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Analysis of Macroeconomic Operational Mechanisms Based on Global Value Chains

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Abstract: Global value chains (GVCs), relying on transnational specialized division of labor and resource integration, have become a core force reshaping the logic of macroeconomic operation. Drawing on the structural logic of GVCs, this paper systematically analyzes their transmission pathways, equilibrium effects, policy linkages, and restructuring impacts on the macroeconomy. The study finds that: the resource allocation mechanism of value chains optimizes the allocation of global production factors through trade in intermediate goods, and digital technology is enhancing their transmission efficiency to macroeconomic variables such as inflation and trade fluctuations. While value chain division of labor improves overall global economic efficiency, it also amplifies macroeconomic co-fluctuations and structural imbalances. Policies and regional agreements such as the EU carbon tariff (CBAM) and the RCEP have a significant impact on the layout of value chains, thereby reshaping the trajectory of macroeconomic operation. Currently, the regionalization, shortening of supply chains, and greening of GVCs are reshaping the driving forces of macroeconomic growth and the transmission pathways of risks. This study reveals the inherent linkages between GVCs and macroeconomic operation, providing theoretical support for responding to global economic fluctuations and improving policy regulation.

Keywords: Global value chains, macroeconomy, transmission mechanism, policy interaction, value chain restructuring.

1. Introduction

Since the 1990s, the profound development of global value chains has profoundly reshaped the traditional international division of labor. The production process has been broken down into transnationally distributed value-added links, forming a global production network characterized by interconnectedness. Data shows that nearly 60% of global trade currently consists of intermediate goods, a proportion that directly reflects the dominant influence of value chains on international trade and the macroeconomy. In this context, macroeconomic operations are no longer confined to the internal circulation of a single country but are deeply integrated into the global value chain's division of labor. Traditional macroeconomic theory, which often uses individual countries as independent units of analysis, struggles to explain typical phenomena in the contemporary economy, such as "cross-border inflation coordination" and "rapid transmission of trade fluctuations." For example, global supply chain disruptions in 2022 led to synchronized inflation in multiple countries, and the 2008 financial crisis rapidly spread through value chain networks. These cases highlight the necessity of studying macroeconomic operations from a value chain perspective. While existing research has focused on the role of value chains in trade and industry, it still lacks an understanding of how they systematically influence macroeconomic mechanisms. This article systematically analyzes the impact of global value chains on macroeconomic operations from five perspectives: resource allocation, transmission pathways, economic equilibrium, policy interaction, and restructuring effects. By integrating data from authoritative institutions and typical cases, this article reveals the inherent connection between value chains and macroeconomic variables, providing a theoretical basis and practical reference for understanding the nature of global economic fluctuations and formulating precise regulatory policies.

2. Components and Driving Factors of the Global Value Chain

As the core vehicle for macroeconomic operations, the global value chain's structural system and driving mechanisms profoundly influence the efficiency of macroeconomic resource allocation and its operational dynamics. From a structural perspective, a complete value chain encompasses the entire value chain, encompassing value-added links such as raw material procurement, manufacturing, R&D and design, marketing, and services, extending beyond traditional manufacturing to encompass all industries. Intermediate product trade is a key link in the value chain, the "bloodstream" of the global production network. In 2023, intermediate product trade accounted for over 50% of China's total import and export volume, a figure that directly confirms its central role in the trade structure [1]. The efficient operation of a value chain relies on the synergistic effect of multiple driving mechanisms. The wave of economic globalization has provided the foundation for the formation of value chains. Multinational corporations, through vertical division of labor, minimize costs and maximize market share, becoming the core force dominating the layout of value chains. Taking the automotive industry as an example, Germany focuses on the R&D of core components such as engines, China undertakes vehicle assembly, and Southeast Asia supplies electronic components, forming a typical transnational division of labor system. Technological progress is the core driving force behind value chain upgrading. Digital technologies such as the Internet of Things and big data are driving the upgrade of value chains towards platformization and networking, significantly improving the responsiveness and matching efficiency of production processes and, in turn, optimizing global resource allocation. Policy factors have a significant guiding role in the layout of value chains. On the one hand, trade agreements have

