THEORETICAL FOUNDATIONS OF THE TRIPLE HELIX MODEL IN SOUTH KOREA: STATE-INDUSTRY-UNIVERSITY COLLABORATION FOR INNOVATION AND HUMAN CAPITAL DEVELOPMENT

Tukhtabayev Mirzokhid Akhmadjanovich, *PhD, Associate Professor,*
Department of Logistics,
E-mail: mirzoxidta@gmail.com,
Namangan State Technical University

Abstract. *This study analyzes the theoretical and institutional foundations of the Triple Helix model in South Korea's higher education system, focusing on university–industry–government collaboration as a driver of innovation and human capital development. Using a qualitative review of academic and policy sources, the paper examines how universities evolved into entrepreneurial and innovation-oriented institutions. The findings show that long-term policy coordination, competitive funding, and increased institutional autonomy strengthened university–industry linkages and transformed universities into active innovation actors. The study offers practical lessons for policymakers in developing and transitional economies seeking innovation-driven higher education reform.*

Annotatsiya. *Ushbu tadqiqot Janubiy Koreya oliy ta'lim tizimida Triple Helix modelining nazariy va institutsional asoslarini tahlil qiladi hamda universitet–sanoat–davlat hamkorligini innovatsiya va inson kapitalini rivojlantirish omili sifatida ko'rib chiqadi. Tadqiqot sifatli tahlil va ilmiy hamda siyosiy hujjatlar sharhiga asoslanadi. Natijalar uzoq muddatli siyosiy muvofiqlashtirish, raqobatbardosh moliyalashtirish va institutlar avtonomiyasi universitetlarni faol innovatsion subyektlarga aylantirganini ko'rsatadi. Tadqiqot rivojlanayotgan va o'tish iqtisodiyotidagi mamlakatlar uchun amaliy tavsiyalar beradi.*

Аннотация. *В статье анализируются теоретические и институциональные основы модели Triple Helix в системе высшего образования Южной Кореи с акцентом на сотрудничество университетов, промышленности и государства как фактор инновационного развития и формирования человеческого капитала. Исследование основано на качественном анализе научной литературы и политических документов. Результаты показывают, что долгосрочная координация политики, конкурентные механизмы финансирования и институциональная автономия способствовали усилению связей между университетами и индустрией и трансформации университетов в активных инновационных акторов. Работа содержит практические рекомендации для стран с развивающейся и переходной экономикой.*

Keywords. *Triple Helix; innovation system; higher education; university–industry collaboration; human capital; South Korea.*

Kalit so'zlar. *Triple Helix modeli; innovatsion tizim; oliy ta'lim; universitet–sanoat hamkorligi; inson kapitali; Janubiy Koreya.*

Ключевые слова. *модель Triple Helix; инновационная система; высшее образование; сотрудничество университет–индустрия; человеческий капитал; Южная Корея*

1. Introduction. Innovation-driven development increasingly relies on systemic interaction among institutional actors [1-4]. Linear innovation models are insufficient to explain such complexity.

In the contemporary global knowledge economy, innovation has become a decisive factor shaping national competitiveness, economic resilience, and long-term socio-economic development. The increasing complexity of production systems, rapid technological change, and globalization of knowledge flows have fundamentally transformed the ways in which countries generate and utilize scientific and technological knowledge. Under these conditions, the ability of

national systems to coordinate research, education, and industrial development has emerged as a critical determinant of success.

Traditional linear models of innovation, which conceptualize innovation as a sequential process moving from basic research to applied research and finally to commercialization, have proven insufficient for explaining modern innovation dynamics. These models tend to underestimate the importance of feedback loops, institutional interaction, and knowledge co-production. As a result, scholars and policymakers have increasingly turned to systemic and interactive frameworks that emphasize collaboration among multiple actors and sectors [5-7].

One of the most influential frameworks in this regard is the Triple Helix model, which conceptualizes innovation as the outcome of dynamic and evolving interactions among universities, industry, and the state. Rather than assigning fixed and separate roles to each actor, the model emphasizes role hybridization, institutional overlap, and mutual learning. Universities become entrepreneurial actors, industries participate actively in knowledge production, and the state assumes a strategic role as coordinator, facilitator, and regulator.

