

Research on How University Science and Technology Innovation Promotes the Development of New-Quality Productive Forces

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Abstract: This paper examines the relationship between university scientific and technological innovation and the development of new-quality productive forces. New-quality productive forces are driven by scientific and technological innovation, characterized by high technology, high efficiency, and high quality. The study indicates that university scientific and technological innovation serves as its core driving force, while new-quality productive forces provide goal-oriented direction for university innovation. Universities exert their influence through knowledge spillovers, talent cultivation, and disciplinary integration, leveraging mechanisms such as technology supply, achievement transformation, and collaborative innovation. To enhance this impact, efforts should focus on strengthening basic research, aligning with national strategies, deepening reforms, and optimizing the innovation ecosystem. These findings hold significant implications for promoting the integrated development of scientific and technological innovation and new-quality productive forces.

Keywords: Scientific and Technological Innovation in Universities; New-Quality Productive Forces; Internal Logic; Mechanism of Action; Implementation Pathways.

1. Introduction

The report of the 20th CPC National Congress established high-quality development as the primary task in building a modern socialist country in all respects. As its core engine, new-quality productive forces represent a new form of productive forces driven by scientific and technological innovation, achieving a fundamental transformation in production methods and development drivers, signifying a profound shift from traditional growth models^[1]. As a key component of the national innovation system, universities play an irreplaceable role in scientific and technological progress and economic and social development. Their scientific and technological innovation serves as a vital platform for basic research and technological development, while also providing crucial support for nurturing emerging industries and transforming production methods. Against the backdrop of intensifying global technological competition and accelerating industrial transformation, this paper focuses on the relationship between university scientific and technological innovation and new-type productive forces. It analyzes the intrinsic logic of their development, dissects collaborative mechanisms, and proposes implementation pathways. This provides theoretical and practical support for deepening university-enterprise collaboration, optimizing resource allocation, building a modern innovation system, and achieving high-quality development^[2].

2. The Intrinsic Logic of University Scientific and Technological Innovation in Promoting New Quality Productivity Development

University scientific and technological innovation comprehensively drives the formation and development of new quality productivity through multiple mechanisms,

including knowledge creation and diffusion, talent cultivation and supply, interdisciplinary integration, innovation ecosystems and collaboration, fundamental research and support, as well as institutional innovation and leadership. This provides powerful momentum for high-quality economic and social development^[3].

(I) Knowledge Spillover Effects

Through channels such as personnel mobility, technology transfer, and collaborative research, universities disseminate cutting-edge knowledge and technologies to society. Enterprises absorb these innovations and transform them into new products and services, driving technological and business model innovation. This not only enhances competitiveness but also propels industrial upgrading. Particularly in high-tech fields, the diffusion of advanced technologies often triggers disruptive transformations, a process accelerated in the digital economy era^[4].

(II) Talent Development Effect

This effect cultivates individuals with innovative awareness, capabilities, and spirit through systematic curricula, practical training, research exercises, and entrepreneurship education. Upon entering society, these talents become core forces—capable of excelling in corporate R&D roles or launching startups to create new growth points. High-level research talents further drive industrial technological transformation.

(III) Interdisciplinary Integration Effect

Leveraging universities' multidisciplinary strengths, this effect fosters knowledge convergence and innovation through cross-disciplinary platforms and interdisciplinary teams. The resulting breakthroughs are often disruptive, giving rise to emerging industries. Currently, the convergence of information technology with biology, energy, materials, and other fields is incubating revolutionary breakthroughs.

(IV) Innovation Ecosystem Building Effect

The innovation ecosystem building effect fosters a virtuous

cycle through close collaboration between universities, enterprises, governments, and research institutions. This collaboration enables resource sharing, complementary strengths, risk-sharing, and profit-sharing, thereby reducing innovation costs, enhancing efficiency, and accelerating the commercialization of scientific and technological achievements.