effectively reduced cross-border transaction costs. After the entry into force of the RCEP, tariffs on intermediate goods within East Asia were significantly reduced, driving the proportion of added value in regional value chain trade from 31% in 2010 to 36.5% in 2020. On the other hand, industrial policies are promoting the upgrading of value chain segments. China, through policies supporting new energy industries, is promoting the photovoltaic industry to move from manufacturing to high-end segments such as R&D and design [2]. It is noteworthy that geopolitical risks are driving the transformation of value chains from "long" to "short" chains. To reduce external dependence, some companies are concentrating production within regions, giving rise to a new spatial structure for value chains. The dynamic adjustments of these components and driving mechanisms provide a foundational framework for macroeconomic operations.

3. Macroeconomic Transmission Mechanisms in Global Value Chains

Global value chains transmit macroeconomic variables across borders through multi-dimensional pathways, with the efficiency and depth of these transmissions increasing with increasing value chain integration. Demand transmission is the most direct pathway. Changes in end-market demand are transmitted upstream along the value chain, triggering adjustments to the production rhythm throughout the entire chain. In 2020, the global pandemic triggered a contraction in end-user consumption, a sharp drop in China's export orders in the short term, and a subsequent reduction in upstream raw material procurement and a decline in capacity utilization. This demand shock was rapidly transmitted to major manufacturing countries around the world through the value chain network, ultimately leading to a synchronized economic downturn. This transmission effect is particularly pronounced in the durable consumer goods sector, which has a longer production chain and a higher reliance on intermediate goods, making the transmission effect of the shock more significant. Supply-side transmission primarily relies on price fluctuations of intermediate goods and production capacity adjustments. With the deepening division of labor in the global value chain, countries' reliance on imported intermediate goods has significantly increased. Fluctuations in upstream raw material prices can be amplified through multiple rounds of intermediate goods trade, ultimately affecting the pricing of end products. Research by the Chinese Academy of Social Sciences shows that value chain trade has a significant positive impact on the coordinated effects of PPI inflation, forming a dynamic of "global production pricing, intermediate goods transmission, and domestic inflation." During the 2021 global chip shortage, rising chip prices spread throughout the electronics manufacturing value chain, putting pressure on production capacity in sectors such as automotive and consumer electronics. The global manufacturing PMI declined for six consecutive months, demonstrating the powerful impact of supply shocks transmitted through the value chain [3]. Digital technology is reshaping the spatiotemporal nature of transmission mechanisms. Traditional transmission models are constrained by logistics timelines and information lags. The development of digital platforms enables real-time data exchange across the value chain, enabling demand information to be instantly transmitted to upstream production centers, significantly reducing transmission lags from months to weeks. Furthermore, digital technology broadens the scope of transmission. As small and medium-sized enterprises integrate into the global value chain through e-commerce platforms, production fluctuations that were once limited to a region can quickly escalate into global impacts. Furthermore, the rise of service value chains has expanded the scope of transmission. Fluctuations in high-end sectors such as R&D and financial services will influence the innovation capabilities and financing costs of various countries through knowledge spillovers and capital flows, thereby establishing a new macroeconomic transmission channel.