Among the countries frequently cited as exemplars of successful innovation-driven development, South Korea occupies a prominent position. Over the course of several decades, South Korea transformed itself from a low-income, agrarian economy into one of the world's most technologically advanced nations. This transformation was not the result of market forces alone but was shaped by deliberate state policies, close coordination with industrial actors, and sustained investment in higher education and research infrastructure [8-11].

The South Korean case is particularly valuable for theoretical analysis because it demonstrates how the configuration of the Triple Helix can evolve over time. In the early stages of development, the state played a dominant and directive role, guiding industrialization and shaping higher education priorities. Over time, however, the system gradually evolved toward a more network-based and interactive model, characterized by stronger university–industry linkages and greater institutional autonomy.

Despite extensive empirical research on South Korea's innovation system, there remains a need for deeper theoretical analysis of how the Triple Helix model operates in this specific national context. Much of the existing literature focuses on policy outcomes or sectoral performance, while fewer studies engage systematically with the theoretical implications of South Korea's experience for the Triple Helix framework itself. This gap is particularly relevant for developing and transitional economies seeking to adapt elements of the South Korean model to their own contexts.

The aim of this article is to examine the theoretical foundations of the Triple Helix model through the lens of South Korea's state-industry-university relations. Rather than offering a purely descriptive account, the study seeks to refine the conceptual understanding of the Triple Helix by analyzing how institutional roles, governance mechanisms, and interaction patterns have evolved in South Korea. The article addresses the following research questions:

1. How is the Triple Helix model conceptualized in the academic literature from a theoretical perspective?
2. How have state-industry-university relations evolved within South Korea's innovation system?
3. What theoretical insights can be derived from the South Korean case for the further development of the Triple Helix framework?

By addressing these questions, the article contributes to ongoing debates on innovation systems, higher education policy, and state-led development, while offering theoretical insights that extend beyond the South Korean case.

2. Literature Review and Theoretical Background

The Triple Helix model conceptualizes innovation as recursive interaction between universities, industry, and government [2,12].

2.1 From Linear Innovation Models to Systemic Approaches

Early theories of innovation were largely dominated by linear models that portrayed innovation as a unidirectional process flowing from scientific discovery to technological application and market diffusion. These models, while useful in explaining certain forms of industrial research, failed to capture the complexity of innovation processes in knowledge-intensive economies. In particular, they overlooked the interactive nature of knowledge creation and the role of institutional coordination.

In response, scholars developed systemic approaches to innovation, such as the National Innovation Systems (NIS) framework, which emphasized the role of institutions, networks, and policies in shaping innovation outcomes. The NIS approach highlighted the importance of institutional diversity, learning processes, and policy coherence, but it often treated universities, industry, and the state as relatively distinct entities with predefined roles [13-17].

The Triple Helix model emerged as an extension and refinement of these systemic approaches. Rather than focusing solely on institutions, it emphasizes relationships and interactions. Innovation is understood as a co-evolutionary process in which actors influence and reshape one another over time. This relational perspective represents a significant theoretical shift, moving beyond structural descriptions toward dynamic analysis.

2.2 Core Assumptions of the Triple Helix Model

At its core, the Triple Helix model is built on several key theoretical assumptions. First, it assumes that knowledge is the primary resource in modern economies and that innovation depends on the effective circulation and recombination of knowledge. Second, it posits that institutional boundaries are increasingly porous, allowing actors to adopt hybrid roles. Third, it emphasizes that innovation systems are evolutionary, shaped by historical trajectories and contextual factors.

Universities, within this framework, are no longer viewed solely as institutions of teaching and basic research. Instead, they are seen as entrepreneurial organizations that engage in applied research, technology transfer, and regional development. This transformation reflects broader changes in higher education governance and funding structures, as well as growing expectations from policymakers and industry.

Industry, in the Triple Helix model, is not merely a consumer of academic knowledge but an active participant in knowledge production. Firms collaborate with universities in joint research projects, contribute to curriculum design, and invest in human capital development. This interactive role challenges traditional distinctions between science and production.

