Korea Journal, vol. 63, no. 3 (Autumn 2023): 170–200.
doi: 10.25024/kj.2023.63.3.170

A Policy Text Created from History:
Choi Hyung Sup's Theory of Scientific and Technological Development Applicable to Developing Countries

Manyong MOON

Abstract

Choi Hyung Sup's Gaebaldosangguk-ui gwahak gisul gaebal jeollyak *(Development Strategies for Science and Technology in Developing Countries) trilogy is a seminal work covering science and technology policy studies in Korea, though it is not often evaluated as such, instead usually being treated as a history. This paper will describe the background and intended meaning of his publication through an examination of the Choi Hyung Sup Archives at Jeonbuk National University and a review of the English-language version of Development Strategies. Based on Korean history of the 1960s and 1970s, Choi's text reflects his experiences at KIST. Writing for an international audience, Choi does not mention any of the significant policy changes that occurred in the 1980s (when the work was published in English), such as the reorganization of Korea's government-funded research institutes and the establishment of a national R&D program. I also examine how Choi's ideas are distinct from those of contemporaneous non-Korean scholars who also wrote on the area. Finally, I discuss the present value of the framework Choi articulated in these volumes by tracing how the work is currently utilized in Korea's official development assistance efforts.*

Keywords: Choi Hyung Sup, science and technology policy, developing countries, KIST, *Gaebaldosangguk-ui gwahak gisul gaebal jeollyak*

I am very grateful to the anonymous reviewers for their critical comments.

Manyong MOON is an associate professor at the Korean Research Institute of Science, Technology and Civilization at Jeonbuk National University. E-mail: mymoon@jbnu.ac.kr.

Introduction

The economist Robert Wade, who studied the processes of industrialization in East Asia, found the books of Friedrich List, which present a theory of protective trade applicable to latecomer nations, filled the bookshelves of college bookshops in Seoul when he was teaching in South Korea (hereafter, Korea) in 1979. Upon transferring to MIT, however, he discovered that List's representative work, only one book of which was housed in the university's library, and this had last been checked out in 1966 (Wade [1990] 2004, xlvi). This shows that economic policies suitable for nations at different stages of stages differ considerably from one another. This in turn implies that science and technology (S&T) policies appropriate for developing countries and developed countries likewise should differ from each other. Interestingly, List's books are among the oldest works to be frequently referenced in research concerning science innovation policy. Christopher Freeman, who developed the concept of the national innovation systems (NIS) to explain Japan's economic growth, has presented, as the origin of NIS, the "national system of political economy" used by List while explicating how Germany caught up with the UK (Martin 2012).

In fact, while the role of S&T for national development is important for advanced and developing countries alike, it is difficult for latecomer countries to apply previously successful models wholesale due to their vastly different socioeconomic conditions. This was the view of Choi Hyung Sup, the first president of KIST (Korea Institute of Science and Technology), as well as the second minister of science of technology. While developing nations could develop methodologies with less trial and error by referencing advanced nations' experiences, it was as a practical matter impossible to recreate the precise path those advanced nations had followed. Consequently, Choi published in 1980 and 1981 a three-volume work entitled *Gaebaldosangguk-ui gwahak gisul gaebal jeollyak* (Development Strategies for Science and Technology in Developing Countries. Hereafter, *Development Strategies*) which summarized Korea's experiences and his own ideas concerning how developing countries could develop S&T.

> …science and technology play a different role in developing [countries] than they do in developed countries. And this difference ultimately stems from the relatively disadvantageous position of the developing countries due, externally, to their dependence on the technology of the advanced countries and, internally, to the various problems rooted in their economic and social backwardness which are characteristic of them. (Choi Hyung Sup 1983, 20)

This quote explains the background to the publication of these books. A recent report on innovation policy in developing countries also argues that because developing countries lack high levels of investment, the appropriate policy model for innovation is different from that of developed countries, in which research and development (R&D) is prioritized (Cirera and Maloney 2017).

Since becoming a full member nation of the Development Assistance Committee (DAC) within the OECD in 2010, Korea has been the only country to successfully switch from aid recipient to aid donor. Korea's official development assistance (ODA) projects have likewise become more active, and development in S&T has proceeded as well. Developing countries have shown an interest in Korea's compressed scientific and technological development process. Choi's S&T policy applicable to developing countries announced in the 1980s still serves as a useful reference. In fact, a historian of science sharing the same name, Choi Hyungsup, and co-author Im Jae Yoon, have argued that despite the passage of more than 30 years since the publication of *Development Strategies*, Korea's S&T ODA to developing nations remains unable to transcend the explanatory framework set forth in this text (Im and Choi 2017). More positively, however, this suggests that the articulations of S&T policy for developing countries provided by Choi are valid even today, and that analysis of his work is still necessary.

Despite their importance, Choi's books are not recognized as science policy work by scholars in Korea. In 2018, an attempt was made to reexamine the state of S&T policy studies in the nation and suggest a revised research scope for the discipline (Yi et al. 2018). Though diverse terms such as "science policy," "technology policy," and "industry policy" were used

depending on the period and the researcher, it was noted that a gradual convergence on "science, technology and innovation policy" or "STI policy" was occurring. Because the policy emphasizes different points depending on a nation's conditions, it is difficult to formulate a S&T policy studies applicable to all societies. Consequently, even abroad, single-volume works foregrounding S&T policy studies are rare. While many works in the social sciences written by authors overseas are translated within Korea, translations in the field of S&T policy are very rare, though the publication of domestic books is comparatively active. Against this background, three science policy researchers investigated a total of nineteen single-volume works related to S&T policy published in Korea since the 1980s. They analyzed these monographs, ranging from *Gisul hyeoksin-ui gwajeong-gwa jeongchaek* (Process and Policy of Technological Innovation, 1982) by Kim Linsu and Lee Jinjoo to Hong Heung-deug's *Gwahak gisul jeongchaengnon* (Science and Technology Policy, 2016), and categorized these various studies into policy perspectives, technology innovation, and technology management and economics. Intriguingly, this review did not include Choi's three-volume *Development Strategies*.

Of course, the aforementioned review was not exhaustive. The authors excluded such works as *Hanguk-ui gukga hyeoksin cheje* (Korean National Innovation System, 1998), published by STEPI, a research institute specializing in S&T policy, and Park Kyung-jin's *Gwahak gisul jeongchaeng-non* (Policy for Science and Technology, 2008) (recognized in 2008 as an excellent academic book by the Ministry of Culture, Sports, and Tourism), as well as works by technological economists on the phenomenon of technology catch-up. Interestingly, the books excluded from the analysis, including *Development Strategies*, are characterized by their emphasis on Korea's experiences, as opposed to generalized discussions of S&T policies. It has been suggested that that study excluded those works as amounting to histories or memoirs summarizing the development of modern technology in Korea, rather than the development of S&T policy. One of the authors of that study, Yi Chan-Goo, has argued elsewhere that "in policy research, where it is necessary to simultaneously analyze present state and explore policy alternatives, theory-based research has become one of the ways to

increase the likelihood of securing coherence and systematicity in the development of logic" (Yi et al. 2022, 201). This suggests that *Development Strategies*, which is based on history, was considered weak as a policy text.

