

Research on the Mechanism and Enhancement Path of the Domestic Economic Circulation's Impact on the Controllability of High-Tech Industrial Chains

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Abstract

Against the backdrop of global industrial chain restructuring and intensified technological blockade, enhancing the controllability of key links in high-tech industrial chains has become a crucial strategic task in building my country's new development pattern. The domestic economic cycle, as a core support for the smooth operation of the national economic system in the new development stage, may become a significant mechanism driving the self-reliance and resilience of industrial chains through its structural functions in promoting factor flows, strengthening industrial support, and expanding domestic demand. However, existing research lacks a systematic theoretical framework and mechanism identification for "how the domestic economic cycle affects the controllability of high-tech industrial chains." Based on this, this paper constructs a domestic economic cycle index from the three-dimensional structure of supply, demand, and circulation, and designs an evaluation system for the controllability of industrial chains around the controllability of independent technologies, the localization rate of key links, and the risk of external dependence. On this basis, it constructs a framework of the mechanism of "domestic economic cycle → resource allocation efficiency → self-reliance enhancement," analyzing the inherent logic of the cycle-driven formation of controllability. The study further points out that policy tools such as fiscal subsidies, government procurement, and guidance funds have significant reinforcing or mediating effects in the mechanism chain, and can further enhance controllability by improving innovation capabilities, improving industrial synergy, and reducing external dependence. Finally, based on the mechanism identification results, this paper proposes three paths to enhance the controllability of high-tech industrial chains: localization of supply-side development, coupling of innovation chains and industrial chains, and optimization of policy support systems. This research provides a new analytical framework for understanding the structural role of the domestic economic cycle in industrial chain security, and also offers policy references for the government to promote the independent control and security governance of high-tech industrial chains in the new era.

Keywords

Domestic Economic Cycle; High-Tech Industrial Chain; Controllability; Mechanism of Action; Policy Adjustment; Improvement Path.

1. Introduction

Against the backdrop of accelerated restructuring of global industrial chains and increasingly fierce international technological competition,^[1] the stability and self-controllability of key links in high-tech industrial chains have become core factors affecting national industrial security and technological competitiveness. In recent years, affected by geopolitical conflicts,

escalating technological barriers, and external supply chain disruptions,^[2] my country has repeatedly encountered risks such as supply disruptions and bottlenecks in high-tech fields like chips, key materials, and precision equipment, exposing the structural contradiction of dependence on others for some key links in the industrial chain. Against this backdrop, building a new development pattern with the domestic cycle as the mainstay and the domestic and international cycles mutually reinforcing each other has been elevated to a strategic axis for national economic security and industrial upgrading.^[3] The domestic cycle not only aims to smooth the supply and demand structure and strengthen local supporting industries, but also emphasizes the efficient flow of factor resources within the country, enhancing resilience against external shocks by cultivating a complete domestic demand system and improving the self-reliance of the industrial chain. Although the "domestic cycle" has become a frequently used theme in macroeconomic policy, the academic community still lacks a full understanding of the structural relationship between the domestic cycle and industrial chain security. Existing research focuses on two aspects: firstly, defining the connotation, operational mechanisms, and measurement methods of the domestic economic cycle, emphasizing its systemic integration role in production, distribution, circulation, and consumption; secondly, it pays attention to the resilience of high-tech industrial chains, breakthroughs in key technologies, and the risk of external dependence. However, most studies remain at the level of macro-level judgments or policy discussions, lacking a systematic identification of the micro-level transmission mechanisms of "how the domestic economic cycle affects controllability." At the same time, the reinforcing or constraining effects of policy intervention in the aforementioned mechanism chain have not been fully discussed, which is crucial for understanding the process of industrial chain self-reliance in China. In other words, current research lacks a unified analytical framework that can simultaneously integrate the relationship between "the level of the domestic economic cycle-the controllability of the industrial chain-the role of policy regulation."^[4]

