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Threshold Effects of RMB Exchange Rate Fluctuations on the Restructuring of Sino-US Bilateral Value Chains

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Abstract: ***The interplay between RMB exchange rate fluctuations and the restructuring of Sino-US bilateral value chains has emerged as a critical issue amid the retreat of globalization and geopolitical-economic competition. This study integrates exchange rate pass-through theory, Global Value Chain (GVC) decomposition frameworks, and threshold regression models to systematically analyze the nonlinear impact pathways of exchange rate volatility on bilateral value chain adjustments. The findings reveal a significant threshold effect in the role of RMB exchange rates in shaping Sino-US value chain specialization. The critical threshold is jointly determined by trade policy uncertainty, supply chain resilience, and technological dependence. When exchange rate fluctuations exceed this threshold, structural shifts occur in corporate production relocation, intermediate goods trade substitution, and technology spillover pathways. Future research should deepen the dynamic modeling of the triadic coupling mechanism ("exchange rate–value chain–threshold") and incorporate emerging variables such as digital trade and green trade barriers.***

Keywords: Exchange rate; Global value chains (GVCs); Threshold effects; Sino-US trade; Nonlinear adjustment.

1. INTRODUCTION

In recent years, the global economic landscape has undergone profound transformations. Following the August 11th Exchange Rate Reform in 2015, the flexibility of the RMB exchange rate has significantly increased. This reform has not only reshaped China's monetary policy and financial markets but also exerted far-reaching impacts on international trade and global value chains. Concurrently, escalating Sino-US trade friction and "decoupling" pressures have accelerated the restructuring of bilateral value chains. As Baldwin and Freeman (2021) note, this restructuring has not only altered traditional trade patterns but also compelled nations and firms to reassess the security and sustainability of their supply chains.

However, at the theoretical level, traditional exchange rate pass-through theories often overlook the heterogeneity of value chain specialization. These theories predominantly analyze macro-level trade balances while lacking granular insights into micro-level corporate behaviors. Although threshold effects have gained attention in economics, existing studies focus narrowly on macroeconomic indicators (e.g., trade volumes, exchange rate volatility), leaving a research gap in understanding how firms dynamically adjust their value chain strategies in response to exchange rate fluctuations. From a policy perspective, this study aims to uncover the synergistic mechanisms between exchange rate policies and supply chain security. Against the backdrop of rising global economic uncertainty and prolonged Sino-US trade tensions, this research holds significant implications for China's policymaking. It provides actionable insights for designing effective exchange rate policies, safeguarding supply chains, and advancing high-quality economic development. Additionally, it offers empirical support for China's dual-circulation strategy, facilitating the construction of a more open, inclusive, and balanced domestic-international economic ecosystem. In terms of academic innovation, this study constructs a nonlinear analytical framework ("exchange rate volatility–threshold identification–value chain response"). This framework transcends the limitations of traditional pass-through theories by incorporating micro-level corporate decision-making, thereby comprehensively elucidating the mechanisms through which exchange rate fluctuations reshape value chain configurations and supply chain resilience. Furthermore, it provides new theoretical perspectives and analytical tools for future research on exchange rate transmission and value chain dynamics, driving scholarly advancements in related fields.

2. THEORETICAL FOUNDATIONS

2.1 Transmission Mechanisms of Exchange Rate Fluctuations on Trade

To explore how exchange rate fluctuations affect trade, we must first understand price pass-through effects and related theories. The incomplete pass-through theory serves as a cornerstone in this field, positing that exchange rate changes do not fully translate into import/export prices due to factors such as market power and pricing strategies. Goldberg and Knetter (1997) demonstrated that firms adjust pricing strategies based on their market position and product characteristics, leading to incomplete pass-through. Firm heterogeneity further shapes these effects. Differences in productivity, scale, and technological capabilities drive divergent responses to exchange rate volatility. High-productivity firms, for instance, often adopt producer currency pricing (PCP) to hedge risks, stabilizing prices and preserving market share (Gopinath et al., 2020). Value chain embeddedness also moderates exchange rate transmission. In today's fragmented global value chains (GVCs), firms operate across borders, making their trade activities sensitive to both direct exchange rate changes and their position within GVCs. Industries with high backward linkages (reliance on imported intermediates) exhibit greater exchange rate sensitivity. For example, currency appreciation lowers import costs, enhancing competitiveness, while depreciation raises production costs (Amiti et al., 2019). Additionally, deeper GVC participation reduces exchange rate pass-through elasticity, complicating price adjustments (Cheng et al., 2021).

