Some Thoughts on Constructing a Science and Technology Innovation Policy System: Postprint

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Abstract

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Preamble

Since the launch of reform and opening-up policies, the Chinese government has introduced a series of measures to support and incentivize scientific and technological innovation activities, tailored to evolving socioeconomic development strategies and the needs of the scientific enterprise. These policies have covered all aspects of scientific work and every link in the innovation chain, establishing a preliminary framework for a science and technology innovation policy system with Chinese characteristics. Facing the new domestic and international landscape, the 18th National Congress of the Communist Party proposed implementing an innovation-driven development strategy, emphasizing

that scientific and technological innovation constitutes strategic support for enhancing social productivity and comprehensive national strength, and must be placed at the core of national development. To implement this strategy, China must now further explore and innovate its policies, accelerate the formulation of measures suited to new circumstances, enhance the scientific basis of science policy decision-making, and continuously optimize and improve its science and technology innovation policy system.

1 Significant Achievements in China' s Science and Technology Innovation Policy System

Science and technology innovation policies are government measures and actions that guide, incentivize, and regulate innovation activities. Their primary functions encompass three dimensions: first, a guiding function that steers the direction of innovation development through resource allocation, such as formulating five-year science and technology development plans and implementing key R&D programs; second, an incentivizing function that motivates innovation actors through tax incentives and other means, such as allowing pre-tax deductions for corporate R&D expenses and implementing equity incentives for scientific personnel; and third, a regulatory function that defines behavioral boundaries for innovation actors through norms and restrictions, such as establishing bioethics guidelines and research integrity policies.

Since reform and opening-up, China' s rapid scientific development has been accompanied by the formulation of numerous innovation policies across different periods, effectively supporting the implementation of national science and technology strategies at each stage. This has resulted in a diversified policy system that covers various innovation actors including research institutes, universities, enterprises, and intermediary service organizations; spans all innovation stages from basic research and technology development to technology transfer and industrialization; addresses supply-side, demand-side, and environmental dimensions; and employs diverse instruments including fiscal, tax, financial, and intellectual property policies.

China' s science and technology innovation policy system has been gradually established and continuously improved through successive rounds of science and technology system reform and the implementation of major innovation strategies. The evolution of this system follows a clear trajectory: at different development stages, ongoing reforms and strategies generate policy demands; in response to these reform initiatives and strategic requirements, corresponding policy measures are introduced to concretize and institutionalize reforms and strategies; through continuous summarization, optimization, and refinement of policies, social consensus gradually emerges and is elevated into law, progressively achieving rule-of-law governance in science and technology. For instance, in 2006, the Central Committee of the Communist Party and the State Council made a strategic decision to enhance independent innovation capabilities and build an innovative nation, issuing the *National Medium- and Long-Term Pro-*

gram for Science and Technology Development (2006-2020) (hereinafter referred to as the *Medium- and Long-Term Program*). To support its implementation, the State Council formulated 60 supporting policies covering science and technology investment, tax incentives, and financial support, while various ministries issued over 70 detailed implementation rules. After practical testing, many of these policies were incorporated into the revised *Law of the People' s Republic of China on Science and Technology Progress* passed at the end of 2007.

Overall, the development of China' s science and technology innovation policy system exhibits three major characteristics. In terms of policy scope, it has expanded from "small science" to "large innovation," shifting from primarily incentivizing scientific progress and technological development to encouraging innovation development more broadly. Regarding policy targets, it has evolved from an early focus on research institutes and universities to encompassing all innovation-related actors including research institutions, enterprises, technology service organizations, and venture capital. In terms of policy instruments, it has moved from an early emphasis on factor inputs to a current focus on creating an enabling environment for innovation.