At the practical level, significant differences exist among different regions in China in terms of industrial base, innovation capabilities, and the intensity of policy support.^[5] This leads to a marked regional differentiation in the operational level of the domestic economic cycle and the improvement of the controllability of high-tech industrial chains. For example, the developed eastern regions have a better foundation in terms of domestic demand absorption,^[6] industrial support, and technological innovation, while the level of industrial chain autonomy in the central and western regions is more affected by differences in technology source structure, industrial agglomeration conditions, and policy support. Therefore, studying how the domestic economic cycle can improve the controllability of high-tech industrial chains through optimal resource allocation, efficient flow of factors, and the innovation chain-industrial chain coupling mechanism is not only of theoretical value but also of practical necessity for formulating regionally differentiated industrial security strategies. Against this backdrop, this paper aims to conduct research from three dimensions: theoretical mechanism, indicator construction, and path optimization. First, at the theoretical level, it systematically analyzes the mechanism by which the domestic economic cycle affects the controllability of the high-tech industrial chain, and constructs a multi-dimensional transmission mechanism covering localization of supply, absorption capacity of demand, efficiency of factor flow, and innovation support system. Second, based on the operational characteristics of the domestic economic cycle and the structural characteristics of the industrial chain, it constructs a quantifiable indicator system to provide a measurement basis for subsequent mechanism identification.^[7] Finally, from the perspective of strategy design, it explores the paths to enhance controllability under different regions and different industrial chain structures, providing practical reference for optimizing government policy tools and promoting the construction of independent and controllable industrial chain capabilities.^[8]

The innovations of this paper are mainly reflected in three aspects: First, it regards the domestic circulation as a structural driving force for promoting the self-reliance of high-tech industrial chains, deepening the theoretical explanation of the "dual circulation-industrial security" logic; second, in the construction of the indicator system, it systematically integrates elements such as localization rate, proportion of self-owned technology control, and external dependence on key links to form a more comparable and operable controllable capability evaluation framework; third, it proposes a policy intervention path system from a multi-dimensional mechanism perspective, providing policy recommendations with technical support and scenario adaptability for enhancing industrial chain security under the domestic circulation background.^[9] The structure of this paper is as follows: Part II analyzes the mechanism of action of the domestic circulation and the controllability of high-tech industrial chains; Part III constructs the domestic circulation index and the industrial chain controllability indicator system; Part IV discusses the key transmission paths and policy adjustment effects in the mechanism; Part V proposes paths to improve the controllability of high-tech industrial chains; and finally, it presents the conclusions and policy implications.^[10]

2. The Mechanism of Domestic Economic Circulation and Controllability of High-Tech Industrial Chains

2.1. The Connotation of the Domestic Circulation and its Economic Operation Logic

The domestic economic cycle refers to a complete economic cycle system based on the domestic supply system, driven by domestic demand, and supported by the efficient flow of factors of production within the country. Its essence is to strengthen the autonomy and stability of the economic system by improving the matching efficiency of the industrial chain, supply chain, and value chain within the country. From the supply side, the domestic economic cycle emphasizes the localization and coordination capabilities of the production system, enabling a higher degree of endogenous integration between domestic intermediate goods supply, independent technology supply, and high-end manufacturing capabilities. From the demand side, the cycle expands domestic demand and enhances the absorption capacity of the domestic market, creating a stable demand foundation for the large-scale production and iterative upgrading of high-tech industries. From the circulation side, the cycle emphasizes the smooth flow of factors, products, and knowledge within the domestic spatial scope, promoting a more stable cycle system within the industrial chain by optimizing regional division of labor and improving the coupling efficiency of the industrial chain. Under this framework, the domestic economic cycle is not only an adjustment of the macroeconomic operation mode but also a deep-seated mechanism driving the optimization of resource allocation, production organization, and market structure, having a direct structural impact on the autonomy and security of the high-tech industrial chain.