The state occupies a central but evolving position within the Triple Helix. Rather than acting solely as a regulator, the state functions as a strategic coordinator, shaping incentives, funding mechanisms, and institutional frameworks. Importantly, the model does not prescribe a uniform role for the state; instead, it allows for variation depending on national context and development stage.

2.3 Critiques and Extensions of the Triple Helix Model

Despite its widespread adoption, the Triple Helix model has been subject to critique. Some scholars argue that it overemphasizes harmony and collaboration while underestimating power asymmetries and conflicts of interest. Others question its applicability in contexts where institutional capacity is weak or where universities lack autonomy.

In response to these critiques, researchers have proposed various extensions, such as the Quadruple Helix and Quintuple Helix models, which incorporate civil society and environmental sustainability. While these extensions broaden the analytical scope, they also raise questions about conceptual clarity and empirical applicability.

Within this debate, the South Korean case offers a valuable opportunity to assess the strengths and limitations of the original Triple Helix model (Fig.). South Korea’s experience demonstrates both the potential benefits of strong coordination and the risks associated with excessive centralization. As such, it provides a nuanced perspective that enriches theoretical discussions.

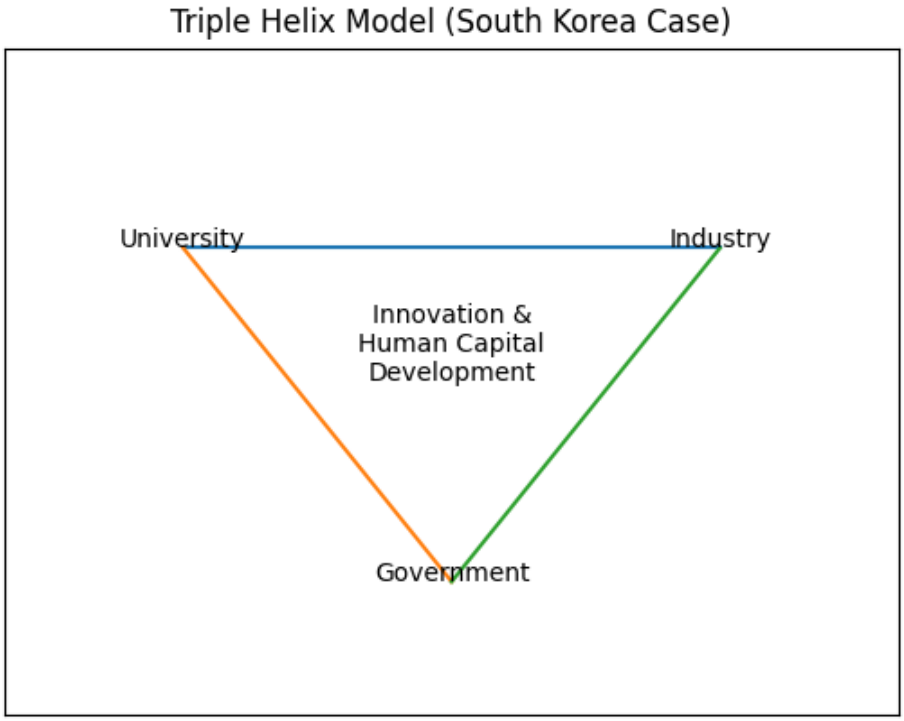


Figure 1. Triple Helix Model (South Korea Case)

2.4 The South Korean Context in the Literature

The literature on South Korea's innovation system frequently emphasizes the role of the developmental state, characterized by long-term planning, selective industrial policy, and close ties with large conglomerates. Higher education institutions played a crucial role in supplying skilled labor and conducting research aligned with national priorities.

Over time, however, South Korea's innovation system diversified, with increased emphasis on university autonomy, international collaboration, and entrepreneurship. This evolution aligns closely with the theoretical propositions of the Triple Helix model, making South Korea a compelling case for theoretical analysis rather than mere empirical illustration.

3. Methodology. This study adopts a qualitative and theoretical research design based on an extensive literature review [18-21].

This study adopts a qualitative and theory-oriented research design aimed at refining the conceptual understanding of the Triple Helix model through in-depth analysis of a national case. Rather than testing specific hypotheses, the research seeks to generate theoretical insights by synthesizing existing literature and interpreting institutional developments within South Korea's innovation system.