However, most Korean historians of science do not view Choi's books as history texts. Kang Mi Hwa, a historian who has analyzed *Development Strategies*, has argued that these volumes highlight Choi Hyung Sup's acumen as an S&T policy theorist (Kang 2006). If so, for what purposes did Choi pen these volumes and what meanings did he assign to them? How do S&T policies for developing countries differ from those for advanced countries? Based on the Choi Hyung Sup Archives at Jeonbuk National University and the English translation of *Development Strategies*, this paper will attempt to determine the background and meaning of this publication. The contents of *Development Strategies* trilogy have been analyzed in detail by Kang Mi Hwa (2006), and Im Jae Yoon and Choi Hyungsup have argued that Choi's theory of S&T policy did not simply theorize Korea's experiences, but rather occurred within the context of broader discussions concerning the S&T policies of developing nations in the international community at the time (Im and Choi 2017). Im and Choi's work focuses on a comparison of Choi and Yelavarthy Nayudamma's views on S&T policies in developing countries. In contrast, here I focus on the process leading up to Choi's presentation of his theory of S&T development for developing countries, and seek to demonstrate that his theory of policy was an extension of his experiences at KIST and was written for an audience of overseas readers. *Development Strategies* makes no mention of the changed situation in the 1980s, when the volumes were published in English. I will also discuss in what respects the S&T policy strategies for developing nations that he presented can be distinguished from those of Michael J. Moravcsik. Lastly, I will trace how Choi's initiative is currently practiced in Korea's S&T ODA, and show that *Development Strategies* is not just history, but remains a valuable source for policy formulation in developing countries.

S&T Policies for Developing Countries by the "Minister of KIST"

Even in the West, it was only during the latter half of the 1950s that research on S&T policy began in earnest. Prior to the 1960s, during which time a linear model of science as a driver of technology and innovation was dominant, science policy (emphasis on *science* in a narrow sense) was effectively research policy (Martin 2012). The 1960s saw a search for S&T policies applicable to developing countries that would allow them to embrace advanced technology and induce socioeconomic development. The UN Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, held in Geneva in February 1963, discussed those S&T policies applicable to latecomer countries through the presentation of over two thousand academic papers. This event was attended by five figures from Korea, including Won Tae-sang, a Seoul National University professor and a civil engineer, and Chun Sang Keun, the head of the Bureau of Technology Management in the EPB (Economic Planning Board), who was responsible for the Korea's S&T policies (Won 1963). The results of this general assembly were published in eight volumes of reports, the seventh of which addressed suitable technology policies and the question of specific planning across various industries under the title of *Science and Planning* (United Nations 1963). During this conference, Ignacy Malecki presented the problems faced and tasks to be resolved by scientific research organs in developing countries on the basis of his years of work as the head of the Institute of the Polish Academy of Sciences (Malecki 1963). In addition, Yvan de Hemptinne, a biochemist representative of the Research Organization Unit of the UNESCO, discussed appropriate science policies needed by developing nations (de Hemptinne 1963). Each of their presentations argued that science must be used to accomplish important tasks for national development in order to enhance economic and social welfare.

Starting with the inception of the Bureau of Technology Management within the EPB in 1962, Korea likewise began to establish S&T policies, such as the mandated aggregation of statistics related to S&T. As the director of the AERI (Atomic Energy Research Institute), and consistent with his

personal interests, Choi participated in international meetings and academic conferences, deepening his knowledge regarding S&T policy and research institution management (Im and Choi 2017). Choi's opinions were also influenced by his long career in industry, and at universities, government ministries, and research institutions, and as an active leader of a new generation of scientists and engineers that had completed their studies in the United States. Upon his appointment as the first president of the KIST in 1966, Choi strived to establish firm roots for the research institution, and his success in this endeavor was recognized by his appointment in June 1971 to the position of minister of science and technology. As the longest-serving minister (seven years and six months) in the nation's constitutional history, he laid the foundations for the national policy of S&T development. As the minister-cum-chairman of the Korea Science and Engineering Foundation, Choi had acquired direct experience supporting university R&D efforts. Following his retirement, Choi went on to advise concerning science policy through tours of diverse developing nations in Asia, Latin America, and Africa, referencing his own theories of S&T policy (Editor 2010).

Historian Choi Hyungsup lamented that while the former minister had left behind several memoirs and other works that recorded his experiences, this paradoxically had prevented a full understanding by reinforcing his image as "Choi Hyung Sup, the eternal Minister of Science and Technology" (Hyungsup Choi 2023). However, until new sources are unearthed, we can only approach Choi's thought and life step by step through existing materials and interviews. This paper reflects one such attempt to do so.

While overseeing S&T in Korea, Choi began systemizing both Korea's experiences and his own ideas. He summarized and presented the nation's experiences at international meetings and academic conferences, and his presentations were subsequently included in monographs. Though he primarily discussed the establishment and management of KIST while he served as its president, after being appointed minister, he pivoted to discussions of the country's industrial and S&T policy. Based on Korea's industrialization, his writings reflected attempts to uncover general strategies applicable to all developing countries. His presentations stressed the importance of intermediary research organs, like KIST, that could introduce

and domestically disseminate Western technology.

Indeed, KIST was the impetus for Choi's earnest attempt to articulate his theory of S&T policy. From 1973, he summarized his perspective of the processes of founding and managing KIST in a single-volume work titled *Gaebaldosangguk-ui gongeop yeongu* (Industrial Research in the Less-Developed Countries). This work was published in 1976. Covering the establishment of industrial research organs abroad and addressing the foundation, research, and administrative management at KIST, as well as the contributions of that institute to Korea's industrialization and its future development, this book is Choi's first work covering research management policy. Though the work deals exclusively with KIST, he presented it as a general model that developing nations could refer to. According to this text, developing countries should embrace the accumulation of technology from advanced countries while avoiding their failures as much as possible. They should strive to bridge the gap with advanced nations within a short time by establishing research institutions directly related to the industries sought to be developed. The duties of these organs should not be limited to research but should encompass all technological and economic services needed to develop these industries within the country and disseminate the results of their research in order to pave a shortcut to industrial development. Alternatively, these duties could be performed by research institutions independently, or on a contract basis in partnership with the government. His conclusion was that Korea industrialized thanks to such industrial research organs (of which KIST was one example).

