

Government Intervention in High-Tech Industrialization: Strategies for Sustainable Growth and Innovation

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ABSTRACT

This study examines the role of government intervention in China's high-tech industrialization, highlighting the challenges and market failures that hinder sustainable growth. China's rapid industrialization and technological progress are guided by government policies, yet issues such as misaligned roles, inconsistent implementation, and innovation system delays remain barriers. The paper draws on successful practices from developed nations to propose strategic adjustments that optimize governmental support for high-tech industries. Key strategies include addressing energy, resource, and environmental constraints through technological innovation and policy adjustments. Emphasizing an enterprise-centric approach, the study advocates for dynamic government intervention tailored to China's unique context, ensuring a balance between market forces and state support. These recommendations are crucial for transforming China's economic growth model into a more sustainable and resilient system of high-tech industrialization.

KEYWORDS

Government Intervention; High-tech Industrialization; Sustainable Development; Innovation Policy; Market Failures

1. INTRODUCTION

China's pursuit of industrialization and technological advancement has been supported by a series of government policies aimed at fostering the growth of high-tech industries and the adoption of innovative technologies. These efforts have established a preliminary framework for policy support in high-tech industrialization. However, several challenges remain, including limited understanding of high-tech industry development dynamics, misaligned governmental roles, inconsistent policy implementation, and delays in building a robust innovation system [1]. These issues undermine sustainable innovation capacity and technological resilience, posing significant barriers to the sustainable growth of China's high-tech industries.

This study objectively analyzes the role of the Chinese government in advancing high-tech industrialization, drawing on successful practices from developed nations. It also considers China's unique context to propose adjustments to the policy support system, aiming to enhance governmental management and effectiveness in fostering high-tech industrial development. By addressing energy, resource, and environmental constraints through technological innovation, these strategies contribute to the strategic adjustment of industrial structures [2]. This approach has practical significance for transforming China's economic growth model and achieving comprehensive, coordinated, and sustainable development.

The paper explores the necessity, implementation, and strategic improvement of government involvement in high-tech industrialization.

2. KEY MANAGEMENT CONCEPTS FOR GOVERNMENT INTERVENTION IN HIGH-TECH INDUSTRIALIZATION

In a market economy, the development and function of high-tech industrialization largely rely on market mechanisms. Since Adam Smith introduced the theory of the "invisible hand," the market has been regarded as an efficient mechanism for regulating economic activities and optimizing resource allocation. However, as market economies evolve, the limitations of market mechanisms, or "market failures," become evident. Market failures, such as inefficiencies and misallocation of resources, prevent the economy from achieving Pareto optimality [3].

To ensure efficient economic operation and maximize social welfare, government intervention becomes necessary. This involves managing, regulating, and addressing various forms of market dysfunction, including monopolies, imperfect competition, information asymmetry, risks, and externalities. As noted by the economist Xu Zhi, government intervention is justified when such dysfunctions impede economic performance and resource allocation [4].

2.1. Defining the Characteristics of High-tech Industrialization

High-tech industrialization is a systematic, complex, and dynamic process integrating technology and economics, distinct from traditional industrialization in several key aspects:

Innovation-driven development. High-tech industrialization involves not only revolutionary technological advancements but also the cumulative application of basic and applied research, fostering new research paradigms and technical pathways. At its core, high-tech industrialization is a process of innovation, which serves as its foundation, vitality, and prerequisite for success [5].

High input intensity. High-tech industries are labor-, capital-, and technology-intensive, with investment in research, development, and industrialization typically following a 1:10:100 ratio. Substantial capital is required for developing new technologies, creating products, and entering markets. Once large-scale production is achieved, additional funding is necessary to sustain growth.

Elevated risks. The uncertainties of technological development and the challenges of production, marketing, and financing contribute to significant risks in high-tech industrialization. These include technological, market, and management risks. For example, data from the United States indicates that in Silicon Valley, 20–30% of newly established high-tech firms fail, 60–70% achieve moderate success, and only 5% generate substantial profits [6].