(V) Basic Research Support Effect

Leveraging universities' strengths in fundamental research, this effect involves long-term scientific exploration to accumulate original knowledge. Though short-term economic returns may be elusive, such research serves as the wellspring of disruptive technological innovation. It can trigger paradigm shifts, catalyze emerging industries, and provide inexhaustible momentum for new-quality productive forces.

(VI) Institutional Innovation Leadership Effect

The institutional innovation leadership effect fosters systems aligned with new-quality productive forces through reforms in research evaluation, organizational models, and conversion mechanisms. This enhances institutional efficiency and innovation capacity while providing insights for societal innovation system reforms, thereby unlocking innovation potential [5].

3. Mechanisms Through Which University Scientific and Technological Innovation Promotes New-Quality Productive Forces Development

University scientific and technological innovation promotes the development of new-quality productive forces through multiple mechanisms [6], primarily including:

(I) Technology Supply Mechanism

The technology supply mechanism serves as the core support. Universities leverage basic and applied research to generate advanced technologies and knowledge, which are then systematically, scaled, and industrialized to transform into tangible productive forces. Technologies are delivered to enterprises through channels such as technology transfer, patent licensing, and collaborative R&D, precisely addressing critical industrial bottlenecks and pain points. In frontier fields like artificial intelligence, quantum information, and biomedicine, universities demonstrate significant advantages in fundamental research. They steer technological transformation, drive the industrialization of high-tech sectors, facilitate the upgrading of traditional industries, and foster regional economic specialization, thereby accelerating the formation of new-quality productive forces.

(II) Talent Supply Mechanism

The talent supply mechanism injects core momentum into new-quality productive forces. As the primary battleground for talent cultivation, universities nurture professionals equipped with specialized knowledge, skills, innovative thinking, and practical capabilities through professional education, research training, and innovation practice [7]. High-level research talents support corporate R&D, while entrepreneurial talents create new growth points through independent ventures. Universities also offer continuing education to help working professionals update knowledge and enhance skills, transforming talent dividends into innovation dividends by optimizing knowledge structures, elevating competency levels, and fostering innovative thinking.

(III) Knowledge Dissemination Mechanism

The knowledge dissemination mechanism fosters a favorable innovation environment. Universities disseminate research outcomes and innovative concepts through academic conferences, journal publications, patent applications, and science outreach activities. Academic conferences facilitate intellectual exchange, scientific journals document and disseminate achievements, patent applications protect innovations while promoting technology diffusion, and science outreach activities cultivate scientific spirit and innovation culture. This mechanism accelerates knowledge flow, promotes technological exchange, nurtures innovation culture, and enhances the societal impact of scientific and technological innovation.

(IV) Think Tank Support Mechanism

The think tank support mechanism enhances the scientific basis of decision-making. Universities leverage their disciplinary strengths and talent pools to establish high-level science and technology think tanks, providing policy research, trend analysis, and strategic planning services to governments and enterprises. They offer theoretical and empirical support for policy formulation, deliver targeted recommendations for corporate planning, and improve the coordination of new productive forces development and optimize resource allocation efficiency through forward-looking assessments, systematic analysis, and strategic consulting.

(V) Incubation and Commercialization Mechanism

The incubation and commercialization mechanism facilitates the implementation of research outcomes. Universities establish a transformation system encompassing technology transfer centers, science parks, and business incubators, forming an innovation value chain from laboratory to market. Technology transfer centers drive marketization of achievements, science parks promote industry-academia-research integration, and business incubators mitigate entrepreneurial risks. These platforms accelerate the conversion of scientific discoveries into industrial applications, bridging the innovation chain with the industrial chain.

(VI) Collaborative Innovation Mechanism

The collaborative innovation mechanism integrates diverse resources. Universities partner with enterprises, research institutes, and governments to build open innovation networks. Through platforms like joint university-enterprise laboratories and industrial technology alliances, they achieve complementary strengths: universities contribute knowledge R&D, enterprises drive market application, research institutes provide technical support, and governments ensure policy safeguards. This forms flexible and efficient innovation organization, enhancing systemic innovation and overall effectiveness.