KIST was, from this perspective, a pivotal institution in Choi's framework, and many of his policies as minister had their roots in KIST. He established government-funded research institutes (GRIs) in each field, modeled after KIST, and created Daedeok Science Town for GRIs. These new institutes were staffed by KIST alumni, and KIST was prioritized to receive governmental funding for national R&D projects. In doing so, KIST was transformed from a contract research institute to an organization that performed national tasks, a model that was extended to other GRIs after Choi left the ministry. Choi was sometimes referred to as "minister of KIST, not minister of MOST (Ministry of Science and Technology)" during his

tenure (Kang 1974). As this criticism highlights, KIST was essential to Choi's views, and was relied on as a foundation from which the rest of his policy schemes proceeded.

Immediately after publishing *Industrial Research in the Less-Developed Countries*, Choi sought to publish an English translation of this book through Im Yong-gyu, the chief of the Bureau of Cooperation within MOST. Im sent a letter stating that the publication of an English translation would require a text approximately twice as long and richer content. Donald D. Evans, a former resident officer from KIST's sister research institute, the Battelle Memorial Institute, and Lee Chong-Ouk, a scientist returning to Korea after working for AT&T in the US, responded positively to the idea of an English translation.[1] Embracing their positive feedback, Choi published a series of papers on industrial technology and S&T strategies in developing nations in the *Journal of the Korean Operations Research Society* and the *Journal of the Korean Nuclear Society*, then gathered and published these in 1980 and 1981 as a trilogy under the title *Development Strategies*. His theory of S&T policy applicable to developing nations began from systematization regarding KIST.

In the preface to *Development Strategies* Choi explains that "In this work, I have not attempted to make a theoretical or systematic exposition of a science and technology development strategy for developing countries. Rather, I have tried to describe the approach we took in Korea given the background and conditions we confronted in the late 1950s and early 1960s with the emphasis on how we actually went about implementing the projects planned. I have recorded, therefore, the lessons we learned from our experiences in the form of a kind of memoir" (Choi Hyung Sup 1983, vii). Unlike the numerous other memoirs Choi left, however, *Development Strategies* is an academic text with a list of references attached to each chapter.

Development Strategies, Part 1 elucidates a general theory concerning

1. Letters sent to the Minister of Science and Technology, document box 33, Choi Hyung Sup Archives, Jeonbuk National University: Im Yong-gyu (September 9, 1976); Donald Evans (September 24, 1976); Lee Chong-Ouk (November 16, 1976).

the direction of development and constructs a basis for the indigenization of S&T. Translated by Lee Chong-Ouk, this was published by the Asian Productivity Organization (APO) in Japan under the title *Bases for Science and Technology Promotion in Developing Countries* (1983). In explaining the direction of part 1, Choi begins by explaining how Korea had no choice but to implement a dual strategy of pursuing both light industry-centered industries to substitute for the import of consumer goods in conjunction with export-oriented industrialization and that, consequently, technological development policy was a critical component that determined success or failure in economic development. To reinforce this, he introduced general information concerning the S&T policy of other advanced nations and their technological development strategies, before describing Korea's industrial process and development strategies. He also describes in greater detail some elements that played important roles in these processes, including practices of international technological cooperation and S&T workforce development.

Dealing with the issue of industrial technology necessary for economic development, *Development Strategies, Part 2* was translated by Mok Young Il and published, again by the APO, under the title *Technology Development in Developing Countries* (1986). Containing what would later be recognized as the most crucial discussions in the trilogy, this volume attracted considerable interest abroad and was translated into Chinese and Persian as well. Part 2 concentrates on the development of specific industrial technologies. According to Choi, a focus on industrial technology development was a critical component of S&T policies. He introduces the idea of GRIs, such as KIST, and the construction of the Daedeok Science Town, to mediate industrial technologies and also addresses corporate R&D, technology introduction policies, and fostering engineering industry, resource development, agriculture, and community development.

Development Strategies, Part 3 presents S&T development plans that developing nations should prepare if they are to achieve a highly advanced industrial society in the future. Translated by scientists including Park T. J., this book was published by the UN ESCAP, a UN organ, as *Springboard Measures for Becoming Highly Industrialized Society* (1989). Part 3 presents the issue of creating a S&T climate, along with basic sciences, information

industry, and technological development strategies related to energy, environment, and welfare societies that are necessary for achieving an advanced industrial society. Choi emphasizes the importance of the information industry, referencing the Bureau of Information Industry that was created during his time as minister. Notably, Korea subsequently established itself as an IT powerhouse with the development of information and communications technology.

The Korean and English versions did not differ in meaningful ways, though the latter somewhat abridged specific discussions that were more complete in the Korean original. A concluding chapter absent from the Korean editions was added to both parts 1 and 2, and each volume had its own title to make the discussion complete as a single-volume work. That these works were published not as *A History of Science and Technology Policy in Korea* but as *Development Strategies* suggests that Choi aimed at a general theory of policy for developing nations, as opposed to a memoir concerning Korea's experiences. The Korean version was titled *Development Strategies for Science and Technology in Developing Countries*, while the English titles emphasized *Technology Development* and *Industrialization*, suggesting that the trilogy was related to his earlier monograph covering KIST, *Industrial Research in the Less-Developed Countries* (1976), and suggested to his readership that the purpose of S&T development should be industrialization.

In 1984 the director of the RCTT (Regional Centre for Technology Transfer) under the UNESCAP, M. Nawaz Sharif, requested that Choi to participate in the creation of a country report. The idea was to draw up a country report covering technology policies and plans for Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, and Korea, and ultimately draft a regional report. Though he showed interest in advising the RCTT, Choi was lukewarm toward the idea of participating in the creation of country reports. Though he expressed concern at the impossibility of securing suitable personnel to take charge of the task, in actuality he felt that his own book already held an adequate explanation of the Korean case. Indeed, the specific outline of a country report sent by the RCTT held in the Choi Hyung Sup archive includes a detailed table of

contents, which has marked references to chapters from his own work.[2] This implies that, in Choi's view, a further Korean report was unnecessary as he had already amply summarized Korea's case. He no doubt also felt it was somewhat inappropriate for Korea to be lumped in with these nations intended to be covered by country reports, as Korea had already reached a considerable level of development. Indeed, out of the nations listed, he had provided or would provide science policy advice to Thailand, Sri Lanka, Pakistan, and Bangladesh. At the time, Choi was busy translating his books into English. Ultimately, he had no reason to accept the RCTT's offer.

These books established Choi as a theorist systemizing S&T policy. Of his over 50 years spent as a researcher, the first half consisted mainly of basic or applied research in the field of metallurgy, while the latter half was spent researching management, science policy, and investigating strategic fields related to technological development. In other words, on the basis of his experiences as president of KIST, and as a minister in the Korean government, he sought to describe a model of technological development applicable to developing nations. Because these discussions were based not only on theory but on actual accomplishments, his model attracted the interest of many developing countries.