2.2. Structural Characteristics and Influencing Factors of Controllability in High-tech Industrial Chains

The controllability of a high-tech industrial chain reflects a country's or region's degree of control over key links in the high-tech industrial chain, such as critical technologies, key equipment, and core raw materials. It is an important indicator for measuring the security and self-reliance of the industrial chain. The formation of controllability depends not only on local technological innovation capabilities but also on multiple factors, including core process equipment, independent intellectual property rights, supply chain support systems, and the domestic production capacity of key materials. Structurally, high-tech industrial chains are typically characterized by long chains, complex links, high technological barriers, and strong

reliance on foreign countries. They require not only continuous technological investment and innovation breakthroughs but also systematic supply capabilities across the entire chain. Factors influencing controllability include R&D investment intensity, technological accumulation level, and enterprise innovation capabilities, as well as industrial ecosystem elements such as the degree of industrial agglomeration, regional division of labor structure, and cross-regional collaboration capabilities. Furthermore, variables reflecting external dependence risks, such as import substitution rate, supply chain resilience, and the domestic production rate of key products, also determine the stability of the industrial chain under external shocks. Therefore, building controllable high-tech industrial chains is not only a technological issue but also a comprehensive reflection of industrial organization, factor allocation, and regional collaboration capabilities.

2.3. The Domestic Economic Cycle Drives the Improvement of the Controllability of High-tech Industrial Chains

The domestic economic cycle's contribution to enhancing the controllability of high-tech industrial chains is a multi-dimensional and multi-layered transmission process, primarily achieved through three key pathways: strengthened supply capacity, improved efficiency in factor allocation, and a collaborative mechanism between the innovation chain and the industrial chain. First, the domestic economic cycle strengthens the supply foundation of high-tech industrial chains by increasing the domestic substitution rate of intermediate goods, local manufacturing links, and key raw materials, gradually freeing key links from dependence on external supply systems. Second, the deepening of regional division of labor and efficient allocation of factors within the domestic market promoted by the domestic economic cycle improves the overall operational efficiency of the industrial chain, making enterprises more secure in their positions within the chain and reducing systemic risks caused by supply chain disruptions. Third, the domestic economic cycle strengthens the coupling between the innovation chain and the industrial chain, enabling R&D results to be transformed into industrialization capabilities more quickly, and enhancing the self-sufficiency level of key links in the industrial chain through technological breakthroughs, process evolution, and equipment upgrades. Furthermore, the domestic economic cycle can expand domestic demand and promote market expansion, providing a more stable market platform for high-tech products, allowing enterprises to accumulate experience, achieve economies of scale, and accelerate technological iteration in a larger domestic market. From a mechanism perspective, the domestic circulation has formed a complete capacity-enhancing chain through "supply-side restructuring, circulation-side optimization, and innovation-side coupling," providing endogenous impetus for the continuous enhancement of the controllability of the high-tech industrial chain.

3. Construction of Domestic Circulation Index and Industrial Chain Controllability Indicator System

3.1. The Construction Logic of the Domestic Circulation Index

The construction of the domestic circulation index aims to systematically quantify the circulation level of the three ends of supply, demand, and circulation within the economic system, providing measurable core explanatory variables for identifying the mechanism by which the circulation system affects the controllability of the industrial chain. Theoretically, the operational level of the domestic circulation system depends not only on the degree of localization of production but also on market absorption capacity, regional production-sales matching efficiency, and the mobility of factors within the country. Therefore, the construction of the circulation index needs to revolve around the structural logic of "supply autonomy-

demand embedding-circulation efficiency." In the supply dimension, indicators such as the domestic substitution rate of intermediate goods and the proportion of domestic supply of key components can reflect the autonomy of the domestic production system. In the demand dimension, indicators such as the proportion of Chinese products in end-consumer goods and the proportion of regional products absorbed by domestic demand can reflect the internal circulation characteristics of the market structure. In the circulation dimension, indicators such as the degree of production-sales matching between regions, factor allocation efficiency, and the strength of industrial linkages can characterize the smoothness of the domestic economic circulation. Based on these multi-dimensional indicators, after standardization, principal component analysis (PCA) or entropy methods can be used for weight allocation, thereby constructing a comprehensive index that can fully reflect the operational level of the domestic circulation system. This index can not only compare the development level of the large-scale circulation in different regions horizontally, but also reflect the dynamic changes of the circulation system vertically, thus possessing strong explanatory power and policy analysis value.

