, AI translation technology and the cross-border e-commerce ecosystem will enter a trajectory of co-evolution. The evolution of algorithms towards agents possessing deep contextual awareness and proactive communication capabilities may give rise to closer and more complex cross-border collaborative relationships; in turn, the continuously evolving demands of transactions will consistently inform and define the direction of technological iteration. Subsequent research can build upon this foundation to further explore specialized issues such as multimodal information translation, the deeper impact of algorithmic explainability on trust, and the capability evolution pathways of entities of different scales during the technology diffusion process.

Fund Projects

References

[1] Gan, Mengke. "Error Analysis of Machine Translation for Cross-border E-commerce Products and Exploration of Pre-translation Editing Strategies." Overseas English, no. 12 (2024): 11-13.
[2] Zhang, Yali. "Cultivation of Business English Translation Talents and Development of Cross-border E-commerce under Economic Integration-A Review of Construction of the Curriculum System for the Cross-border E-commerce Direction of Business English Major." Commercial Economic Research, no. 08 (2024): 2.
[3] Ye, Lu, et al. "A Study on the Multimodal Discourse Construction and Translation of Cross-border E-commerce English Websites-Taking Amazon as an Example." Overseas English, no. 07 (2024): 82-85.
[4] Shen, Yuanyuan. "A Brief Exploration of Business English Translation Techniques in the Context of Cross-border E-commerce." English Square, no. 26 (2023): 27-30.
[5] Hao, Dandan. "A Brief Discussion on Business English Translation Techniques in the Context of Cross-border E-commerce." Campus English, no. 08 (2023): 190-192.
[6] Yan, Chunjing, and Roujia Huang. "A Study on the Translation of Cross-border E-commerce Product Titles from the Perspective of Skopos Theory." Foreign Economic Relations & Trade, no. 08 (2022): 123-126.