The primary method employed is a systematic review of academic literature on innovation systems, higher education policy, and state-led development, with particular attention to studies addressing the Triple Helix model and the South Korean context. Peer-reviewed journal articles, scholarly books, and policy-oriented analyses form the core of the data base.

In addition to academic sources, the study draws on policy documents, government reports, and institutional publications related to higher education reform, research and development policy, and industry–university collaboration in South Korea. These documents provide insight into governance mechanisms, strategic priorities, and institutional arrangements that shape Triple Helix interactions.

The analysis follows an interpretive approach, focusing on the evolution of institutional roles and relationships over time. By examining changes in policy orientation, organizational

structures, and collaboration mechanisms, the study identifies key patterns that inform the theoretical interpretation of the Triple Helix model.

This methodological approach is particularly suited to the objectives of the study, as it allows for contextualized and historically informed analysis. Rather than treating the Triple Helix as a static framework, the study emphasizes its dynamic and evolutionary character, consistent with contemporary theoretical perspectives on innovation systems.

5. Evolution of the Triple Helix Model in South Korea

South Korea's innovation system evolved from a state-led model to a network-based Triple Helix configuration [5].

The evolution of the Triple Helix model in South Korea reflects a gradual but profound transformation of institutional roles and interaction patterns within the national innovation system. This transformation did not occur spontaneously; rather, it was shaped by historical contingencies, strategic state intervention, and the adaptive capacities of universities and industry (Ahn, 1995). As such, South Korea offers a compelling example of how the Triple Helix configuration can evolve over time in response to changing developmental needs.

In the early stages of industrialization, particularly from the 1960s through the 1980s, South Korea's innovation system was characterized by a strong state-led model. The government played a central and directive role in defining national development priorities, allocating resources, and coordinating research and development activities. Industrial policy focused on targeted sectors such as heavy industry, electronics, and later information and communication technologies. During this period, universities primarily functioned as suppliers of skilled human capital rather than as autonomous research and innovation actors.

Despite the limited autonomy of universities in the early phase, the foundations for later Triple Helix interactions were gradually established. Significant public investment in higher education expanded the capacity of universities to conduct research and train scientists and engineers. Institutions such as the Korea Advanced Institute of Science and Technology (KAIST) and the Pohang University of Science and Technology (POSTECH) were created with explicit mandates to support national technological development. These universities represented early forms of hybrid institutions, combining academic research with close ties to industry and government.

From the 1990s onward, South Korea's innovation system underwent a significant reconfiguration. Economic liberalization, globalization, and the increasing complexity of technological innovation exposed the limitations of centralized control and hierarchical coordination. In response, the state gradually shifted from direct intervention toward a more facilitative and incentive-based approach. Competitive research funding, performance-based evaluation systems, and legal frameworks supporting technology transfer were introduced to stimulate collaboration between universities and industry.

Universities, in turn, expanded their institutional roles within the Triple Helix. Technology transfer offices, industry liaison units, and university-affiliated research centers became common features of the higher education landscape. Academic entrepreneurship gained legitimacy, and faculty members were increasingly encouraged to engage in applied research, patenting, and start-up formation. These developments signaled a transition from a teaching-oriented university model to an entrepreneurial university paradigm.

Industry–university collaboration also intensified during this period. Large industrial conglomerates, as well as small and medium-sized enterprises, increasingly relied on university research for technological upgrading and innovation. Collaborative research projects, joint laboratories, and internship programs facilitated knowledge exchange and human capital development. Importantly, these interactions were embedded within broader policy frameworks that aligned educational outcomes with industrial needs.

By the early 2000s, South Korea's innovation system exhibited many of the defining characteristics of a mature Triple Helix configuration. Institutional boundaries became more porous, hybrid organizations proliferated, and knowledge flows intensified across sectors. While the state retained a strategic role in setting long-term priorities and providing funding, innovation increasingly emerged from decentralized and network-based interactions among universities, industry, and government agencies.

6. Discussion and Theoretical Implications

The case confirms the flexibility and context-dependent nature of the Triple Helix model [1].