3.2. Construction of a High-Tech Industrial Chain Controllability Evaluation System

The construction of the High-Tech Industrial Chain Controllability Index aims to quantify the degree of independent control over key links in the industrial chain and identify the security and stability of the industrial chain under external shocks. The index is constructed around three core dimensions: "independent technology control capability," "localization level of key links," and "external dependence risk," to reflect the structural characteristics of the industrial chain's controllability. In the technology dimension, indicators such as the self-sufficiency rate of key technologies, the number of core patents held, and the proportion of independent intellectual property rights can be used to measure technological control. In the industrial support dimension, indicators such as the localization rate of key equipment and materials and the domestic substitution rate of core components can be used to describe the endogenous supply capacity of the supply chain. In the external dependence dimension, indicators such as import dependence and the concentration of foreign supply of key products can reflect the vulnerability of the industrial chain to the external system. After standardization, these indicators can be integrated by weight to form the "High-Tech Industrial Chain Controllability Index," thus providing quantifiable explanatory variables for subsequent empirical models. By constructing this index, it is possible to objectively assess the differences in the capabilities of different regions or industries in terms of industrial chain autonomy, supply chain resilience, and control over key links. It also facilitates further identification of the strength and transmission path of the domestic economic cycle in the formation of controllability.

3.3. Application Value and Mechanism Identification of Indicator System

Constructing a domestic circulation index and a supply chain controllability index not only provides a unified quantitative basis for subsequent mechanism identification but also enhances the scientific rigor of the research in model identification and policy derivation. First, by comprehensively measuring the circulation level and controllability, the one-sidedness of individual indicators can be effectively avoided, allowing variables to better reflect the systematic characteristics of supply and demand structures, industrial structures, and regional division of labor. Second, the comprehensive index construction method reduces information redundancy and improves the comparability between variables, enabling them to maintain stable explanatory power in cross-regional and cross-industry analyses. Third, in mechanism identification, indexed variables are better able to capture marginal changes in the domestic circulation and the dynamic evolution of supply chain controllability, thus supporting the construction of more accurate regression models and policy simulation frameworks. Finally,

the index system can directly serve policy evaluation; by observing the trajectory of index changes, the impact of policy interventions on the domestic circulation system and the construction of supply chain self-reliance can be identified, providing a quantitative basis for formulating differentiated and precise policies. Overall, this index system provides a scientific, standardized, and interpretable tool for analyzing the interaction between the domestic circulation and supply chain controllability, laying the foundation for enhancing the theoretical depth and policy value of the research.

4. Identification of Mechanisms and Policy Adjustment Effects of the Domestic Economic Cycle on the Controllability of the Industrial Chain

4.1. The Direct Mechanism by Which the Domestic Economic Cycle Affects the Controllability of the Industrial Chain

The domestic economic cycle directly enhances the controllability of high-tech industrial chains through three mechanisms: supply strengthening, demand absorption, and factor mobility. From the supply side, the domestic economic cycle increases the domestic substitution rate of intermediate goods and strengthens localized production capacity, gradually freeing key links in the industrial chain from external dependence, thus strengthening the security of the supply system. From the demand side, the expansion of the domestic market brought about by the domestic economic cycle not only provides stable market support for high-tech products but also drives enterprises to accelerate technological upgrades and enhance their independent technological control under demand. From the circulation side, the domestic economic cycle promotes the efficient allocation of factors among regions, improves internal cooperation within the industrial chain, and fosters closer spatial synergy and value chain coupling within the industrial system, thereby enhancing the resilience of the supply chain. Furthermore, the integration within the industrial chain and regional collaborative development promoted by the domestic economic cycle enable enterprises to obtain more stable capital, technology, and knowledge spillover effects within a well-developed industrial ecosystem, creating conditions for technological breakthroughs and capacity building in core links. Therefore, the domestic economic cycle not only promotes economic growth by improving its own operating system but also strengthens the controllability of high-tech industrial chains through structural mechanisms, playing a significant and direct role in enhancing self-reliance and reducing external dependence.