Policy Text vs. History Text

Across all three volumes of *Development Strategies*, Choi addressed most of the major issues associated with S&T policy. Yi et al. (2018) have described the four research focuses of STI policy as (1) macroscopic S&T policy process, (2) middle-level public management of S&T, (3) microscopic research management, and (4) technological innovation. Choi's work situates macroscopic S&T policy in the center, focusing less on the management of research institutions and corporate technological development. Since his experience was rooted in his time at KIST, he focused on the operation of research institutes. However, as the micro-level

2. Country Report file 19-4, document box 19, Choi Hyung Sup Archives.

administrative management of the institute, such as personnel, finance, and material management, was covered in the monograph on KIST, *Development Strategies* only dealt with the establishment and initial operation of GRIs.

We can understand the differences in the works by comparing *Development Strategies* and Choi Seok Sik's *Gwahak gisul jeongchaengnon* (Science and Technology Policy Theory, 2011) which is included in the 19 books analyzed by Yi et al. Choi Seok Sik is a former vice-minister of science and technology, and his book also reflects his experiences. *Gwahak gisul jeongchaengnon* is organized such that it covers the following: significance and agenda of S&T policy, strengthening S&T inputs (investment, manpower, information, infrastructure), efficiency of S&T activities (national defense, national R&D programs, international cooperation), strengthening S&T outputs (commercialization, security), working with people (safety, community development), and S&T policy system (administration, law, publicity). A general discussion of each topic is presented first, after which the specific situation of Korea with its associated systems, institutions, and projects is covered. The topics and methods covered in *Gwahak gisul jeongchaengnon* do not differ much from those covered in *Development Strategies*. However, *Development Strategies* hardly discusses national defense, S&T investment, and national R&D programs in detail.

Despite its importance in the 1970, defense-related R&D, including the development of nuclear weapons, was not covered because this was considered sensitive information.[3] Choi Hyung Sup, then minister of science and technology, was at this time the center of controversy over the introduction of nuclear fuel reprocessing technology. Until the 1970s, the S&T budget was not discussed separately because the government's large-scale investments in infrastructure, such as establishing GRIs and building a science town, were considered more important than recurring R&D funding. These infrastructure investments were generally determined by the

3. Kim Chung-yum, who served as the president's chief of staff for more than nine years in the 1970s, made no mention at all of the nuclear projects, stating that they were "an eternal top secret of the state" (Rhyu 2022, 67).

government's political judgment. Instead, Choi describes in detail the Technological Development Reserves and financial intermediaries necessary for corporate R&D.

That *Development Strategies* does not address national R&D programs is a testament to the book's time. Although the third part of this text was translated and published in 1989, its content generally remains rooted in the concerns of the 1970s. In short, circumstantial changes after the completion of the original Korean manuscript are not faithfully reflected in the text. The national R&D program, first initiated by MOST in 1982, was the most important policy and distinguished the S&T policies of the 1980s from its predecessors, and since spread to other ministries and to become a cornerstone of Korea's S&T policy (Yoo 2020). That Choi does not mention this at all in his work suggests that he was indifferent to the new policies, and that his targeted readership was not in Korea.

In addition, GRIs were merged or abolished in Korea in 1980. KIST no longer existed, with only the merged KAIST remaining. However, in his triology, Choi refers only to KIST and makes no reference to subsequent developments.[4] This is consistent with his treatment of other GRIs subjected to merger and abolishment. Of course, KIST and other GRIs are the centerpiece of the book's thesis, so it would have weakened his argument to describe this reconstruction.

In Korea, government investment in R&D surpassed that of the civilian sector until the 1970s, but this situation reversed in the early 1980s. This decade also witnessed significant increases in the number of independent research centers established by corporations. Choi was skeptical of these developments: he thought it was questionable whether this trend could be maintained. While Choi's work thus generally and competently explains the overall process of growth of S&T in the 1970s, to its detriment it ignores the 1980s, an era of dramatic changes that included heightened protectionism and import regulation.

4. In 1989, KIST and KAIST were re-separated, an arrangement that continues to this day, with the former as a research center and the latter as a university specializing in science and engineering.

Perhaps Choi's text addresses only the period up to the 1970s and does not reflect subsequent changes because it was penned with publication for an international audience in mind from the beginning. Though Choi's accounts of Korea's experiences might make his text read like a *memoir* to most Koreans, it could nevertheless serve as a useful theoretical text for a readership in developing countries interested in devising policies to immediately boost S&T. *Development Strategies* would have been considered by current STI policy scholars as a history text that summarized Korea's experience rather than as a policy text articulating a general theory of S&T policy.

Choi acknowledged that no universal model commonly adoptable by all developing countries could exist, and emphasized that Korea's experiences likewise did not reflect imitation of a single Western nation. He stressed on numerous occasions that even the example set by Japan, which is widely considered to have influenced Korea's economy and S&T policies considerably, was inappropriate for Korea. Japan adopted a strategy of industrial development that included the introduction, assimilation, and improvement of advanced imported technology, and Korea adopted a similar approach. Choi saw the Japanese model as difficult to follow for Korea, however, as Japan brought about industrial growth and technological development through the expansion of scale. What Choi had in mind instead as the most appropriate models for Korea were the small but strong nations of Europe. In other words, he emphasized that one must strive to achieve creative development by taking following the policies that prompted the development of small but top-type specialized industries in countries such as Switzerland, Belgium, the Netherlands, Denmark, and Sweden. He nevertheless allowed a role for Japan's improvement-of-engineering type. In order to devise and execute these policies, Choi's argument ran, methods of selecting and effectively assimilating and absorbing technologies appropriate for each nation represented an important component of each nation's strategy, and research centers were critical to the development of this component.

Intriguingly, in the conclusion to part 3 of this series, Choi explains that "the excessive attachment of weight given to the enlargement of facility

investment rather than technology, under the support of the government, caused a weakness in the industrial structure according to the unbalance between each field of industry, thus weakening our international competitive power" (Choi Hyung Sup 1989, 225). In other words, Korea's economy had not yet been removed from the stage of mere external growth without substantiality. Consequently, he reiterates that S&T in Korea must follow the example of small but advanced type of technology-intensive industry, as in European nations, and forego Japan's method of inducing growth through investment intended to expand scale.

In reality, since the 1980s the growth trajectory of S&T in Korea has paralleled that of the economy. As of 2023, S&T policies in Korea do not differ much in their characteristics of the nation's economy from those pointed out by Choi. In other words, he also criticizes S&T as being relatively slow to develop qualitatively because it has been pursuing quantitative growth under government protection. Consequently, the country's S&T has been described as a "Korean R&D paradox," in which a deficit in the technological trade balance increases despite increases in investment (Ma et al. 2022). This situation means that the strategies for S&T development that Choi presents (i.e., modeled on European nations) failed to be adopted in Korea in the 1980s. In fact, the R&D paradox is a feature of many European economies as well, including that of Sweden (Cirera and Maloney 2017). Even Sweden, which Choi considered a model for Korea, ranked first and second in the world in R&D investment as a percentage of GDP in the 1990s (Ejermo and Kander 2006). Korea has performed similarly since the 2010s. The situation in Sweden and Korea shows that the reality of STI policies is much more complicated than what Choi describes, and suggests how complicated it is to translate large R&D investments into economic growth. Currently, Korea is transitioning to a post-catch-up level and is not yet performing well enough as a first mover. Choi's books, which deal only with the catch-up period, are therefore regarded as only of historical relevance to science policy scholars who are preoccupied with Korea's current situation.