(VII) International Cooperation Mechanism

The international cooperation mechanism broadens global perspectives. Universities participate in global innovation through international joint laboratories and transnational projects, drawing on advanced experiences, introducing cutting-edge technologies, and contributing to international scientific and technological standard-setting. By facilitating knowledge exchange, technology introduction, talent cultivation, and standard development, this mechanism expands global resources for new-quality productive forces development and enhances international competitiveness.

4. Implementation Pathways for University Scientific and Technological Innovation to Promote New Quality Productivity Development

To better leverage the role of university scientific and technological innovation in advancing new quality productivity development^[8], efforts should focus on the following areas:

(I) Strengthening Basic Research to Solidify the Foundation of Scientific and Technological Innovation

Universities must increase investment in basic research and establish long-term, stable support mechanisms for it. Dedicated basic research funds should be established to prioritize support for young scholars engaged in exploratory research in frontier fields, encouraging researchers to target fundamental scientific questions underlying “chokepoint” technologies. The evaluation system for basic research should emphasize originality and long-term commitment, shifting away from short-term metrics to allow researchers to dedicate themselves to sustained, long-term research. Universities should also strengthen foundational disciplines, particularly supporting fields like mathematics and physics, to provide a solid foundation for interdisciplinary innovation. Implement special talent zones for basic research, offering preferential policies in recruitment, title evaluation, and compensation to attract and retain internationally-minded leading researchers. By enhancing basic research, universities can accumulate original knowledge, master the origins of key core technologies, and provide sustained momentum for developing new productive forces^[9].

(II) Conducting Collaborative Innovation Aligned with National Strategic Needs

Universities should proactively align with major national strategic demands by organizing interdisciplinary, cross-sectoral, and transregional research teams focused on collaborative innovation in strategic fields such as artificial intelligence, quantum information, and biomedicine. Establish university-industry joint laboratories and industrial technology research institutes to build innovation communities deeply integrating industry, academia, research, and application. Improve mechanisms for dynamically adjusting academic disciplines and programs, promptly realigning disciplinary structures and program offerings with national strategic needs. Universities should also assemble strategic scientific and technological forces to undertake major national scientific missions, playing a leading role within the national innovation system^[10]. Develop and implement special action plans for universities to serve major national needs, annually selecting several critical technological challenges and organizing top research teams for concentrated breakthrough efforts. Through collaborative innovation addressing national strategic demands, universities can more precisely transform scientific and technological innovations into tangible productive forces that serve national development.

(III) Deepen Reform of the Scientific Research System to Stimulate Innovation Vitality

Higher education institutions should deepen reforms of scientific research systems and mechanisms, refining evaluation frameworks oriented toward quality, performance, and contribution. Reform the professional title evaluation

system by establishing a classification-based assessment mechanism, applying distinct criteria for fundamental research, applied research, and technology transfer. Implement more flexible scientific research management systems, streamline procedures for project applications and fund utilization, and grant researchers greater autonomy in determining technical approaches and managing budgets. Improve incentive mechanisms for technology transfer, increase researchers' share of commercialization revenues, and permit researchers to pursue entrepreneurship with their research outcomes while employed or through part-time ventures. Establish a research integrity system, rigorously combat academic misconduct, and foster a clean and upright research environment. Deepening research system reform will fully unleash the innovative potential and commercialization motivation of university researchers, accelerating the transformation of scientific and technological innovations into new productive forces^[11].