4.2. The Moderating Effect of Policy Support on the Mechanism Transmission Process

In the mechanism chain of the domestic economic cycle driving the formation of controllable industrial chain capabilities, policy tools, as exogenous intervention factors, play a key regulatory role in strengthening or weakening the mechanism. Fiscal subsidies can amplify the positive role of the domestic economic cycle in the path of technological self-reliance by reducing enterprise R&D costs and increasing the expected returns of technological breakthroughs; government procurement policies can enhance the endogenous expansion momentum of the supply system and accelerate the increase in localization rates by stabilizing market demand and increasing the market share of local products; capital support policies such as industrial guidance funds can improve the financing environment for high-tech enterprises, promote large-scale investment in key links, and enable the supply-side advantages under the domestic economic cycle to be transformed more quickly into improved controllability. From a mechanistic perspective, policy tools change the intensity and direction of the domestic economic cycle's effect on the controllability of the industrial chain by influencing enterprise innovation capabilities, factor input structure, and the efficiency of collaboration within the

industrial chain ; in some situations, insufficient policy support or structural imbalances may even weaken the positive role of the domestic economic cycle, leading to a decline in resource allocation efficiency. Therefore, accurately identifying the regulatory effect of policy support in the "circulation-controllability" path not only helps to understand the synergistic relationship between policy and market forces but also provides a key basis for constructing a precise and effective industrial policy system.

4.3. Regional Differences and Industrial Heterogeneity in the Mechanism of Action

The operational level of the domestic economic cycle and its impact on the controllability of the industrial chain exhibit significant heterogeneity across different regions and industries, reflecting the structural effects of differences in resource endowment, industrial base, and policy system. At the regional level, the eastern region, with its strong industrial base, high innovation capabilities, and efficient factor mobility, demonstrates a higher level of domestic economic cycle operation and a more significant driving effect on the controllability of the industrial chain. In contrast, the central and western regions, constrained by insufficient industrial agglomeration and higher external technological dependence, rely more heavily on policy support and industrial guidance for the transmission mechanism of the domestic economic cycle, exhibiting stronger institutional sensitivity in its operational chain. At the industry level, the technological structure and supply chain organization models of different industries also significantly influence the strength of the domestic economic cycle's impact on controllability. For example, the electronics and information industry, with its high concentration of core technologies and complex supply chains, relies more on technological breakthroughs and the improvement of localized supply systems to enhance its controllability. Meanwhile, industries such as new energy equipment and new materials rely more on regional division of labor and factor synergy, with improvements in regional economic cycle efficiency having a more pronounced effect. This dual heterogeneity across regions and industries means that while the global economic cycle is the overall direction for improving controllability, its intensity and path structure are not homogeneous. Therefore, policy-making must take into account actual differences and form a policy system that is categorized and implemented with precision.

5. Pathways to Enhance the Controllability of High-Tech Industrial Chains

5.1. Strengthen the Self-sufficiency of the Supply Side

Enhancing the controllability of the high-tech industrial chain hinges primarily on building a more self-reliant supply system, ensuring a secure and stable domestic supply of key technologies, core components, and basic materials. This requires a systematic approach encompassing technological breakthroughs, industrialization capacity building, and localized supporting systems. On one hand, strengthening original breakthroughs and engineering efforts in key core technologies will enhance technological control over critical links, fundamentally freeing the industrial chain from dependence on external technological systems. On the other hand, the development of a localized supply system for key equipment, materials, and components should be promoted, forming a complete chain covering basic research, technological development, and industrialization domestically, gradually increasing the domestic substitution rate for key components. Furthermore, strengthening collaboration among upstream and downstream enterprises in the industrial chain and optimizing the regional production network structure can improve the robustness and resilience of the supply chain. Establishing a self-sufficient industrial base on the supply side is the fundamental guarantee for the continuous improvement of the controllability of the high-tech industrial chain and a prerequisite for the domestic economic cycle to play a supporting role.