The South Korean case provides strong support for the central propositions of the Triple Helix model while also offering important qualifications. One of the key insights is that the effectiveness of Triple Helix interactions depends on the alignment between institutional roles and developmental objectives. In South Korea, the state's early dominance was instrumental in mobilizing resources and building foundational capacities. However, sustained innovation required a gradual shift toward institutional autonomy and network-based governance.

These finding challenges simplistic interpretations of the Triple Helix model that assume symmetrical relationships among actors from the outset. Instead, the South Korean experience suggests that asymmetry and hierarchy may play a productive role during certain stages of development, provided that they evolve over time. The model thus functions not as a static blueprint but as an adaptive framework that accommodates different configurations.

Another important insight concerns the role of universities as agents of structural transformation. In South Korea, universities did not merely respond to policy incentives; they actively reshaped their organizational identities and missions. The emergence of entrepreneurial universities reflects broader changes in academic norms, funding mechanisms, and societal expectations. This transformation underscores the importance of institutional learning and internal capacity-building within the Triple Helix framework.

At the same time, the case highlights potential tensions inherent in Triple Helix interactions. Performance pressures, commercialization incentives, and policy-driven evaluation systems can create conflicts between academic autonomy and economic objectives. Managing these tensions requires careful governance and continuous dialogue among stakeholders. South Korea's experience illustrates both the opportunities and challenges associated with balancing excellence, relevance, and inclusiveness in higher education.

7. Policy Implications. The findings offer policy insights for developing economies seeking innovation-driven growth.

From a theoretical perspective, the South Korean case contributes to the refinement of the Triple Helix model in several ways. First, it reinforces the notion that innovation systems are evolutionary and path-dependent. The configuration of the Triple Helix reflects historical trajectories and institutional legacies rather than universal principles. Second, it emphasizes the importance of temporal dynamics, suggesting that the roles of the state, industry, and universities change over time in response to developmental pressures.

The case also highlights the need to integrate governance and power relations more explicitly into Triple Helix theory. While the model emphasizes collaboration and synergy, the South Korean experience demonstrates that coordination often involves negotiation, contestation, and strategic compromise. Incorporating these dimensions can enhance the explanatory power of the framework.

From a policy standpoint, the findings offer several lessons for developing and transitional economies. Strong state coordination can be effective in the early stages of innovation system development, particularly when institutional capacities are weak. However, long-term success depends on fostering institutional autonomy, competition, and collaboration. Policies that support

knowledge exchange, academic entrepreneurship, and human capital development are essential components of a sustainable Triple Helix system.

Importantly, policy transfer should be approached with caution. Rather than replicating institutional arrangements wholesale, policymakers should adapt the underlying principles of the Triple Helix model to local contexts. This adaptive approach increases the likelihood of achieving meaningful and sustainable innovation outcomes.

8. Conclusion

The South Korean experience refines the theoretical understanding of the Triple Helix model [6].

This article has examined the theoretical foundations of the Triple Helix model through an in-depth analysis of South Korea's state-industry-university relations. The findings demonstrate that innovation-driven development is most effective when supported by dynamic, context-sensitive, and evolving interactions among key institutional actors.

The South Korean experience illustrates how a state-led system can transition toward a network-based Triple Helix configuration, enhancing knowledge circulation, institutional learning, and innovation capacity. From a theoretical perspective, the case underscores the importance of viewing the Triple Helix model as an evolutionary framework rather than a fixed institutional design.

By refining the conceptual understanding of the Triple Helix model, this study contributes to broader debates on innovation systems, higher education reform, and development policy. The insights derived from the South Korean case are particularly relevant for countries seeking to build innovation-driven economies through strategic coordination of education, research, and industry.