High profitability. Despite the risks, high-tech products often yield significant profits due to their high technological value. These profits are derived from two main sources: (1) returns on high-risk investments, which justify the viability of high-tech venture capital industries; and (2) monopoly profits, as successful industrialization enables enterprises to enjoy temporary market dominance.

2.2. Addressing Market Failures in High-tech Industrialization: The Need for Government Intervention

High-tech industrialization is characterized by high innovation, investment, competition, risk, and knowledge intensity, as well as rapid theoretical and technological advancements. These traits complicate market resource allocation, leading to inherent market mechanism failures during its development and evolution. The innovation behaviors of high-tech industries rely heavily on technical information, knowledge, and resources, often adhering to a "winner-take-all" dynamic. High-tech enterprises typically secure intellectual property (IP) and patent rights early, leveraging

them for market monopoly to achieve high profits—serving as a key motivator for high-tech industrialization [7]. Consequently, monopolies based on technological innovation are nearly unavoidable.

Recent trends reveal a convergence of technical standards and IP protection, forming coalition monopolies that utilize the privileged status of standards to fortify IP control. This practice often monopolizes certain technical standards, hindering the dissemination and adoption of advanced technologies.

Additionally, high-tech industrialization faces challenges related to incomplete information. During research and development (R&D), scientific institutions often lack adequate commercialization insights. Similarly, incubators may fail to fully evaluate the business potential or incubation capacity of high-tech projects. In the venture capital phase, information asymmetries persist between startups and investors. Furthermore, once products reach the market, consumers encounter barriers such as limited knowledge, cultural constraints, and high information acquisition costs, making it difficult to fully understand high-tech products.

High-tech industrialization entails high investment and risk. From R&D to marketing, it faces diverse risks, including market, technological, financial, and managerial risks, resulting in low success rates and long payback periods. Traditional financial institutions, prioritizing asset security, are reluctant to invest, creating capital bottlenecks that restrict industry development [8].

Mankiw, in *Principles of Economics*, categorizes technology into basic science and applied technology. Basic science, as a public good, is freely accessible and prone to "free-riding." Applied technologies, while more exclusive, are quasi-public goods, susceptible to imitation and plagiarism. Stiglitz also emphasized that knowledge, distinct from other goods, exhibits public good characteristics, often resulting in "public failure" due to its non-exclusive nature in production and use.

R&D activities for new technologies generate significant positive externalities. Monan and Lippi's research highlights widespread innovation spillovers, wherein high-tech advancements not only drive the high-tech sector but also benefit the broader economy and society. These innovations transform production processes, lifestyles, and societal progress, contributing to economic growth and improvements in material and cultural standards. However, positive externalities often prevent investors from fully capturing returns, reducing their incentive to invest in technological innovation and ultimately hindering high-tech industrialization [9].

The development of high-tech industries faces persistent market failures, including issues related to public goods, monopolies, imperfect competition, information asymmetry, risk, and externalities. These challenges necessitate government intervention to address market deficiencies and ensure effective management. Striking a balance between the interests of enterprises and society as a whole is essential for maintaining orderly market operations and fostering the sustainable development of high-tech industrialization.

2.3. Core Principles for Government Intervention in High-tech Industrialization

Market failures demonstrate that sole reliance on market mechanisms cannot ensure rational resource allocation or the balanced development of the economy and society. This underscores the necessity of defining the scope and role of government intervention within a market economy. However, the presence of "government failures" in high-tech industrialization highlights the need for government actions to align with the unique developmental laws of the sector. Failure to do so could not only minimize the government's effectiveness but also impede the progress of high-tech industries. To address this, government interventions in high-tech industrialization should adhere to the following principles:

2.3.1. Adherence to Market Principles

Government actions must respect fundamental market principles, including the laws of supply, demand, and competition. Intervention should be limited to addressing market failures, avoiding subjective overreach into economic activities. The scope and extent of intervention should be proportionate to the market's ability to manage the challenges of high-tech industrialization [10].

