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Research on the Mechanism of Chain Governor System Promoting Innovation of Enterprises in the Chain

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Abstract: Against the background of emphasizing technological self-reliance and self-improvement as well as industrial chain security, this paper focuses on how the "chain governor system," an institutional innovation, promotes the innovation of enterprises in the chain. The study systematically analyzes its internal mechanism, mainly including four core paths: the resource empowerment mechanism addresses factor constraints through precise R&D support and talent guarantee; the network construction mechanism facilitates knowledge spillover and collaborative research by building innovation consortia; the demand-driven mechanism clarifies innovation directions and reduces market risks through releasing demand lists and government procurement; the risk-sharing mechanism enhances enterprises' innovation motivation by sharing R&D risks and creating a fault-tolerant atmosphere. On this basis, the paper puts forward policy suggestions such as deepening "one chain, one policy" precise empowerment, strengthening the responsibilities of "chain leader" enterprises, and optimizing the innovation factor supply ecosystem. It aims to improve the design of the chain governor system, effectively activate the innovation potential of the entire chain, and provide theoretical reference and practical guidance for enhancing industrial chain resilience and security.

Keywords: Chain governor system; Enterprise innovation; Mechanism

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1. Introduction

Amid the intensifying global technological competition and China's efforts to promote technological self-reliance and self-improvement, enterprises, as the main innovation entities, their innovation capabilities are directly related to the resilience and security of the industrial chain. As an institutional innovation aimed at improving the overall efficiency of the industrial chain, one of the core functions of the "chain governor system" is to stimulate and empower the innovation activities of enterprises in the chain. However, as a government-led governance model, how to effectively embed and influence the market-oriented enterprise innovation process, its internal logic remains to be clarified. Will the intervention of the government's "visible hand" replace the market mechanism and inhibit enterprises' internal motivation, or can it complement the market to build a better innovation ecosystem? What are its specific action paths, mainly through resource inclination or the construction of collaborative networks? Are there differences in its innovation incentive effects on enterprises of different sizes and types? Therefore, systematically analyzing the internal mechanism of the chain governor

system affecting the innovation of enterprises in the chain, and accurately identifying its key action channels and boundary conditions, is of crucial theoretical and practical significance for optimizing the policy design of the chain governor system, avoiding government intervention failure, and truly activating the innovation potential of the entire chain.

2. Literature review

Through sorting out existing literature, it is found that scholars have formed a relatively concentrated consensus on the mechanism of the chain governor system, and existing studies mainly carry out from the following perspectives.

2.1. Resource empowerment perspective: Addressing innovation factor constraints

A large number of studies point out that the chain governance system can inject precise resources into enterprise innovation through administrative means. Financial empowerment: The chain governance system has changed the universal subsidy model to "precision drip irrigation" based on industrial chain needs. The government directly provides financial support for key technological research of enterprises in the chain through establishing industrial chain development funds and implementing special plans such as "unveiling the list and taking command", effectively reducing enterprises' R&D costs and risks [1-2]. Secondly, the chain governor can coordinate key indicators such as land, energy consumption, and emissions to give priority to ensuring key innovation projects [3]. At the same time, by promoting the development of industrial chain finance, it enhances the credit of small and medium-sized enterprises in the chain with the credit of core enterprises, solving their "financing difficulties" problem. Finally, talent aggregation: The chain governor system can implement "map-based" talent policies, lay out talent chains around industrial chains, and orientally introduce and cultivate innovative talents for enterprises through co-building industrial colleges and providing supporting services [4].

2.2. Network construction and knowledge spillover perspective: Promoting collaborative innovation

Many studies emphasize that the core value of the chain governor system lies in its "connector" function. The chain governor system builds innovation consortia: Using its credibility and coordination capabilities, the chain governor takes the lead in establishing innovation consortia with "chain leader" enterprises as the core and multi-participation of industry, university and research institutions, to conduct collaborative research on common technologies and "bottleneck" problems [5]. This organized scientific research model breaks institutional barriers and realizes the spillover and integration of knowledge, especially tacit knowledge, among heterogeneous subjects [6]. Secondly, the chain governor system promotes the integration of large, medium and small enterprises: Through establishing regular docking mechanisms, the chain governor system encourages "chain leader" enterprises to open their supply chains and innovation chains, providing technical standards, R&D guidance and trial-and-error scenarios for small and medium-sized enterprises [7]. This process of "learning by doing" and "learning by using" is an important path for small and medium-sized enterprises to achieve technological catch-up and iterative innovation [8].