References

1. Etzkowitz, H. (2008). *The Triple Helix: University–Industry–Government Innovation in Action*. Routledge.
2. Uralov, O. S. (2020). Internationalization of higher education in Uzbekistan. Social Sciences & Humanities Open, 2(1), 100015.
3. Muratov B. and Wilkins S. (2024). The development of Uzbekistan as a transnational higher education hub: government and institution rationales, and early outcomes. Journal of Higher Education Policy and Management, 46(5), 523-541.
4. Ovezmyradov B. and Kepbanov Y. (2020). Comparative analysis of higher education and research in Central Asia from the perspective of internationalization. Central Asian Law: Legal Cultures, Governance and Business Environment in Central Asia, (25).
5. Ahn, S. I. (1995). A new program in cooperative research between academia and industry in Korea involving centers of excellence. *Technovation, 15*(4), 241–257. https://doi.org/10.1016/0166-4972(95)00005-K
6. Boachie, K. K., & Kwak, Y. (2024). Exploring the lived experiences of African international students in graduate education in Korea. *Innovation and Education, 6*(1), 30–57. https://doi.org/10.1186/s42862-024-00187-3
7. Cui, Z., & Li, E. (2022). Does industry–university–research cooperation matter? An analysis of its coupling effect on regional innovation and economic development. *Chinese Geographical Science, 32*(5), 915–930. https://doi.org/10.1007/s11769-022-1290-5
8. Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research Policy, 29*(2), 109–123. https://doi.org/10.1016/S0048-7333(99)00055-4
9. Eom, B. Y., & Lee, K. (2010). Determinants of industry–academy linkages and their impact on firm performance: The case of Korea as a latecomer in knowledge industrialization. *Research Policy, 39*(5), 625–639. https://doi.org/10.1016/j.respol.2010.01.015

10. Suh, Y., Woo, C., Koh, J., & Jeon, J. (2019). Analysing the satisfaction of university–industry cooperation efforts based on the Kano model: A Korean case. *Technological Forecasting and Social Change, 148*, 119740. https://doi.org/10.1016/j.techfore.2019.119740

11. Lee, D. H., Bae, Z. T., & Lee, J. (1991). Performance and adaptive roles of the government-supported research institute in South Korea. *World Development, 19*(10), 1421–1440. https://doi.org/10.1016/0305-750X(91)90086-E

12. Tukhtabayev, M. A. (2025). Public–private sector partnership in engineering manpower development in the South Korean education system. *Science, Research and Development, 3*(11), 96–100. https://doi.org/10.65322/j.srd.03112025.21

13. Kim, J. (2024). Why do teachers not change while the national curriculum repeatedly changes? The "hidden" resistance of teachers in the centralized education system of South Korea. *International Journal of Educational Development, 109*, 103105. https://doi.org/10.1016/j.ijedudev.2024.103105

14. Kwon, Y. (2011). The developmental history of labor education in South Korea from a sociopolitical and economic perspective. *International Journal of Educational Development, 31*(5), 524–531. https://doi.org/10.1016/j.ijedudev.2010.12.002

15. Lee, H. C., & Hwang, S. J. (2025). Occupational class and income stratification in South Korea, 1998–2022. *Research in Social Stratification and Mobility, 89*, 101087. https://doi.org/10.1016/j.rssm.2025.101087

16. Yun, J. J., Zhao, X., Koo, I., Sadoi, Y., & Pyka, A. (2025). Open innovation and digital transformation in the automotive industry: A comparative analysis of South Korea, Japan, and Germany. *European Journal of Innovation Management*. https://doi.org/10.1108/EJIM-01-2024-0039

17. Tukhtabayev, M. A. (2025). Opportunities for Uzbekistan to introduce industrial and educational cooperation based on the experience of South Korea. *Science, Research and Development, 2*(10), 87–91. https://doi.org/10.65322/j.srd.02102025.18

18. Tukhtabayev, M. (2025). The role of public policy in managing the integration between industry and education: the case of South Korea. Science, research and development. 5(13), 342-346. doi.org/10.65322/j.srd.05132025.58

19. Boachie, K. K. and Kwak, Y. (2024). Exploring the Lived Experiences of African International Students in Graduate Education in Korea. Innovation and Education, 6(1), 30-57.

20. Leal Filho, W., Dinis, M. A. P., Sivapalan, S., Begum, H., Ng, T. F., Al-Amin, A. Q., ... and Neiva, S. (2022). Sustainability practices at higher education institutions in Asia. International Journal of Sustainability in Higher Education, 23(6), 1250-1276.

21. Kwon, Y. (2011). The developmental history of labor education in South Korea from a sociopolitical and economic perspective. International Journal of Educational Development, 31(5), 524-531.