(IV) Strengthen Talent Development to Enhance Innovation Capabilities

Universities must innovate talent cultivation models by integrating innovation and entrepreneurship education throughout the entire talent development process. Adjust disciplinary curricula to increase the proportion of interdisciplinary courses, strengthening students' comprehensive qualities and innovation capabilities. Reform teaching methods by promoting case-based learning, project-based learning, flipped classrooms, and other pedagogical approaches to enhance students' practical problem-solving skills. Establish an innovation and entrepreneurship education system featuring specialized course series, innovation competitions, maker spaces, and practical training bases to provide abundant hands-on opportunities. Implement excellence programs by selecting outstanding students for research teams and engaging them in real-world projects to cultivate top-tier innovators. Establish university-industry collaboration mechanisms to deepen corporate involvement in talent development, enhancing program relevance and applicability. Through strengthened talent cultivation, universities can continuously supply high-caliber innovative professionals to support new productive forces development^[12].

(V) Optimizing the Innovation Ecosystem to Promote Achievement Transformation

Universities should construct open and shared innovation ecosystems, breaking down resource barriers between campus and external entities to facilitate the efficient flow and optimized allocation of various innovation factors. Improve the scientific and technological achievement transformation service system by establishing specialized service institutions such as technology transfer centers and intellectual property operation centers to provide full-process services for achievement transformation. Establish technology transfer funds and achievement transformation funds to address funding bottlenecks in transforming scientific and technological achievements. Establish strategic cooperation mechanisms between universities and local governments, industrial parks, and industry enterprises to foster a virtuous cycle of demand-driven innovation and supply-responsive development. Cultivate an alumni entrepreneurship ecosystem, leveraging alumni networks to advance technology transfer and innovation-driven entrepreneurship. Create information-sharing platforms for scientific achievements to achieve precise alignment between research

outcomes and market needs. By optimizing the innovation ecosystem, universities can eliminate barriers between scientific innovation and industrial application, accelerating the transformation of scientific achievements into tangible productive forces^[13].

(VI) Building High-Level Innovation Platforms to Aggregate Resources

Universities should actively pursue and establish high-level innovation platforms such as national key laboratories, engineering research centers, and technology innovation centers to create hubs for scientific and technological advancement. These platforms should target global technological frontiers and national priorities, pooling superior resources to tackle major scientific challenges. Construct open-access research facilities and large-scale instrument platforms to enhance equipment utilization efficiency and support high-caliber scientific research. Establish technology innovation centers and industrial innovation centers to facilitate precise alignment between technological innovations and industrial demands. Develop science and technology innovation incubation bases to provide comprehensive support—including space, equipment, and services—for technology transfer and entrepreneurial teams. Attract high-level domestic and international talent to form internationally influential innovation teams, thereby enhancing the core competitiveness of innovation platforms. By building high-level innovation platforms, universities can pool innovation resources, strengthen scientific and technological innovation capabilities, and provide robust support for the development of new-quality productive forces.

(VII) Elevating International Collaboration to Expand Innovation Horizons

Universities should comprehensively enhance international scientific cooperation and actively integrate into global innovation networks. Establish international joint laboratories and research centers to conduct substantive collaborative research with world-class universities and research institutions. Implement international science and technology cooperation programs, organizing joint international efforts to tackle shared scientific challenges and technological obstacles. Strengthen international academic exchanges by regularly hosting high-level international conferences to foster in-depth interactions among researchers and their global peers. Refine mechanisms for attracting and cultivating international talent, drawing high-level overseas professionals to work on campus while sending outstanding young faculty members for visits and training at prestigious foreign institutions. Participate in major international scientific initiatives and projects to enhance capabilities and influence in global science governance. Actively engage in setting international scientific standards to increase global discourse power. By elevating international cooperation, universities can draw on advanced international experiences, leverage global innovation resources, expand innovation space, and strengthen the international competitiveness of scientific and technological innovation.