Relevant Research vs. Basic Research

The basic idea articulated in *Development Strategies* is that S&T must contribute to national development:

> This is essential in selecting the technological development strategy of a developing country, because the primary purpose of scientific and technological development is to contribute to the nation's economic growth and the improvement of national welfare. The development directions and strategies for science and technology must be selected as an integral part of the nation's economic and social development plan. (Choi Hyung Sup 1983, 234)

As a general rule, plans for developing S&T and ideas as to how use them to foster social and economic development are both part of STI policies. However, of the two, Choi emphasizes S&T's contribution to national development. He also argues that because the socioeconomic development of latecomer countries is reflected in measures of industrialization, direct R&D must prioritize the development of industrial technologies. A representative case demonstrating this is KAIS (Korea Advanced Institute of Science), a mission-oriented postgraduate S&T institution. KAIS, which began to recruit students in 1973, grew into a science and engineering graduate school of the highest caliber thanks to the efforts of its outstanding faculty and its focus on providing students with special benefits, including special exceptions from compulsory military service for male students, dormitories, and scholarships. KAIS attracted the most talented candidates and led the way in graduate education in science and engineering at the time.

Interestingly, Choi emphasizes that KAIS must become a "center of relevance" for the development of the national economy, not a "center of excellence" or ivory tower removed from society (Choi Hyung Sup 1983, 241–242). Of course, this was not entirely his idea alone, but rather reflects the orientation of the so-called Terman Report, which served as an important guiding document during the establishment of KAIS. This

argument, in line with the idea that a high-level scientific and engineering workforce needed by the Korean industries and R&D sector had to be fostered, was an idea emphasized by Frederick Terman (Kim and Leslie 1998). Taking this idea one step further, Choi viewed the unconsidered adherence to the idea of establishing "center of excellence" as a serious deficit in the S&T policies of many developing nations (Choi Hyung Sup 1975). In his view, this concept, while helping to spread talent, could not act as the breeder of talent needed by a given society. According to Choi's thinking, more important than a single organ with outstanding abilities was an organ that could disseminate the effects and value of R&D activities, including basic test analysis, and foster research capacity right up to the point that it reached a critical mass. To pursue his idea in KAIS, upon becoming minister, Choi appointed Joseph D. Park the second president of KAIS. Park was a joint developer of chlorofluorocarbons (CFCs) and a chemistry professor at the University of Colorado. Though Park was a Korean-American not even proficient in Korean, he offered a wealth of experience relevant to the industrialization of R&D, which was lacking in Korea at the time and fit well with Choi's philosophy of contributing to economic development through research into industrial technology. Park agreed wholeheartedly with the minister's idea and prioritized the development of scientists and engineers in areas of applied science where Korea was lacking, and he maintained this principle in his selection of KAIS faculty.[5]

Choi's philosophy can be contrasted with that of Michael J. Moravcsik, an American physicist with considerable interest in Third World science policy. Born in Hungary, Moravcsik served as a professor of theoretical high- and intermediate-energy physics at the University of Oregon from 1967 and also researched science policy and development. While serving on the Atomic Energy Commission within the Atomic Energy Center of

5. Included in the Choi Hyung Sup Archives at Jeonbuk National University (document box 20), Park's letter dated November 1971 contains his evaluation of KAIS faculty candidates. He placed the greatest weight on whether or not a candidate's research field or career was suited to Korea's situation at the time, assessing that it would be premature to hire some candidates, though they were outstanding researchers.

Pakistan during 1962–1963 as an IAEA visiting professor, he took an interest in in the issue of science policy and scientific development in the Third World, eventually researching both physics and science policy at the University of Sussex during 1975–1976. He subsequently visited research institutes and universities in Thailand, Pakistan, Indonesia, Sri Lanka, Bangladesh, and Nepal, advising each on their respective science policies. Moravcsik's theory of science policy was highly esteemed by the Ford Foundation, UNESCO, the UN Commission on Science and Technology for Development, and USAID (Goldstein 1990).

In a monograph on scientific development in developing nations published in 1975, Moravcsik explained that his was practically the first book on scientific development within developing countries and that his reasons for drafting the book included the regrettable reality that science was too often disregarded in these nations. Asserting that education was the most important aspect of science, the volume addressed the issue of science education first. He subsequently considered issues including the workforce, science communication, scientific research, planning, policy and management, and international aspects. In particular, at the end, the book criticized how, in authoritarian nations, science had to serve the ruling ideology and therefore was often controlled by politicians, and bemoaned how certain scientists blurred the boundary between politics and policy in science (Moravcsik 1975, 142). According to Moravcsik, scientists in developing countries must realize they were more effective in their roles when they devoted themselves to scientific development alone, rather than politics, and he suggested they were liable to lose at both if they were pursued together. However, scientists in Korea understood that, for scientific development to occur, closeness to politicians was inevitable. Though these scientists were not engaged in politics, they understood well that they must link the interests of politicians to their own scientific activities (Kim 2018). Indeed, Choi, mentioning a paper by Stevan Dedijer, stated that the speed of the promotion of S&T could be increased in latecomer countries, by appealing to the interests and drawing on the will of the leadership.

Moravcsik mentions Korea several times in his 1975 book, expressing dissatisfaction that KAIS had become a technological training center.

Voicing disappointment with the institute's failure to fulfill the expectations it would become the KIST's scientific counterpart, he complains that while the KAIS is often regarded as Korea's MIT, MIT is a research organ oriented around science education, while the KAIS plays the role of technological training center despite its lack of technology (Moravcsik 1975, 210). In fact, KAIS had recently initiated education at the time Moravcsik's book was published, and it gradually evolved to stress excellence in education and research through the 1980s.

Moravcsik's science policy was characterized by his argument that basic research, instead of relevant research, must be reinforced. According to him, there were two possible approaches to scientific development in developing countries. One approach emphasized supporting technological activities that benefit the economy as the goals of science in the context of short-term economic growth. The other considered the goals and benefits of science in a broader, long-term context. In his judgment the Third World had focused on the former over the past 40 years, and therefore failed to achieve necessary scientific development.

> There is no special "Western science" or "Third World science," and no "communist science" or "capitalist science," and no "Muslim science" or "Christian science," and no "white science" or "black science." There is only one science, which all of us work on. There may be differences in detail in the practice of science in various institutions around the world, just as there are also such differences among institutions within the scientifically advanced world. These are, however, quite minor compared to the unifying features that tie together all science around the world. (Moravcsik 1986, 8)

In Moravcsik's view, the fact that only a single science existed, and that technology transfer required a certain degree of scientific literacy, universal scientific knowledge was the top priority. Consequently, his work focused on ways of evaluating the growth of science, devoting considerable research also to scientometrics and the science of science. Choi also did not believe there was a separate science for developing countries, but rather that these

countries should prioritize the development of relevant science in a different manner than developed countries.