5.2. Building a Capability System that Deeply Integrates the Innovation Chain and the Industrial Chain

Enhancing the controllability of high-tech industrial chains depends not only on the independent construction of the supply system but also on the deep synergy between the innovation system and the industrial system. Building a close coupling between the innovation chain and the industrial chain helps promote rapid technology transfer, accelerate industrial iteration, and provide continuous impetus for the accumulation of capabilities in key links. On the one hand, it is necessary to further improve national and regional innovation systems, strengthening the connection between basic research, applied research, and industrialization through multi-entity collaboration among research institutions, universities, and enterprises, thereby accelerating the transfer of technological achievements from the laboratory to the production stage. On the other hand, it is essential to strengthen the construction of industrial clusters by combining the technological evolution laws of key links in the industrial chain, promoting technology diffusion, knowledge spillover, and efficient flow of factors through spatial agglomeration effects, and creating a dynamic match between innovation activities and industrial needs. Furthermore, utilizing digital technologies to improve the collaborative efficiency of the industrial chain, achieving real-time linkage between the innovation chain and the industrial chain through intelligent manufacturing, the industrial internet, and supply chain digitalization, can further improve the overall operational efficiency and controllability of the industrial chain. The higher the degree of coupling between the innovation chain and the industrial chain, the stronger the industrial chain's autonomy and technological updating capabilities, which helps enhance its structural resilience in the face of external shocks.

5.3. Build a Precise and Effective Policy Support System

In the process of enhancing the controllability of the industrial chain driven by the domestic economic cycle, government policy support plays an irreplaceable regulatory and guiding role. Therefore, it is necessary to construct a more precise, differentiated, and systematic policy mix. First, in terms of financial support, a targeted system of fiscal subsidies, government procurement, and guidance fund allocation should be established to provide long-term and stable policy support for key technologies, critical links, and strategic high-tech industries, thereby enhancing enterprises' enthusiasm for R&D investment and technological breakthroughs. Second, in terms of institutional arrangements, the modernization of the industrial chain governance system should be promoted. This can be achieved by improving industrial planning, strengthening cross-regional collaboration, and improving industry-academia-research cooperation mechanisms to optimize the allocation efficiency of factors at different stages of the industrial chain, enabling policy tools to accurately match the needs of industries at different stages of development. Furthermore, in terms of regulatory and incentive mechanisms, a fault-tolerance mechanism and a performance evaluation system should be established to make policy implementation more flexible and sustainable, avoiding resource misallocation or policy "hanging." Simultaneously, given the different development foundations of different regions and industries, the policy system should reflect the principle of differentiation, strengthening basic capacity building in areas with weak industrial chains and promoting competitiveness enhancement and industrial upgrading in advantageous areas, forming a nationwide tiered support structure. In summary, by constructing a precise, multi-level, and dynamically adjustable policy system, we can effectively strengthen the transmission effect of the domestic economic cycle and promote a continuous leap in the controllability of key links in the high-tech industrial chain.

6. Conclusion and Policy Recommendations

Overall, the domestic circulation strategy, as the core mechanism for promoting endogenous growth and structural reshaping of the economic system under the new development paradigm, has a significant structural impact on enhancing the controllability of key links in China's high-tech industrial chain. By strengthening the localization capacity of the supply system, expanding the absorption capacity of domestic demand, and improving the efficiency of factor allocation within the country, the domestic circulation strategy can systematically enhance the self-reliance and operational resilience of the industrial chain. Simultaneously, policy tools play a crucial regulatory role in this mechanism, not only amplifying the positive effects of the domestic circulation strategy on technological breakthroughs and industrial synergy, but also guiding resources to flow precisely to key areas through fiscal support, procurement guidance, and capital empowerment, thereby improving weak links and institutional constraints in the industrial chain. Further research shows that the interaction path between the domestic circulation strategy and controllability exhibits significant heterogeneity across different regions and industries, suggesting that policymaking should adhere to differentiated policies and governance to achieve regional coordination and overall industrial chain security. Based on this, this paper proposes three pathways to enhance controllability: supply-side self-sufficiency, deep coupling of the innovation chain and industrial chain, and the construction of a precise policy system. This provides theoretical support and policy reference for promoting the independent, controllable, safe, and efficient operation of China's high-tech industrial chain. Future research could be expanded to include micro-level corporate behavior, digital governance of industrial chains, and global supply chain interactions, in order to deepen the understanding of industrial chain security governance mechanisms under the context of the global economic cycle.

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