2.3. Demand-driven and risk-sharing perspective: Stabilizing innovation expectations

Some studies have begun to pay attention to the role of the chain governor system in the demand side and risk management. Creating certain demand: By releasing industrial chain "demand lists", encouraging "chain leader" enterprises to issue technical standards, and implementing government first-purchase policies, the chain governor system provides clear market outlets and stable demand expectations for enterprises' innovative products. This greatly reduces the market uncertainty of enterprise innovation and enhances their confidence in innovation investment [9,10]. Sharing innovation risks: Through R&D subsidies, innovation risk compensation funds and other methods, the government essentially shares the high risks in the front-end of innovation with enterprises. In addition, the "tolerance for failure" culture advocated by the chain governor system creates an institutional environment conducive to exploratory innovation, expanding enterprises' "innovation possibility boundary" [11,12].

3. Mechanism of the chain governor system promoting high-quality economic development

As an innovative industrial governance model, the significance of the chain governance system lies not only in ensuring supply chain security, but also in reshaping the innovation ecosystem through systematic institutional arrangements, effectively addressing many bottlenecks faced by enterprises in the innovation process. Its mechanism for promoting the innovation of enterprises in the chain is a complex and dynamic process with multiple paths and levels, which can be specifically decomposed into the following core mechanisms.

3.1. Resource empowerment mechanism: Addressing innovation factor constraints

Enterprise innovation, especially that of small and medium-sized enterprises, often faces the dilemma of resource scarcity. Through its unique administrative coordination and resource allocation capabilities, the chain governor system injects key factors into enterprise innovation. Precise R&D support: Different from the traditional "sprinkling pepper" type of scientific research subsidies, relying on a profound understanding of the industrial chain "panoramic map", the chain governor system can accurately identify the "bottleneck" technologies and common technical problems that restrict the upgrading of the entire industrial chain. Systematic talent guarantee: Innovation-driven is essentially talent-driven. The chain governor can coordinate human resources and social security, education, and other departments to implement "one chain, one policy" talent plans. Around the needs of the industrial chain, co-build characteristic industrial colleges with universities and vocational schools to customize the training of engineers and technical skills talents [13].

3.2. Network construction mechanism: Promoting knowledge spillover and collaborative research

Innovation often arises from the collision of ideas and the recombination of knowledge. By actively building and optimizing innovation networks, the chain governor system breaks the "innovation islands" among enterprises. First, building integrated innovation platforms: Acting as a "super connector", the chain governor regularly organizes industrial chain docking meetings and technical seminars, forcing or inducing "chain leader" enterprises, upstream and downstream supporting enterprises, universities and scientific research institutes to gather on the same platform. Second, establishing innovation consortia: For major technical problems that are difficult for a single enterprise to tackle, the chain governor personally coordinates to form systematic and task-oriented innovation consortia with "chain leader" enterprises as the leader, combined with universities and scientific research institutions. Third, opening application scenarios: The chain governor can use government forces to provide first-set and first-batch application scenarios for new technologies and products [14].

3.3. Demand-driven mechanism: Clarifying innovation directions and reducing market risks

Market uncertainty is a key factor inhibiting enterprise innovation investment. By shaping clear and stable demand expectations, the chain governor system provides a "navigator" and "stabilizer" for enterprises' innovation activities. First, releasing industrial chain "demand lists": The chain governor's office can systematically sort out and release demand lists for key technologies, core components, basic software, etc., in the industrial chain. This list is equivalent to a clear market "order", indicating the R&D direction for all potential innovators, and avoiding the waste of innovation resources caused by unclear directions of enterprises. Second, the pulling effect of "chain leader" orders: Encouraged and coordinated by the chain governor, "chain leader" enterprises will put forward higher technical performance, quality standards and customized requirements to their upstream suppliers. To obtain and maintain this stable order, supporting enterprises must continuously carry out technological innovation and process improvement. This "pressure-based" innovation, based on actual orders, has a more lasting and stronger motivation. The chain governor system makes this policy tool more targeted, which can accurately support those innovative products in the critical period of market introduction, helping enterprises cross the "valley of death" [15].