2.3.2. Enterprise-Centric Approach

The government should uphold the principle of "enterprise as the primary actor" in high-tech industrialization, exercising restraint to avoid overstepping its authority. It should focus on creating a favorable environment for enterprises. At the microeconomic level, the government's role should involve negative regulation to prevent market failures, such as monopolies, barriers to technological progress, and inefficient resource allocation. At the macroeconomic level, it should use fiscal, monetary, and industrial policies to guide and support the development of high-tech industries effectively [11].

2.3.3. Restoring, Not Replacing, Market Functions

Government intervention should aim to restore and enhance the market mechanism rather than replace it. The degree of intervention should be dynamic, adapting to economic conditions. In underdeveloped or unbalanced market environments, stronger intervention may be necessary, while in mature and balanced markets, intervention should be scaled back [12].

2.3.4. Targeted Resource Allocation

To avoid the dispersion of resources—a common manifestation of government failure—intervention must prioritize key areas. The principle of "limited objectives, focused breakthroughs" should guide the government in selecting priority targets for high-tech industry development. By leveraging its unique capacities, the government can consolidate resources and ensure significant advancements, especially in countries with limited comprehensive national strength, such as China [13].

2.3.5. Dynamic Policies and Strategic Entry Points

The government must choose appropriate entry points for intervention. While high-tech industries cannot rely solely on the market for growth, government involvement should evolve with the industrialization process. During the early stages, the focus should be on fostering enterprises, enabling them to achieve industrial scale. As enterprises grow stronger and become capable of independent development, government support should gradually diminish, allowing market forces and technological innovation to drive further growth [14].

3. GOVERNMENT APPROACHES TO HIGH-TECH INDUSTRIALIZATION IN DEVELOPED COUNTRIES

The government's approach to fostering high-tech industries is shaped by a country's political system, economic structure, and cultural traditions. These factors influence the extent and manner of government intervention in scientific and technological activities and their integration with economic production. Variations are evident in areas such as resource allocation for science and technology, administrative structures for control and management, the organization of research and development (R&D) and production, and the process of technology commercialization. Broadly, the government behavior patterns in high-tech industrialization among developed countries can be categorized into two primary models: the decentralized, market-driven approach exemplified by the United States and the United Kingdom, and the government-led approach represented by Japan and Germany [15].

The United States and Japan, as global leaders in science and technology, demonstrate distinctive imprints of high-tech industrialization on their paths to economic prosperity. Both nations have consistently been at the forefront of high-tech industrialization, setting benchmarks for others. Their

government intervention models in managing high-tech industrialization offer valuable lessons for other countries aiming to advance their high-tech industries [16].

3.1. The U.S. Model: Decentralized and Diversified Government Intervention

The United States, with its well-established market mechanisms, minimizes direct government intervention in the market. Its approach to high-tech industrialization policy is characterized by a diversified and decentralized model that emphasizes organizational structure, resource allocation, and specific policy measures. Under this model, there is no unified national plan for science, technology, or industrial development. Instead, various government departments independently formulate science and technology policies, while the federal government focuses on organizing and implementing major R&D projects and strategies. It oversees basic and applied research as well as development initiatives in a coordinated manner.

Private enterprises serve as the primary drivers of high-tech R&D and industrialization. Rather than creating specific policies for technological innovation, the government relies on market mechanisms to guide innovation, ensuring enterprises respond to market demands. The government's role is primarily to establish a supportive external environment and provide effective services to facilitate enterprise-driven innovation. A defining characteristic of this model is the strong autonomy granted to private entities in R&D and production, allowing them to fully leverage market mechanisms to advance high-tech industries.

3.2. Japan's Government-Centric Model for High-tech Industrialization

Although Japan's market economy is well-developed, the government maintains a clear and consistent approach to intervening in high-tech industries and macroeconomic control [17]. While private enterprises are the primary drivers of R&D, commercialization, and industrialization of high-tech innovations, the government plays a central role. The Japanese government acknowledges that market imperfections can be mitigated through direct intervention. As such, it actively promotes technological innovation and industrialization through measures such as direct subsidies and financial incentives.