Perhaps because Choi's perspective was so different than that of Moravcsik, Choi never referenced the former in his many works. Indeed, the bibliography of *Development Strategies* includes none of Moravcsik's books or papers. In 1984, Moravcsik sent a letter inviting Choi to join the International Task Force for Science Indicators for the Indicator of Measurement of Impact of Science and Technology on Socio-economic Development Objectives project. The goal of the project was to grasp the effects of scientific research on developing countries, with the results to be published in 1986 as *Bibliographic Indicators of the Third World's Contribution to Science*. However, Choi declined Moravcsik's invitation, citing an incompatible schedule. Choi also refused to send manuscripts to *Scientometrics*, an academic journal in which Moravcsik was involved. There were numerous reasons for this, including the fact that the requests were one-sided, making schedule adjustments difficult, and Choi did not have much of a presence for Moravcsik, to the extent that the latter misspelled the former's name as "Hyong Sup" in his letter of invitation. More fundamentally, however, there seems to have been a deep incompatibility between Moravcsik's philosophy and Choi's policy orientation.[6]

While refraining from directly mentioning Moravcsik, Choi did contrast his ideas with those of Nayudamma, who described a model for India. After receiving a doctoral degree in leather science from Lehigh University in the US and serving as director of the Central Leather Research Institute (CLRI) in India, Yelavarthy Nayudamma argued for the promotion of economic development in India through research on natural resources and raw materials. His focus in particular was on increasing employment that relied on traditional technologies and bringing about an import substitution effect (Im and Choi 2017).

Nayudamma shared with Choi the belief that S&T development must contribute to the nation's economic development. However, Nayudamma

6. Moravcsik's letter to Choi and the latter's reply can be confirmed in the Choi Hyung Sup Archives: File 10-7, document box 10.

differed considerably in his proposed method of achieving that goal. In Choi's view, in a country poor in resources like Korea, it would be difficult to justify policy oriented to adaptive technology, employment, development of natural resources, and self-reliant development. Instead, a nation's scientific and technological capacity could be enhanced by inducing industrialization through the introduction, assimilation, and improvement of advanced technology and the installation of research institutions that would mediate such processes. He also emphasized the important role of central government ministries with authority over S&T policies that would synthesize and coordinate these processes. In contrast, Nayudamma advocated growing the economy through the technological development of both traditional industrial technologies and closely related fields and establishing decentralized governance institutions with authority over different areas or industries in lieu of top-down management by a central ministry.[7] Choi elaborated on his idea while taking Nayudamma's claims into consideration.

At an international seminar held in 1972 at the EWC (East-West Center) in Hawaii, KIST vied with the Indian CLRI for recognition as a model to be recommended for adoption by developing countries such as Indonesia (Hyungsup Choi 2022). Indonesia is said to have adopted the KIST model as a result of these discussions. In the 1970s, Indonesia's president, Suharto, recruited B. J. Habibie, an aeronautical engineer, to promote S&T policy and large-scale projects, such as N250 aircraft development, in the country. This led to the creation of a "technological state" (Amir 2013). Suharto sought to develop an economy based on S&T, with rather abundant natural resources, in an approach that followed the model established by KIST. However, it is unclear if Indonesia established a similar institute to KIST. In 1977, the Indonesian chairman of the

7. Nayudamma was a member of the Board of Governors of the International Development Research Centre (IDRC), an organization dedicated to helping developing countries solve their social, economic, and environmental problems, where he worked until his death in 1985. To honor his work, the IDRC established a database of information on technologies developed in the South or for the South and called "The Nayudamma Technology Bank," which reflects Nayudamma's credo.

Management Board of the National Center for Research, Science and Technology (PUSPIPTEK), Mustafa Pamuntjak, expressed an interest in Daedeok Science Town, noting that it had similarities to the scope and plans of the PUSPIPTEK.[8] Despite this, the Center (located in Serpong) does not specify that it was inspired by the Korean experience in its official history.

Choi and Moravcsik stood at antipodes to one another as to their basic philosophies of science policy, while Choi and Nayudamma exhibited considerable differences in the specific methodology each advised. Though Nayudamma did not stress appropriate technology, his idea partly resonated with that technology inasmuch as it basically deployed development strategies appropriate to the industries and environment distinct to each given area. In fact, at the time India was considered a hub of appropriate technology. However, Choi was somewhat skeptical of appropriate technology and viewed industrialization in India at the time as the result, not of the application of appropriate technology, but of the gradual improvement of advanced technology through international cooperation mechanisms such as technology transfers. Claiming that appropriate technology should mean technology suitable for the circumstances in developing nations in contrast to the generally used meaning, he emphasized the role of technological information-analyzing organs in selecting appropriate technologies for transfer (Choi Hyung Sup 1986). His argument was that the strategic selection of appropriate technologies is the first step in determining the effectiveness of technology transfer.

In the end, as Choi argued, there was no single model commonly applicable to all developing nations, and not a few differences existed among strategies articulated by scholars. Though Moravcsik's idea was aimed at the Third World, it was basically in the same vein as science policy in advanced countries. Choi was able to present his own policy suggestions with confidence because of the historical experience of Korea, which had successfully implemented them. *Development Strategies* was not just abstract theory, but a model created by centering the KIST and articulating its

8. Letter sent to the minister of science and technology, document box 33, Choi Hyung Sup Archives: Mustafa Pamuntjak (October 25, 1977).

experiences.

The biggest advantage to Korea's ODA is that Korea is the only country that has transitioned from a recipient to a donor country. Many developing countries seek to receive the benefits of Korea's development experience (Lee et al. 2020). This is why Choi's concept is so important in S&T ODA. The most visible manifestation of Choi's KIST model is the Vietnam-Korea Institute of Science and Technology (VKIST), which was completed after ten years of construction in January 2023. First conceived of in 1996, VKIST aims to provide technology to industry. Vietnam is home to a number of research institutes, including the Vietnam Academy of Science and Technology. In recent years, Vietnam has significantly increased the number of S&T research institutes in the country. Among these is the Vietnam Academy of Agricultural Studies, which was established in 2009 to advance agricultural technology, the country's traditional flagship industry (Thai and Moon 2018). VKIST was built as a laboratory that would contribute to the national economy while maintaining close links to industry.