(VIII) Strengthen Policy Support and Optimize the Development Environment

Governments should enhance policy support for scientific and technological innovation in universities, creating a favorable environment for promoting the development of new productive forces. Improve the fiscal investment mechanism for scientific and technological innovation, increasing support for basic and applied basic research in universities. Reform

scientific research management systems to reduce unnecessary burdens on researchers, allowing them more time and energy to devote to scientific inquiry. Strengthen intellectual property protection and utilization mechanisms to safeguard the legitimate rights and interests of universities and researchers. Optimize financial services for science and technology, broadening financing channels for the commercialization of scientific achievements. Establish special zones for scientific and technological talent, implementing preferential policies in talent recruitment, evaluation, and incentives. Develop industry-academia-research collaborative innovation centers, providing policy support and resource guarantees for university-enterprise cooperation. Improve the legal framework for scientific and technological innovation, fostering a sound legal environment for university innovation. Strengthened policy support will provide a solid foundation for universities to advance new-quality productive forces through scientific and technological innovation.

5. Conclusions

This study concludes that scientific and technological innovation in higher education institutions serves as a key driver for the development of new-quality productive forces, with the two exhibiting a close intrinsic connection and forming a virtuous cycle. Their underlying logic manifests through six major effects, including knowledge spillover, talent cultivation, and interdisciplinary integration. These effects promote the development of new-quality productive forces via seven mechanisms, such as technology supply, talent supply, and knowledge dissemination. Collaborative advancement is required across eight dimensions, including strengthening basic research and aligning with national strategies. Policy recommendations encompass the following dimensions: The state should increase support for fundamental research and refine multi-dimensional evaluation systems; Universities should adjust disciplinary structures and reform talent cultivation models; Local governments should establish collaborative platforms and set up transformation funds; Enterprises should boost R&D investment and deepen university-industry partnerships; Society should foster an atmosphere that reveres innovation.

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References

- [1] Song Yingjie. Three-Dimensional Promotion: The Internal Logic and Advancement Pathways for Universities to Empower the Development of New Quality Productive Forces [J]. Southern Forum, 2024, (09): 72-74.
- [2] Sun Aijuan. Research on Industrial Innovation through Technology-Business Model Synergy [D]. Harbin University of Commerce, 2015.
- [3] Chen Jin, Chen Shujie. Accelerating New Quality Productivity Development through Education-Technology-Talent Integration: Key Issues, Practical Logic, and Primary Pathways [J]. Modern Educational Technology, 2024, 34(07): 5-12.

- [4] Zhou Luyao. Exploring Development Pathways for New Quality Productivity in the Guangdong-Hong Kong-Macao Greater Bay Area Guided by the Spirit of the 20th CPC National Congress [J]. Accounting Monthly, 2024, 45(15):109-115.
- [5] Yin Jun. Building an Education Powerhouse and Developing New Quality Productivity [J]. Beijing Education (Higher Education), 2024, (10): 8-10.
- [6] Xiong Peng. The Internal Logic and Implementation Pathways of Cultivating New Business Talent in Applied Universities to Support New Quality Productivity Development [J]. Coastal Enterprises and Technology, 2024, 29(04): 81-87.
- [7] Jin Ziyu. The Subject Categories, Content Implications, and Practical Requirements of Higher Education Empowering New Quality Productivity [J]. Journal of Mudanjiang Education College, 2024, (04): 22-26.
- [8] Yang Renshu. Strengthening the Strategic Scientific and Technological Forces of Universities to Serve National Scientific and Technological Self-reliance and Self-strengthening [J]. Beijing Education (Higher Education), 2022, (04): 32-34.
- [9] Lan Wenting. Research on Enhancing the Quality and Efficiency of Scientific and Technological Achievement Transformation in Universities Under the Development Needs of New Quality Productivity [J]. Jiangsu Higher Education, 2024, (10): 44-52.
- [10] Zhang Xiaolong, Si Yuna. Digital Empowerment of Talent Cultivation in Universities from the Perspective of New Quality Productivity: Theoretical Framework and Practical Pathways [J]. Education Observation, 2024, 13(28): 103-105.
- [11] Li Gang, Wang Qi. Building a National Science and Technology Innovation System Adapted to New Quality Productivity Development [J]. Administrative Management Reform, 2024, (04): 24-34.