3.4. Risk-sharing mechanism: Enhancing the space for innovation trial and error and fault tolerance

Innovation is essentially a high-risk activity. First, through institutional design, the chain governance system shares part of the innovation risks with enterprises, expanding their "innovation possibility boundary"[16]. Undertaking early R&D risks: The government's financial support for "unveiling the list and taking command" projects essentially undertakes the early stage of enterprises' R&D activities with the highest risks and the most uncertain returns. Second, establishing a fault-tolerant and trial-and-error mechanism: The chain governor system creates a policy atmosphere of "encouraging innovation and tolerating failure." In innovation consortia or research projects, a certain failure rate is clearly allowed, and failure experience is regarded as a valuable asset. Finally, providing innovation risk compensation: By establishing an innovation risk compensation fund, certain compensation or loan interest subsidies are given to high-quality innovation projects that fail due to force majeure, such as wrong technical route selection and severe market fluctuations, helping enterprises tide over difficulties and retain the spark of re-innovation.

4. Policy suggestions

To promote the chain governance system to accurately and efficiently stimulate the innovation vitality of enterprises in the chain and build a sustainable endogenous innovation mechanism, the following systematic policy suggestions are put forward:

4.1. Deepen "One Chain, One Policy" precise empowerment and establish a demand-oriented innovation support system

It is recommended to implement more refined "one chain, one policy" or even "one enterprise, one policy" based on a detailed industrial chain innovation map diagnosis. For "bottleneck" links such as basic materials and core components in the industrial chain, long-term R&D subsidy plans with strong stability should be established, and the procurement and insurance compensation mechanisms of the "first-set and first-batch" policy should be strengthened to reduce market introduction risks. For cutting-edge fields such as artificial intelligence and bio-manufacturing, industrial guidance funds should be established in conjunction with social capital to encourage original innovation with long cycles and high risks. At the same time, establish a dynamic evaluation and filing system for the innovation capabilities of enterprises in the chain to ensure that policy resources can be accurately dripped to the most potential innovation subjects and links.

4.2. Strengthen the responsibilities and incentives of "Chain Leader" enterprises and build a closely collaborative innovation community

It is necessary to clarify and strengthen the leading and spillover responsibilities of "chain leader" enterprises in the innovation ecosystem. By establishing an innovation index evaluation system for "chain leader" enterprises, their effectiveness in opening up innovation resources (such as technical platforms, laboratories, and application scenarios) and driving collaborative innovation of upstream and downstream enterprises should be included in the assessment criteria for enjoying relevant policy support. Vigorously promote the "R&D crowdsourcing" model, where the chain governor's office builds a platform, "chain leader" enterprises release specific technical needs and research lists, and supporting enterprises "unveil the list and take command." The government gives two-way rewards to "chain leaders" and supporting enterprises for successful collaborative innovation projects, forming an "innovation community of shared future" with risk sharing and benefit sharing.

4.3. Optimize the innovation factor supply ecosystem and consolidate the basic support for integrated innovation

Strive to build a number of common technology R&D platforms, pilot-scale maturation bases and inspection and testing centers for the entire industrial chain, and open them to small and medium-sized enterprises in a non-profit or low-cost

manner. Innovate financial support methods, vigorously develop industrial chain finance relying on the credit of core enterprises, and actively explore the development of intellectual property securitization, investment-loan linkage and other businesses to solve the financing difficulties of light-asset innovative enterprises. Implement the "industrial chain-talent chain" integration plan, dynamically adjust the talent catalog according to the needs of the industrial chain, co-build modern industrial colleges with universities, realize the "customized" training and introduction of talents, and create a stable talent supply channel.

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