This government-led model of high-tech industrialization is characterized by strong centralized management, where the government formulates specific policies for science and technology development and directly engages in industrialization activities. By leveraging its resources, the government facilitates the introduction, adaptation, and absorption of technology. It also supports creative technology development to enhance enterprise innovation capabilities and accelerate the industrialization process.

4. IMPLEMENTATION OF HIGH-TECH INDUSTRIALIZATION POLICIES IN CHINA

4.1. Formulating Science and Technology Development Policies and Plans

A science and technology plan is a strategic framework that influences the future development of science, technology, the economy, and society. It concretely reflects the national science and technology development strategy, objectives, key tasks, and policies. In advancing the industrialization of high-tech innovations, ministries such as the Ministry of Science and Technology, the State Planning Commission, and the State Economic and Trade Commission have played a crucial role through various plans. Since 1982, China has launched 17 national science and technology plans [18]. In parallel, local governments have developed regional science and technology development plans tailored to their unique economic, social, and technological needs. This has led to the formation of a comprehensive science and technology planning system.

These multi-level plans address the integration of science and technology with economic development, the advancement of high-tech research, and industrialization. The planning system provides a stable framework for basic research and supports the development of China's high-tech industries. It has fostered the integration of science and technology with the economy and facilitated the upgrading of industrial structures. Key initiatives such as the National High-tech Research and Development Program and the Torch Program have been instrumental in tracking global high-tech advancements, promoting innovation, and supporting the growth of China's high-tech sector.

4.2. Promoting High-tech Industrialization Through Financial Investment and Preferential Tax Policies

To promote the commercialization, industrialization, and internationalization of high-tech achievements, it is essential to design industrial policies that integrate fiscal, tax, investment, financing, and import-export policies. Both central and local governments have implemented various preferential policies, including those supporting high-tech industrial development zones and the transformation of high-tech innovations into new products. These policies, alongside proactive fiscal measures, have significantly accelerated the growth of China's high-tech industries.

China's tax policies for high-tech industry development are informed by international best practices and are both comprehensive and widely applicable. Currently, there are seven key taxes related to high-tech industrialization, including value-added tax, business tax, income tax, and fixed asset investment adjustment tax. Tax incentives come in various forms, such as reductions, exemptions, raised thresholds, and fewer applicants. These incentives target research institutions, universities, enterprises, public institutions, high-tech development zones, scientific personnel, and areas such as R&D, achievement transformation, and import-export trade. Having been in effect for several years, these preferential tax policies have played a critical role in advancing the R&D and industrialization of high-tech innovations in China.

5. KEY ISSUES IN CHINA'S HIGH-TECH INDUSTRIALIZATION POLICY

To promote the development of China's high-tech industrialization, the government has implemented numerous policies and measures, including a wide range of science and technology development plans and preferential policies for high-tech industries [19]. However, overall, these policies are fragmented, limiting the optimization of coordination and affecting their effectiveness.

5.1. Fragmented Leadership and the Lack of Comprehensive Strategic Planning

Currently, the management of high-tech industrialization in China is somewhat fragmented, with various departments such as the Ministry of Science and Technology, Ministry of Education, National Development and Reform Commission, Ministry of Finance, State Administration of Taxation, Ministry of Commerce, and local governments each handling different aspects of the industrialization process. This lack of coordination weakens the support mechanisms, making it difficult to achieve optimal policy synergy. For example, the Decision of the CPC Central Committee and the State Council on Strengthening Technological Innovation and High-Tech Development calls for value-added tax support for high-tech products. However, due to the absence of relevant policy documents from tax authorities, only certain high-tech products like software and integrated circuits receive such support, leaving other high-tech sectors without similar measures.