Under the strong leadership of the Party Central Committee and the State Council, and through active promotion by various ministries and local governments, China' s science and technology innovation policies have achieved remarkable results. In stimulating nationwide innovation enthusiasm, national R&D expenditure exceeded 1.4 trillion yuan in 2015, with R&D intensity reaching 2.1%. Since 2006, national R&D expenditure has grown at an average annual rate of over 21%. In incentivizing corporate innovation, 45,000 enterprises benefited from R&D expense deduction preferences in 2014, with tax reductions growing at an average annual rate of over 30% since 2008. In motivating scientific and technical personnel, equity and profit-sharing incentives for key technical and managerial staff have mobilized their innovation enthusiasm. By the end of 2014, these policies had been implemented in over 200 enterprises in the Zhongguancun, East Lake, and Zhangjiang national innovation demonstration zones and the Hefei-Wuhu-Bengbu comprehensive innovation pilot zone, incentivizing over 2,000 personnel and significantly enhancing enterprises' ability to attract and retain scientific talent. In promoting regional innovation development, China has established 146 national high-tech zones, where R&D intensity reaches 5.5%—2.6 times the national average—and the number of invention patents per 10,000 employees stands at 162.3, 8.5 times the national average.

2 Priorities and Directions for the Science and Technology Innovation Policy System

In recent years, profound changes have occurred in both domestic economic conditions and the international economic landscape, with intensifying global competition around scientific and technological innovation. Science and technology innovation policy work now faces new circumstances and requirements.

First, the Party Central Committee' s high-level attention to scientific and technological innovation provides an important window for policy improvement and environment cultivation. Since the 18th Party Congress, the new central leadership collective with Comrade Xi Jinping as General Secretary has made the major decision to implement an innovation-driven development strategy, proposing a series of new ideas, judgments, and requirements regarding scientific and technological innovation. To support this strategy, the Party Central Committee and the State Council have issued several important documents, including the *National Innovation-Driven Development Strategy Outline* and the *Opinions of the CPC Central Committee and the State Council on Deepening System and Mechanism Reforms to Accelerate Implementation of the Innovation-Driven Development Strategy*. These ideas, judgments, and documents have further clarified the direction of science and technology reform and development in the new era while placing higher demands on innovation policy work. Second, competition in innovation strategies and policies has become the primary means of international competition. Major countries worldwide are actively introducing science and technology innovation policies, with innovation environment competition emerging as a crucial dimension of the new round of global innovation competition. The contest for innovation resources—including talent, capital, markets, and patents—has become increasingly fierce. For example, the United States vigorously promotes manufacturing reshoring and has enacted new immigration reform bills to attract talent; Brazil has launched the "Science Without Borders" program; India has issued the *Overseas Citizen of India Regulations* to encourage overseas citizens to return for innovation activities; and Japan and South Korea have introduced policies to attract foreign R&D institutions. Faced with this global innovation competition, China must strengthen policy research, accelerate policy innovation, and enhance the competitiveness of its science and technology innovation policies. Third, adapting to and actively guiding the new normal has generated urgent demands for innovation policies. China' s economic development has entered a new normal characterized by slower growth, structural optimization, and power conversion, requiring scientific and technological innovation to create new engines under this new normal. The core of supply-side structural reform lies in using scientific and technological innovation to improve total factor productivity and address issues of economic development quality and efficiency. Adapting to and actively guiding the new normal represents a major test for science and technology work in the new period. Under the new normal, science and technology policy work must pay greater attention to the role of science and technology in serving the national economy, strengthen strategic planning and systematic layout for innovation development, create accelerated innovation momentum, generate new advantages for future development, and support medium-high speed economic growth and quality improvement. Fourth, major breakthroughs in science and technology system reform have laid a solid foundation for improving innovation policies. The 18th Party Congress and the Third Plenary Session of the 18th Central Committee proposed overall reform requirements to advance the modernization of the national governance system and give full play to the market' s decisive role in resource allocation. Since

the 18th Party Congress, breakthroughs have been achieved in science and technology system reform, including reforms of central fiscal science and technology program management, the academician system, and the science and technology reward system. These reforms have laid the foundation for formulating and implementing science and technology innovation policies and for policy execution and supervision in the new era. Currently, it is essential to strengthen overall coordination and systematically advance reforms in three areas—the science and technology system, the economic sector, and government management—to create institutions and mechanisms adapted to innovation-driven development and foster an institutional environment that protects innovation, a market environment that drives innovation, and a social environment that supports innovation.