4. The Two-Way Impact of Global Value Chains on Macroeconomic Equilibrium

Global value chains, by optimizing resource allocation, significantly increase macroeconomic potential output and have become a key engine driving global economic growth. Within the value chain division of labor system, countries can concentrate resources on developing advantageous sectors to maximize production efficiency. Developing countries accelerate industrialization by taking on labor-intensive manufacturing processes, acquiring technology transfer and management experience, while developed countries focus on high-end sectors such as R&D and design to consolidate their technological leadership. Thanks to its integration into the global value chain, China's share of global manufacturing value added has risen from 7% in 2000 to approximately 30% in 2022, directly demonstrating the value chain's boost to economic growth. Furthermore, value chain division of labor has fostered the formation of industrial clusters. China-Europe manufacturing clusters, supported by logistics channels such as the Chengdu-Europe Express, have further reduced production costs through economies of scale, improving the overall efficiency of the global economy [4]. However, the division of labor within the value chain has also exacerbated macroeconomic structural imbalances and operational risks. In terms of income distribution, high-end value chain links account for over 70% of value added, widening the income gap between developed and developing countries. By 2023, developed countries' share of value added in the global services value chain will exceed 80%. This imbalance could distort the structure of global demand. Regarding economic stability, the high degree of integration within the value chain has increased economic interdependence among countries, creating a situation where "prosperity is shared, loss is shared." The 2008 US subprime mortgage crisis, which was transmitted through the financial value chain to the real economy, triggered a chain reaction of declines in global manufacturing orders, fully exposing the risk-amplifying effect of value chains. For individual economies, the depth of value chain embeddedness exhibits a nonlinear relationship with macroeconomic resilience: moderate embeddedness can enhance risk resilience through diversified sourcing, but overreliance on specific value chain links can exacerbate economic vulnerability. For example, in the semiconductor industry, Japan's dominant position in key materials such as photoresist has enabled it to maintain relative stability amidst the global chip shortage. Meanwhile, automakers, which rely on imported chips, have experienced idle production capacity due to supply disruptions. This difference suggests that the quality, rather than the quantity, of value chain participation is crucial for macroeconomic

equilibrium, and a rational value chain layout must balance efficiency and security [5].

5. Interaction between Global Value Chain Governance Models and Macroeconomic Policies

Global value chain governance models directly define operating rules, which in turn interact with macroeconomic policies across countries in multiple dimensions. Current mainstream governance models are divided into two categories: producer-driven and buyer-driven. In the producer-driven model, core manufacturing enterprises dominate production layout, such as Toyota, which relies on technical standards to control its global supply chain. In the buyer-driven model, brand retailers lead the way, such as Amazon, which integrates global supplier resources through its platform. The policy impact paths differ significantly between these two models. In the producer-driven model, industrial policies can directly impact core enterprises, influencing the direction of technological upgrades in the value chain. In the buyer-driven model, trade and consumer policies have a more prominent impact on value chain layout. Macroeconomic policies influence the restructuring of value chains through both cost and market channels. At the fiscal policy level, R&D subsidies can enhance the competitiveness of local companies at the high end of the value chain. China's subsidies for the new energy vehicle industry have helped local companies establish a global lead in power batteries. Monetary policy influences the import and export costs of intermediate goods through exchange rate fluctuations. The Federal Reserve's interest rate hike in 2023 will push up the US dollar, significantly increasing import costs for emerging economies in the value chain. Trade policy has a more direct impact on the structure of the value chain. The EU's carbon tariff (CBAM), by imposing taxes on high-carbon imports, forces companies in exporting countries to pursue green transformation and promotes the restructuring of the global value chain towards a low-carbon economy. The US's semiconductor export controls attempt to disrupt the global technology value chain, triggering adjustments in the layout of related industries. The global nature of value chains places greater demands on policy coordination, as unilateral policies often lead to negative "beggar-thy-neighbor" consequences. For example, some countries have implemented industrial reshoring policies to ensure supply chain security. While this has boosted domestic employment in the short term, it has also led to a disruption of the global value chain, increased overall production costs, and ultimately exacerbated domestic inflation. Regional policy coordination, on the other hand, can achieve win-win outcomes. The RCEP, through its unified rules and reduced trade barriers, has reduced trade costs for intermediate goods within East Asia by 12%, fostering the integration and stability of regional value chains and providing sustained momentum for macroeconomic growth. This type of policy interaction clearly demonstrates that value chain governance has become a core issue in global economic governance, and insufficient policy coordination can significantly undermine macroeconomic efficiency [6].