KIST is a representative model of a Korean S&T ODA project (Yang 2022). Outside of Vietnam, various S&T ODA projects are under development in Laos, Indonesia, and Cambodia, such as advising in the formulation of national S&T master plans and supporting the establishment of R&D centers (Kim et al. 2021). In fact, not all of this is based on the principles articulated in *Development Strategies*. As Choi argued, just as developed and developing countries require different approaches due to their different circumstances, the conditions in each developing country necessitate diverse strategies. Nevertheless, the basic philosophical approach, which was shaped by Korea's experiences, remains the focus of these efforts, which are focused not on replicating Korea's path, but on adapting and applying its core insights to the local context. Choi's works are thus best regarded today as a policy guide, not merely as history.

Conclusion

Choi Hyung Sup, who led Korea's technology development efforts in the 1970s, described S&T policies appropriate for developing nations thusly: For technological development necessary for a nation's economic development, the selection of strategic industries must be made and the ensuing strategic technologies must be selected in consideration of the resources and abilities of that nation. As the advanced industrial technologies that would need to be developed strategically were ones that had most often been developed in developed countries, mediums of technological development that would select, introduce, and assimilate advanced technologies in consideration of the nation's conditions and transplant the results in private corporations were necessary. For Choi, this meant KIST, a comprehensive research institute, and GRIs for each field. KIST's and the GRI's roles as mediums for technological development constituted a principle stressed by Choi since his service as the first president of KIST, and policies of the construction of a science town and the establishment of GRIs for different fields were an extension of that idea. From this perspective, Choi's science policies are rooted in his experiences at KIST, and *Development Strategies* was the result of building upon *Industrial Research in the Less-Developed Countries*, which summarized KIST's experiences, and applying these experiences at the national level. KIST was a catalyst that brought about the contemporary scientific and technological system of Korea and served as an originator of the key S&T policies pursued in the 1970s.

Because Choi's goal was the publication of his works in English, the main readers of *Development Strategies* included relevant officials in developing nations beyond Korea. At the time, Choi was not concerned with Korea's changed situation in the 1980s and the new S&T policy schemes such changes had brought. For him, his most important duty was to distill the most important components of the 1960s and 1970s, and do so in a manner that amounted to policy suggestions relevant to other developing countries eager to develop their own S&T. Consequently, Choi's trilogy remains useful for many countries that look to Korea's achievements as worthy of emulation.

Despite their importance, Choi's books have received scant attention from policy scholars. In this sense, the works are similar to those of O Won-chol, a leading technocrat during the Park Chung-hee era who systematized the process of economic growth during that period and modeled it into a Korean-style economic development strategy. O summarized modern Korean industrial and economic history and published the *Korean Economic Construction* series since 1995. In 2006, the seven volumes of his works were reorganized and introduced in a single-volume which was translated into English shortly thereafter (O 2009). While there is a study on O's leadership (Kim and Eom 2018), O's work has likewise not attracted much scholarly attention. In contrast to O, whose heavy chemical industrialization policy has been widely criticized, as a science administrator, Choi is highly regarded in the scientific community. This is evidenced by the fact that Choi was designated a "person of distinguished service to science and technology" by the South Korean government. Nevertheless, because Choi worked as a bureaucrat under an authoritarian regime, public administration and policy scholars do not seem to have shown much interest in his work.

Can Choi's reconstruction of Korea's experiences be applied to today's developing countries in light of the very different historical contexts? This question is linked to the question of whether the economic growth strategies of Korea can be replicated in other countries. Certainly, Korea's compressed development was characterized by the favorable conditions of an auspicious trade environment against the backdrop of the Cold War, but the basic concepts behind the growth Korea achieved are still valid. The rapid recovery of Korea and other East Asian countries after the 1997 Asian Financial Crisis proves that the basic principles articulated by Choi still work. A similar conclusion can be drawn for the S&T policies. While Choi's framework was a unique product of his times and the distinct socioeconomic circumstances of Korea of the 1960s and 1970s, its core concepts can be referred to across different times and countries. The key to his vision is the idea that S&T development should be in the service of the greater economy, and the insight that intermediary research institutes can drive this development. In this sense, Vietnam's attempt to transplant Korea's experiences by establishing the VKIST is noteworthy.

Choi argued that S&T policies should focus on developments that would contribute to the national economy. Article 123-1 of the Korean Constitution (1972), passed during Choi's period of service as minister, stipulated that, "The development of the national economy and science and technology necessary for such development shall be promoted and enhanced." Article 127-1 of the nation's current Constitution (1987) similarly states that "The State shall strive to develop the national economy by developing science and technology, information and human resources and encouraging innovation." In other words, contribution to the development of the national economy remains the stated purpose of S&T. In 2018, Koreans considered amending the Constitution, with some scientists and engineers suggesting that this provision be changed (Lee 2018). However, many Korean scientists and engineers disagreed, and economic development remains the cornerstone of the government's continued support for S&T. As discussions on amending the Constitution in the political arena failed to bear fruit, the argument for amending the article on S&T subsided. The discussion of this article itself, however, demonstrates the continued influence of Choi's works on the basic philosophical orientation of the scientific and technological community in Korea. While Korean S&T policy continues to emphasize the application of a so-called post-catch-up strategy, the value of S&T from the catch-up era still remains. For this reason, Choi Hyung Sup's texts remain a relevant focus of analysis.

REFERENCES

Amir, Sulfika. 2013. *The Technological State in Indonesia: The Co-constitution of High Technology and Authoritarian Politics*. Abingdon, UK: Routledge.

Choi, Hyung Sup. 1975. "Adapting Technology: The Korean Case." In *Views of Science, Technology and Development*, edited by Eugene Rabinowitch and Victor Rabinowitch, 17–28. Amsterdam: Elsevier Science & Technology.

_____. 1976. *Gaebaldosangguk-ui gongeop yeongu* (Industrial Research in the Less-Developed Countries). Seoul: Iljogak.

_____. 1983. *Bases for Science and Technology Promotion in Developing Countries*. Translated by Chong-Ouk Lee. Tokyo: Asian Productivity Organization.

_____. 1986. *Technology Development in Developing Countries*. Translated by Young Il Mok. Tokyo: Asian Productivity Organization.

_____. 1989. *Springboard Measures for Becoming Highly Industrialized Society*. Translated by T. J. Park, et al. Bangkok: APCTT/UN ESCAP.

Choi, Hyungsup. 2022. "'Transnational Intermediaries: The Cold War Origins of the 'Korean Model of Development.'" Paper presented at East Asia Seminar, Cambridge University, May 16.

_____. 2023. "2004-nyeon Choe Hyeongseop, yeongwonhan 'gwagicheo janggwan'-euro namda" (In 2004, Choi Hyung Sup Remains the Eternal 'Minister of Science and Technology'). *HORIZON*. February 28. https://horizon.kias.re.kr/23719/.

Choi, Seok Sik. 2011. *Gwahak gisul jeongchaengnon* (Science and Technology Policy Theory). Seoul: Sigma Press.