Since reform and opening-up, China' s science and technology innovation policy system has continuously developed and optimized. However, facing new circumstances and requirements, certain problems and deficiencies remain. In terms of policy positioning, the government has been insufficient in creating a market environment conducive to innovation, with stronger incentives for investment activities than for innovation activities. Regarding policy priorities, there has been an overemphasis on R&D and the supply side, with inadequate attention to the demand side and innovation environment. In policy instrument selection, there has been a preference for competitive grants and subsidy policies, with few universal policies. In policy orientation, talent evaluation and incentive mechanisms remain imperfect. In policy implementation, some policies have been compromised by poor coordination or lack of detailed implementation rules.

Facing these new circumstances and requirements, science and technology innovation policy work must thoroughly implement the spirit of the 18th Party Congress, the Third, Fourth, and Fifth Plenary Sessions of the 18th Central Committee, and the National Science and Technology Innovation Conference. Following the requirements of the innovation-driven development strategy, it must properly handle the relationship between government and market, be market-oriented, enterprise-centered, and focused on innovation environment construction. It should strengthen overall policy design and coordination, promote a shift from R&D-focused policies to integrated design across the entire innovation chain, place greater emphasis on policy implementation and monitoring evaluation, and attach more importance to demand-side policies, talent incentive policies, and universal policies.

(1) Properly handling the government-market relationship and improving the innovation dynamism mechanism. Government fiscal investment in science and technology should primarily strengthen basic research and major generic key technology R&D, moderately increase basic and generic technology projects, and enhance innovation infrastructure and public platform construction. The market mechanism' s role in incentivizing innovation must be fully leveraged, with improved access systems for new technologies, products, and business models, and encouragement and support for new business forms and models.

(2) Strengthening policy coordination and synergy to create policy 合力. Science and technology policies should be better coordinated with fiscal, tax, financial, trade, investment, industrial, education, and social security policies to form consistent, departmentally aligned policy synergy and improve the policy system supporting innovation. Central and local policy coordination should be enhanced to ensure mutual support and coordination. Implementation should focus on developing supporting measures around key policies to form a complete policy package.

(3) Improving the enterprise-centered, market-oriented technology innovation mechanism. The national investment approach to technology innovation should gradually shift toward universal policies to encourage enterprises to increase R&D investment. A fair and equitable market environment should be created, with continuous improvement of relevant laws, regulations, and standards systems, and strengthened intellectual property protection. Industry-academia-research collaboration should be enhanced to guide various innovation elements to converge on enterprises, promoting their role as the main actors in technology innovation decision-making, R&D investment, research organization, and achievement transformation.

(4) Strengthening demand-side policy guidance. A government procurement system consistent with international rules should be established to increase procurement' s role in driving innovation. Enforcement of energy conservation and emission reduction standards should be intensified to accelerate new technology promotion and application. For innovation products and technologies with social welfare characteristics, price subsidies and consumer subsidies should be implemented to reduce the cost of new technologies entering the market. The inspection and testing service system should be improved to clear channels for innovative products to enter the market.

(5) Establishing a comprehensive, full-process innovation talent policy support system. Talent should be cultivated and attracted according to innovation laws, and allowed to flow freely according to market laws to achieve optimal utilization and fulfillment of potential. Categorized evaluation should be implemented for scientific personnel engaged in different innovation activities to encourage sustained research and long-term accumulation, fully mobilizing and stimulating human initiative and creativity. More competitive international talent attraction policies should be implemented.

(6) Strengthening policy inclusiveness. Infrastructure construction and coverage should be enhanced to provide technical support and public services for innovation and entrepreneurship in rural and remote areas. More low-cost technological innovations in livelihood fields should be encouraged and supported to enable scientific and technological achievements to benefit more low-income groups. Skills training for new technologies should be conducted to improve technology popularization rates.