6. Evolution of Macroeconomic Mechanisms under the Restructuring of the Global Value Chain

In recent years, multiple forces have driven the global value chain into a phase of profound restructuring, and macroeconomic mechanisms are gradually emerging with new characteristics and patterns. Intensified geopolitical conflicts and the rise of trade protectionism have forced businesses to shift their strategic focus from efficiency to security, leading to a more pronounced trend toward shorter and more regionalized value chains. Between 2020 and 2023, the proportion of foreign value added originating in East Asian economies' exports remained stable at over 33%, exceeding 50% for ASEAN countries, directly reflecting the significant improvement in the integration of value chains within the region. This restructuring has led to increasing regional linkages in macroeconomic growth. Economic synergies within regions like East Asia and North America are significantly greater than those between them, thus altering the transmission pattern of traditional global economic cycles. Digital transformation and green development are the two core drivers of value chain restructuring, driving the macroeconomic transition toward high efficiency and low carbon. Digital technology has overcome the constraints of geographic space on the distribution of value chains. Remote collaboration models allow high-end processes such as R&D to be distributed across a wider range of regions globally, significantly enhancing the flexibility and risk resilience of value chains. According to statistics, the proportion of global digital services trade climbed to 25% in 2023, becoming a new engine driving macroeconomic growth. Green transformation aligns with the global goal of carbon neutrality. Policy tools such as the EU Carbon Border Adjustment Mechanism (CBAM) and the US Inflation Reduction Act are driving the full integration of carbon cost accounting into all links of the value chain. High-carbon sectors are facing pressure to phase out or upgrade their technologies, and green industries such as new energy and carbon management are gradually becoming new growth drivers for the macroeconomy. While this may increase business operating costs in the short term, it can significantly enhance the sustainability of economic development in the long term. Value chain restructuring poses systemic challenges to the macroeconomic policy framework [7]. The traditional macroeconomic policy system, centered on a single country, is no longer adaptable to the regionalized development of value chains. There is an urgent need to strengthen regional policy coordination, such as the tariff coordination measures being promoted by ASEAN member states under the RCEP framework. At the same time, policymaking must balance multiple objectives: industrial policy must strike a balance between technological autonomy and openness and cooperation. For example, in China's semiconductor sector, it should continue to increase investment in core technology R&D while maintaining collaboration with the global industrial chain. Environmental policy must fully consider the international spillover effects of the value chain to avoid trade frictions caused by unilateral carbon policies. For developing countries, restructuring the value chain presents both a challenge and an opportunity. By actively embracing relevant links in green industries and the digital economy, they can achieve a leapfrog advancement in their value chain position,

injecting new impetus into macroeconomic growth.

7. Conclusion

The global value chain is no longer simply a production organization model; it has become a core support for macroeconomic operations. Its structural dimensions, transmission logic, and governance model profoundly shape macroeconomic growth momentum, fluctuation patterns, and equilibrium patterns. Research shows that through the resource allocation mechanism, the value chain promotes the efficient combination of global production factors and effectively improves the potential output of the macroeconomy; however, relying on the trade of intermediate products and network connections, the cross-border transmission of macro variables such as inflation and trade fluctuations has also intensified. In different governance models, the paths of fiscal, monetary, trade and other macro policies on the value chain are different, and the lack of policy coordination often leads to structural imbalances in the global economy. At present, the regionalization, shortening and greening of the value chain are continuously reshaping the growth pattern and risk distribution of the macroeconomy. There is a significant duality in the interaction between the global value chain and the macroeconomy: a reasonable layout can drive economic growth through specialized division of labor and technology diffusion, while over-reliance or disordered governance will amplify macroeconomic risks. This conclusion provides key inspiration for policy making: the international coordination of value chain governance needs to be strengthened at the global level. Adjustment is crucial, building an inclusive and open framework of rules to prevent value chain fragmentation. Regionally, free trade agreements can be leveraged to deepen value chain integration and enhance economic synergy. Countries must adopt a dynamic balancing strategy—using innovative policies to drive value chain advancement to the high end, ensuring supply chain security in key links, while also aligning with green and digital transformation. In the future, the restructuring of the global value chain will continue. Technological breakthroughs in artificial intelligence, quantum computing, and the implementation of carbon neutrality goals will further reshape the logic of macroeconomic operations. Studying the dynamic adaptation between these two factors and exploring development paths that balance efficiency and security, growth, and sustainability is not only a key area of academic research but also a practical necessity for addressing global economic uncertainty and achieving stable macroeconomic development.

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