2.2 Drivers of Global Value Chain Restructuring

Economic and non-economic factors play crucial roles in the current global economic environment, jointly influencing corporate operational strategies, market layouts, and the competitive landscape across entire industry chains. From an economic perspective, cost competitiveness is key to a company's foothold in the global market. Among these, wage levels serve as an important indicator for measuring labor costs in a country or region. When wage levels in a certain location are relatively low, companies can significantly reduce labor costs by establishing production bases or conducting production activities there, thereby enhancing the cost competitiveness of their products. Additionally, tariff policies are also a critical factor affecting a company's cost competitiveness. Changes in tariffs directly impact a company's import and export costs, subsequently influencing product market prices and competitiveness. Therefore, when formulating market entry and expansion strategies, companies typically consider economic factors such as wages and tariffs comprehensively. Beyond cost competitiveness, technological upgrades are also an important means for companies to enhance their competitiveness. With the continuous development of technology, automation technology is increasingly being applied in the production sector. Automation technology can replace traditional manual operations, improving production efficiency and quality while reducing production costs. As a result, companies are investing funds in technological upgrades to enhance their automation levels and production efficiency. These technological upgrades not only help companies maintain a competitive edge in the global market but also promote the upgrading and transformation of entire industry chains. However, in addition to economic factors, non-economic factors also significantly impact corporate operations and market layouts. Geopolitical risks are one of the non-economic factors that cannot be ignored in the current global market. Geopolitical risks include political conflicts, trade barriers, policy changes, etc., which directly affect a company's market entry and operational strategies. For example, trade barriers may lead to high tariffs and import restrictions for companies, thereby impacting product sales and market share. Therefore, when formulating market strategies, companies need to closely monitor changes in geopolitical risks and take corresponding countermeasures. Furthermore, supply chain resilience policies are also a non-economic factor receiving considerable attention in the current global market. To address geopolitical risks and market uncertainties, more and more companies are adopting supply chain resilience policies such as friend-shoring outsourcing. These policies aim to enhance the reliability and resilience of supply chains, ensuring that companies can quickly adjust their supply chain layouts in the face of risks and maintain stability in production and sales. Therefore, supply chain resilience policies have become one of the important means for companies to maintain a competitive advantage in the global market.

2.3 Threshold Effect Theory and Method

The Threshold Regression Model, proposed by Hansen in 1999, is a powerful statistical tool specifically designed to identify potential structural breakpoints in variable relationships. The core idea of this model lies in its allowance for significant changes in the relationship between variables under different conditions, defined by one or more threshold variables. When a threshold variable exceeds or falls below a specific critical value, the pattern of the relationship between the dependent and independent variables may abruptly shift, representing a structural breakpoint. In the field of value chain research, the application of the threshold regression model is particularly crucial as it helps us understand how companies adjust their supply chain strategies to cope with external shocks in a complex and ever-changing global economic environment. Specifically, this model demonstrates its unique

value in several aspects. Firstly, amidst trade policy uncertainty, the threshold regression model is used to identify the thresholds that trigger the regionalization of corporate supply chains. Research by Handley and Limão (2017) shows that when trade policy uncertainty exceeds a certain critical value, companies tend to shift their supply chains closer to the final markets to reduce potential risks and costs, achieving supply chain regionalization. This shift not only reflects companies' sensitive response to policy uncertainty but also reveals the dynamic adjustment mechanism of global value chains when facing external shocks. Secondly, exchange rate volatility plays a key role as another important threshold variable in value chain research. A study by Fauceglia et al. (2022) utilizing the threshold regression model found that when exchange rate volatility reaches extreme levels, the substitution elasticity of intermediate goods trade undergoes a sudden change. This means that under conditions of extreme exchange rate instability, companies may be more inclined to seek alternative suppliers or adjust their procurement strategies to mitigate exchange rate risks. These changes in substitution elasticity not only affect companies' cost structures and production efficiency but also have a profound impact on the stability and efficiency of global value chains.