(7) Strengthening policy implementation and supervision evaluation. An inter-agency working mechanism for policy implementation should be established, with pre-assessment and post-tracking of policy formulation. A dynamic policy optimization and adjustment mechanism should be created to form a policy implementation feedback loop for continuous improvement.

3 Think Tanks Should Play a Leading Role in Science and Technology Innovation Policy Theory and Method Research

Science and technology innovation policies are crucial conditions for shaping the innovation environment and stimulating innovation vitality, and their effectiveness and scientific quality directly impact scientific and technological development and its supporting and leading role. However, compared with economic and financial policy fields, the science and technology innovation policy field still lacks a comprehensive theoretical system, has a weak data foundation, insufficient methods and tools, and is sometimes overly influenced by subjective consciousness and value judgments in policy issues, with inadequate theoretical and evidence support in decision-making processes. Strengthening science and technology policy research and enhancing the scientific level of science and technology innovation policy decision-making have become important concerns for major countries worldwide, as exemplified by the United States' vigorous development of the science of science policy and the United Kingdom' s active promotion of evidence-based decision-making in recent years.

Considering current trends in China' s science and technology innovation policy development and the international trend toward scientization of innovation policies, promoting science and technology innovation policy research in China and enhancing intellectual support for these policies requires focusing on four key tasks: constructing a theoretical system for science and technology innovation policy, strengthening policy data infrastructure, developing more applicable professional analytical tools, and developing specialized high-level think tanks.

(1) Strengthening the construction of a theoretical system for science and technology innovation policy to reinforce theoretical support for decision-making. Theoretical system research should be strengthened to promote the formation of a complete theoretical framework with disciplinary attributes and sustain the continuous development of the science and technology innovation policy field. Theoretical research should focus on major policy issues in China' s science and technology system reform (such as science and technology governance, scientific and technological progress and the new normal). The connection between theoretical research and policy practice should be strengthened to keep pace with reform and policy dynamics, identify "real policy problems," and conduct actionable theoretical research that provides direct and effective support for policy for-

mulation and implementation. Simultaneously, attention should be paid to avoiding the perspective limitations that can arise from overemphasizing "problem orientation," and for specific policy issues, a systematic and comprehensive theoretical perspective should be frequently revisited to consider fundamental solutions.

(2) Strengthening policy data infrastructure to solidify the evidence base for decision-making. Currently, many policy issues in China lack effective data foundations, leaving numerous policy debates at the conceptual level. Therefore, efforts should be strengthened to collect and analyze international policy practices and cases, construct a science and technology innovation policy text database; for key policy issues (such as SME innovation), collect accurate, authentic, applicable, and specific original information and data to build factual thematic databases; and strengthen innovation surveys, promote data integration, and form comprehensive databases.

(3) Strengthening the development and application of professional analytical methods and tools to enhance the scientific level of decision-making. Research on policy pre-assessment methods should be conducted to evaluate policy implementation costs and potential effects beforehand, providing more effective guidance for decision-making. Advanced methods and technical means from related fields (such as text mining and big data) should be selectively introduced and integrated to develop specialized analytical methods and tools for specific policy issues (such as bibliometrics and patent analysis). For routine policy issues, simplified and intuitive analytical tools should be developed to improve decision-making efficiency (such as policy content visualization technology). Research on policy post-assessment methods should be conducted to scientifically evaluate policy implementation effects and impacts.

(4) Strengthening the construction of a science and technology innovation policy research community to enhance information diversity in decision-making. The development of relevant societies and groups should be supported and encouraged, with a focus on building a batch of high-level science and technology innovation policy think tanks to provide high-level intellectual support for policy formulation. Discipline construction related to science and technology innovation should be promoted, and international exchanges in research fields should be strengthened. The decision-making consultation mechanism should be improved through policy roundtables and other means to enhance the scientific level of policy decision-making.

Note: Figure translations are in progress. See original paper for figures.