Cirera, Xavier, and William F. Maloney. 2017. *The Innovation Paradox: Developing-Country Capabilities and the Unrealized Promise of Technological Catch-Up*. Washington, D.C.: World Bank Publications.

de Hemptinne, Yvan. 1963. "The Science Policy of States in Course of Independent Development." *Impact of Science on Society* 13.3: 233–247.

Editor. 2010. "Choi, Hyung Sup (1920–2004): A Metallurgist Who Founded Modern Korean Science and Technology." *STI Policy Review* 1.2: 89–96.

Ejermo, Olof, and Astrid Kander. 2006. *The Swedish Paradox*. Lund: CIRCLE (Center for Innovation Research), Lund University.

Goldstein, G. R. 1990. "Michael J. Moravcsik: A Biographical Sketch." *Few-Body Systems* 9: 41–56.

Im, Jae Yoon, and Hyungsup Choi. 2017. "Choe Hyeongseop-gwa 'hanguk-hyeong baljeon model'-ui giwon" (Choi Hyung Sup and the Origins of the 'Korean

Development Model'). *Yeoksa bipyeong* (Critical Review of History) 118: 169–193.

Kang, Mi Hwa. 2006. "Choe Hyeongseop-ui gwahakgisul jeongchaengnon: Gaebal dosangguk-ui gwahakgisul gaebal jeollyak bunseok" (Choi Hyung Sup's Science and Technology Policy Theory for Developing Countries). *Hanguk gwahaksa hakhoeji* (Korean Journal for the History of Science) 28.2: 297–328.

Kang, Shin-gwi. 1974. "Gyunhyeongireun gwahak haengjeong" (Science Administration Out of Balance). *Kyunghyang Shinmun*. March 20.

Kim, Dong-Won, and Stuart W. Leslie. 1998. "Winning Markets or Winning Nobel Prizes? KAIST and the Challenges of Late Industrialization." *Osiris* 13: 154–185.

Kim, Ji Hyun, et al. 2021. *2021-nyeondo gukje gisul hyeoksin hyeomnyeok saeop* (2021 K-Innovation ODA Program). *Jeongchaek yeongu* 2021-38: 1–306.

Kim, Jun Houng, and Seok-Jin Eom. 2018. "Hanguk-ui godoseongjanggi-ui gowi gwallyo-ui yeokhal: 1960–70 nyeondae junghwahak gongeophwa jeongchaek chujin gwajeong-eseo-ui rideosip-eul jungsim-euro" (Role of High-level Bureaucrats in Korea's Era of High Growth: Focusing on Leadership in the Heavy and Chemical Industrial Policy in the 1960s–1970s). *Hanguk sahoe-wa haengjeong yeongu* (Korean Society and Public Administration) 26.4: 287–310.

Kim, Geun Bae. 2018. "The Political Power-Mediated Expansion of Science and Technology under the Park Chung Hee Regime." *Korea Journal* 58.4: 114–142.

Lee, Jaehoon. 2018. "Gwahak gisul hyeoksin jeongchaek-eul wihan heonbeop gaejeong nonui-wa gwaje" (Discussions on and Tasks of a Constitutional Amendment for Science and Technology Innovation Policy). *KISTEP Issue Weekly* 225: 1–34.

Lee, Jungwon, et al. 2020. *Gwahak gisul ODA yunghap peurogeuraem gihoek yeongu* (Planning of ODA Partnership Program in STI). Sejong: Science and Technology Policy Institute (STEPI).

Ma, Hyoung Ryul, et al. 2022. "Identification of R&D Paradox after the Global Financial Crisis: Korean Case Focusing on the Smart Convergence and Conventional Industries." *Science, Technology and Society* 27.2: 1–20.

Malecki, Ignacy. 1963. "Some Problems Concerning Organization of Scientific Research in the Developing Countries." *Impact of Science on Society* 13.3: 181–199.

Martin, Ben R. 2012. "The Evolution of Science Policy and Innovation Studies." *Research Policy* 41.7: 1219–1239.

Moravcsik, Michael J. 1975. *Science Development: Toward the Building of Science in Less Developed Countries*. Ottawa: International Development Research Center.

_____. 1986. "Two Perceptions of Science Development." *Research Policy* 15.1:

1–11.

O, Won-chol. 2009. *The Korea Story: President Park Jung-hee's Leadership and the Korean Industrial Revolution*. Translated by Michael Bujold and Young-ki You. Seoul: Wisdom Tree Publishing.

Rhyu, Sang Young. 2022. *Bak Jeonghui-wa Gim Daejung-ui daehwa: Urideul-ui jahwasang* (The Conversation between Park Chung-hee and Kim Dae-jung: Our Self-portrait). Seoul: Nonhyeong.

Thai, Vinh Tran, and Manyong Moon. 2018. "Hybrid Origins of a Modern Vietnamese Science and Technology System: An Introduction to Contemporary History of Science and Technology in Vietnam." *Hanguk gwahaksa hakhoeji* (Korean Journal for the History of Science) 40.2: 305–325.

United Nations. 1963. *Science and Technology for Development: Report on the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Area, Volume VII. Science and Planning*. New York: United Nations.

Wade, Robert. [1990] 2004. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*. Princeton, NJ: Princeton University Press.

Won, Tae-sang. 1963. "Gwahak gisul-ui eungyong" (Application of Science and Technology: Upon Returning from the UN Science and Technology General Assembly). *Dong-A Ilbo*. May 15.

Yang, Kyu-Hyun. 2022. "Hanguk-hyeong gwahak gisul ODA-eseo KIST model-ui hwaryong: KIST model-ui deungjang-gwa jeonpa noryeok, geurigo VKIST seollip" (Utilization of the KIST Model in Korean Science and Technology Official Development Assistance: With Focus on the Emergence and Export of the KIST Model and the Establishment of the VKIST). Master's thesis, Jeonbuk National University.

Yi, Chan-Goo, et al. 2018. "Gwahak gisul jeongchaekhak-ui paereodaim nonui: Hangmunjeok jeongui-wa yeongu beomwi-reul jungsim-euro" (Discussion of the Paradigm of Studies on Science and Technology Policy: Suggesting the Definition of Discipline and Research Scope). *Gisul hyeoksin hakhoeji* (Journal of the Korea Technology Innovation Society) 21.1: 1–32.

_____, et al. 2022. "Gukga seongjang dongnyeok jeongchaek-ui byeondong bunseok: Jeongchaek munje-wa jeongchaek hyeoksin banghyang" (Policy Change of National Growth Engine Policy in Korea: Policy Problems and Direction for Policy Innovation). *Gisul hyeoksin hakhoeji* (Journal of the Korea Technology Innovation Society) 25.2: 193–226.

Yoo, Sangwoon. 2020. "Innovation in Practice: The 'Technology Drive Policy' and

the 4Mb DRAM R&D Consortium in South Korea in the 1980s and 1990s." *Technology and Culture* 61.2: 385–415.

Received: 2022.11.29. Revised: 2023.04.06. Accepted: 2023.04.20.