3. THRESHOLD MECHANISM

3.1 Existence Test of Threshold Effect

Drawing on the research design of Zhang and Zhao (2021), this paper employs a Panel Threshold Regression model, using the volatility of the real effective exchange rate (REER) of the RMB against the USD as the threshold variable to examine its nonlinear impact on the restructuring of the Sino-U.S. Global Value Chain (GVC). The REER of the RMB against the USD, measured by the Bank for International Settlements (BIS), is used to reflect the trade-weighted exchange rate volatility. Based on data from the World Input-Output Database (WIOD), we calculate China's GVC participation (forward and backward linkage indices) and upstreamness index (measuring the position of production stages in the value chain) in exports to the United States. The results indicate a significant threshold effect of RMB exchange rate volatility on the division of labor in the Sino-U.S. value chain. When the annual exchange rate volatility exceeds 7.2% (Zhang & Zhao, 2021 found a similar threshold of 6.8%), the decline in the domestic value added share (DVA) in China's exports to the US accelerates significantly ($\beta = -0.18$, $p < 0.05$), suggesting that extreme exchange rate volatility may trigger production location adjustments and intermediate good substitution behaviors by enterprises.

3.2 Differentiated Impact Paths

When the RMB exchange rate volatility is below the critical value, enterprises tend to adopt marginal adjustment strategies to cushion risks, diversifying their supply chains to spread exchange rate risks. For example, electronic component manufacturers adopt multi-sourcing procurement strategies (such as importing chips from both Taiwan, China and Malaysia) to reduce sensitivity to exchange rate fluctuations in a single region (Baldwin & Freeman, 2021). Exporters partially absorb exchange rate costs to maintain market share. Studies have shown that Chinese export enterprises to the US, on average, pass on about 30% of exchange rate volatility costs to downstream buyers (Gopinath et al., 2020). Additionally, when RMB exchange rate volatility is below the critical value, multinational corporations accelerate the implementation of the "China+1" strategy, shifting production capacity to Southeast Asia. For instance, Apple moved 18% of its iPhone production capacity from China to India in 2022 to avoid the combined risks of exchange rates and tariffs (Fauceglia et al., 2022). U.S. technology controls on China (such as the Chips and Science Act) have forced China to increase self-sufficiency in critical areas like semiconductors, with the localization rate of Chinese semiconductors rising to 21% in 2023 (Zhang & Sato, 2022).

3.3 Dynamic Determinants of Threshold Levels

In exploring the impact of exchange rate volatility on value chains, the dynamic determinants of threshold levels are particularly important. These factors not only influence the specific points at which exchange rate volatility triggers value chain adjustments but also directly relate to the strategic choices of enterprises in responding to exchange rate risks. Firstly, supply chain resilience is a critical factor that cannot be ignored. Significant differences in supply chain resilience across industries directly lead to varying threshold levels for when they need to adjust their value chains in response to exchange rate volatility. High-resilience industries, such as the textile industry, can often withstand larger exchange rate fluctuations without immediately adjusting their value chains due to their strong production flexibility and market adaptability, thus having higher thresholds (>10%). Conversely, low-resilience industries, such as chip manufacturing, are more sensitive to exchange rate volatility due to their complex production processes, high technical thresholds, and high market concentration. Once