Additionally, although China has developed a series of science and technology development plans, the connection and coordination between these plans are insufficient. The industrialization of high-tech innovations lacks a clear, forward-looking strategic plan, and the focus is not sufficiently concentrated. This has resulted in significant issues, including the homogenization of the high-tech industry structure.

5.2. Unitary and Fragmented Policy Framework for High-tech Industrialization

The Chinese government has introduced a series of preferential policies aimed at promoting the industrialization of high and new technologies, establishing a policy framework for their development. However, these policies lack comprehensive and robust support, leading to a fragmented and narrow focus. The policies are often inconsistent and arbitrarily applied, with insufficient enforcement mechanisms in place. This lack of systemic implementation is further exacerbated by human factors that hinder the full realization of policy objectives.

5.3. Insufficient Scientific and Systematic Design of High-tech Zone Policies

Local governments tend to prioritize regional interests when developing high-tech industrialization policies, often driven by political motivations and short-term gains. These policies are often inconsistent with national strategies and lack scientific rigor, unity, and systemic coherence. For example, in the development of industrial clusters within high-tech zones, the focus tends to be on attracting high-tech enterprises—especially multinational corporations—through incentives such as tax breaks and land subsidies. This has led to repeated and redundant developments, resulting in structural overcapacity across high-tech zones. Furthermore, local "policy competition" has resulted in the creation of unrealistic preferential policies, further diluting their effectiveness. These soft, inclusive policies tend to attract non-high-tech enterprises, undermining the goal of fostering genuine high-tech clusters and preventing the full realization of industrial agglomeration benefits. High-tech enterprises, and the effect of industrial agglomeration cannot be fully brought into play.

6. ACCELERATING ADJUSTMENTS IN HIGH-TECH INDUSTRIALIZATION POLICIES

Since the reform era, China's political and economic reforms have facilitated substantial growth in high-tech production, yet challenges remain in catching up with developed countries. Despite recent progress, China still faces significant policy barriers. To accelerate high-tech industrialization, the government must actively manage the process by drawing lessons from developed nations, while adhering to market principles. Policy adjustments should focus on improving finance, taxation, intellectual property, talent development, and the construction of high-tech zones, fostering rapid growth in the high-tech sector.

6.1. Strengthening Government Leadership in High-tech Industrialization

To address the fragmented development of high-tech industries, China should establish an authoritative coordination body at the national level, led by senior leaders and supported by various government departments, including Science and Technology, Education, and Commerce. This body would ensure effective leadership and coordination of high-tech industrialization efforts.

6.2. Clarifying Policy Directions for High-tech Industrialization

Following the guiding principles outlined in the Science and Technology Progress Law, policy adjustments should focus on overall planning, prioritizing key areas, and leveraging government leadership to concentrate resources. Financial and fiscal tools should be used strategically to support the development of high-tech enterprises and resolve macro- and micro-level challenges in industrialization.

6.3. Reforming Government Procurement Policies to Support High-tech Industrialization

China's government procurement system should be adjusted to better support technological innovation and high-tech industrialization. By prioritizing purchases of key technologies and prototypes from Chinese SMEs, and aligning procurement with national development plans, the government can accelerate the industrialization of high-tech research outcomes [20].

6.4. Enhancing Tax Incentives to Foster High-tech Industrialization

Tax incentives should be tailored to different stages of high-tech industrialization. The system should focus on strategic priorities, with dynamic adjustments based on economic conditions, ensuring that tax policies are optimized for effective resource allocation and maximization of industrialization outcomes.

7. CONCLUSION

High-tech industrialization, characterized by innovation, high investment, and rapid technological progress, poses significant challenges in resource allocation and market mechanisms. Government intervention is crucial to addressing market failures and ensuring the balanced development of the sector. However, it is essential that government actions respect market dynamics, focusing on enterprise-driven growth. As China transitions from an economic power to a technological leader, it must focus on strategic policy adjustments in finance, taxation, government procurement, and industrialization support systems to foster the leapfrog development of its high-tech industries.

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