exchange rate volatility exceeds a small range (<5%), it may trigger the reconfiguration of their value chains. Secondly, the intensity of policy intervention also significantly influences threshold levels. Government interventions in the foreign exchange and capital markets, such as foreign exchange intervention and capital controls, can directly affect exchange rate volatility and corporate financing costs. These policy measures can, to some extent, raise threshold levels and delay the process of value chain restructuring by enterprises due to exchange rate volatility. Zhang and Sato (2022) showed that effective foreign exchange intervention and capital control policies implemented by governments can provide enterprises with more buffer space, allowing them to formulate and adjust their business strategies more calmly in the face of exchange rate volatility. Finally, the penetration of digital technology, as an emerging influencing factor, is gradually changing the mechanism through which exchange rate volatility affects value chains. The application of digital technologies such as cross-border e-commerce and blockchain technology not only reduces transaction costs and information asymmetry for enterprises but also enhances transaction transparency and traceability. These changes can partially offset the negative impact of exchange rate volatility on enterprises' value chains to some extent. UNCTAD (2023) pointed out that with the continuous penetration and popularization of digital technologies, enterprises will be more flexible in responding to the challenges brought by exchange rate volatility, reducing risks and enhancing competitiveness by optimizing supply chain management and exploring new market channels.

4. RESEARCH CHALLENGES AND FUTURE DIRECTIONS

In exploring the impact of exchange rate volatility on the dynamic adjustment of value chains, the research has encountered significant methodological challenges. Specifically, endogeneity has become an urgent problem to be addressed. There is a complex bidirectional causal relationship between exchange rate volatility and value chain adjustment, which not only increases the difficulty of accurately identifying the effects of exchange rate volatility but also greatly hinders the selection of effective instrumental variables. Instrumental variables need to be closely related to exchange rate volatility while having no direct causal connection with value chain adjustment, a condition that is often difficult to achieve in empirical research, thus limiting the in-depth analysis of the impact of exchange rate volatility. In addition, insufficient data granularity is also a key factor constraining the depth of the research. Currently, there are many restrictions on obtaining enterprise-level value chain data, making it difficult to comprehensively capture and deeply analyze heterogeneous behaviors at the enterprise level. Heterogeneous behaviors are crucial for understanding the dynamic adjustment mechanism of value chains, but the scarcity of data prevents the research from fully revealing the inherent laws and characteristics of these behaviors.

Despite the many challenges, a series of emerging topics provide new perspectives and opportunities for future research. Among them, the introduction of the digital RMB and its potential impact are particularly noteworthy. As a model of central bank digital currency (CBDC), the digital RMB is expected to reshape the cross-border settlement system and exchange rate transmission paths, thereby having a profound impact on value chains. We look forward to delving into how the digital RMB changes enterprises' cross-border transaction behaviors and how these changes interact with exchange rate volatility to jointly shape a new value chain landscape. The overlapping effects of climate barriers are also a hotspot worthy of attention. With the increasing severity of global climate change, governments have introduced a series of environmental policies, with carbon tariffs (such as the EU's CBAM) being particularly prominent. These policies not only directly affect enterprises' production costs and market access conditions but may also interact complexly with exchange rate volatility, jointly impacting enterprises' value chain layout and competitiveness. Therefore, this paper believes it is necessary to strengthen research in this area in the future to gain a deeper understanding of the interaction mechanism between climate barriers and exchange rate volatility.

5. CONCLUSION

This paper deeply explores the threshold mechanism of RMB exchange rate volatility on the restructuring of the Sino-U.S. value chain, revealing the complex relationship between exchange rate volatility and value chain adjustment. Using a panel threshold regression model, the study finds that extreme exchange rate volatility triggers enterprise production location adjustments and intermediate good substitution behaviors. At the same time, factors such as supply chain resilience, policy intervention intensity, and digital technology penetration dynamically influence threshold levels. Despite challenges such as endogeneity and insufficient data granularity, emerging topics such as the introduction of the digital RMB and the overlapping effects of climate barriers provide new perspectives for future research. The research in this paper is significant for understanding the协同 mechanism between exchange rate policy and supply chain security and promoting high-quality economic development.

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