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2013 Modularization of Korea's Development Experience:

A Study on the Korean Government's Supporting Measures for Private Firms' Science, Technology, and Innovation Promotion

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Ministry of Science, ICT and Future Planning

STEPI SCIENCE AND TECHNOLOGY POLIC INSTITUTE

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Preface

The study of Korea's economic and social transformation offers a unique window of opportunity to better understand the factors that drive development. Within one generation, Korea had transformed itself from a poor agrarian society to a modern industrial nation, a feat never seen before. What makes Korea's experience unique is that its rapid economic development was relatively broad-based, meaning that the fruits of Korea's rapid growth were shared by many. The challenge of course is unlocking the secrets behind Korea's rapid and broad-based development, which can offer invaluable insights, lessons and knowledge that can be shared with the rest of the international community.

Recognizing this, the Korean Ministry of Strategy and Finance (MOSF) and the Korea Development Institute (KDI) launched the Knowledge Sharing Program (KSP) in 2004 to share Korea's development experience and to assist its developing country partners. The body of work presented in this volume is part of a greater initiative launched in 2007 to systematically research and document Korea's development experience and to deliver standardized content as case studies. The goal of this undertaking is to offer a deeper and wider understanding of Korea's development experience in hopes that Korea's past can offer lessons for developing countries in search of sustainable and broad-based development. In furtherance of the plan to modularize 100 cases by 2012, this year's effort builds on the 20 case studies completed in 2010, 40 cases in 2011, and 41 cases in 2012. Building on the past three year's endeavor that saw publication of 101 reports, here we present 18 new studies that explore various development-oriented themes such as industrialization, energy, human capital development, government administration, Information and Communication Technology (ICT), agricultural development, and land development and environment.

In presenting these new studies, I would like to express my gratitude to all those involved in this great undertaking. It was their hard work and commitment that made this possible. Foremost, I would like to thank the Ministry of Strategy and Finance for their encouragement and full support of this project. I especially would like to thank KSP Executive Committee, composed of related ministries/departments, and the various Korean research institutes, for their involvement and the invaluable role they played in bringing this project together. I would also like to thank all the former public officials and senior practitioners for lending their time and keen insights and expertise in preparation of the case studies.

Indeed, the successful completion of the case studies was made possible by the dedicated efforts of the researchers from the public sector and academia involved in conducting the studies, which I believe will go a long way in advancing knowledge on not only Korea's own development but also development in general. Lastly, I would like to express my gratitude to Professors Kye Woo Lee, Jinsoo Lee, Taejong Kim and Changyong Choi for their stewardship of this enterprise, and to the Development Research Team for their hard work and dedication in successfully managing and completing this project.

As always, the views and opinions expressed by the authors in the body of work presented here do not necessary represent those of the KDI School of Public Policy and Management.

April 2014

Joon-Kyung Kim

President

KDI School of Public Policy and Management

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Summary

Chapter 1. Preface

1. Overview of the Technique Innovation Support System

The Technique Innovation Support System Overview is the artificial policy measures that the government can affect for technological innovation of enterprises. It is being performed through various policy initiatives and institutions. Research & Development (R&D) activities expanded and distributed, and each department is responsible depending on the role and functions. The 2012 brochure 'Technique innovation support system (KOITA, 2012. 8)' is divided by the field of details, into taxation and finance, human resources, technology, appearance, certification, and procurement.

In this study, we will look at the tax incentives and support for the financial support system as the most significant affect for private technique innovation activities.

Table 1 | Technical Innovation Support System Classification and Information

Classification	Support Information
Tax Support	Reserve funds for R&D and human development, Levels of R&D tax incentives (ex. research and personal development costs, tax credit, etc.) and special exemption for small corporations
Subsidy Support	Supporting contributions and subsidies of participating national R&D programs (special R&D projects, industrial technology development business, industrial R&D infrastructure building program)
Investment /Loan Support	Scientific and technological rising fund, Industrial foundation /base fund, Informatization promotion fund, Technology fund support (commercial bank loans)
Manpower of Technology Support	Technical workforce security and utilization support (ex. technical research personnel system, job placement (utilizing overseas manpower for technique), On-site work program (professor))
Cooperative Research Support	Cooperative research support (ex. joint industry-academia-research technology development project, clustering technology research project (techno-park), promoting and supporting business research cluster, Technology transfer center)
Technology Information Support	Technical information services (internal and external technology information, human power information) through KISTI (Korea Institute of Science and Technology Information) and TIPA (Korea Technology & Information Promotion Agency for SMEs)
Other Support	Industry standard tests for evaluation, Industrial property, Technology assistance of SMEs, Technical and market advance support through facilitating commercialization of new technologies

Source: Presidential Advisory Council on Science & Technology (2004).

2. Background of the Private Companies Technology Innovation Promotion Policy

For industrial technology development, various attempts were made to explore new growth engines in the process of industrialization and to find new key drivers of the economy. However, in the 1960s when the needs of technology development were not recognized, it was mostly turn-key based introductions of technology along with the facility and actual developments of industrial technology were not executed.

The process of industrialization in Korea can be identified in two ways, the replacement of imported products and production of exports operating in parallel. Technology development

was also performed with a focus on technology required for strategically important export industries. In the 1960s, science and technology were largely applied to address issues arising in the field in the process of companies applying technologies to production lines.

During the 3rd and 4th 5-year Economic Development Plan in the 1970s, machinery, steel, ship building and electronic engineering were selected as strategic industries, and science and technology began to take the role of improving and enhancing newly-introduced and existing technologies, not just fixing problems in the field. However, as companies were not capable of developing these strategic technologies, the government had to take the initiative to build specialized strategic industrial research institutes in each field of industrial technology and digest and improve newly-introduced technology before rolling it out across industries.

During the 1960s and 1970s, instead of domestic technology development with internal capital, Korea adopted a growth-oriented strategy focusing on the government's export industry oriented policy with the support of introduction of capital resources from foreign nations, technology introduction and abundant low cost labor and was able to maintain relative competitiveness with labor-intensive products in the global market. This led to remarkable economic growth. However, as the global economy was hit by the recession in the late 1970s, regulations of the advanced nations on products exported from Korea were tightened and technology protectionism was strengthened with growing reluctancy in sharing core technologies. In this situation, Korean companies faced challenges that required even greater efforts on developing new products, improving and enhancing existing products and streamlining existing production lines based on the technology basis accumulated until that point.

During this time, Korea was actively seeking stable growth and opened its market, responded to deterioration of global market environments including the global economic recession and tightening up of protectionism with external oriented growth strategies. However, as the situation continued to deteriorate, changes were required to seek breakthroughs and renew growth engines and promotion and facilitation of industrial technology became even more important.

With the launch of the 5th Republic in the early 1980s, the government adopted an economic and social development plan led by technological innovation in an effort to seek new growth engines for economic development. Korean companies that had been highly dependent on introduced technology did not have the potential to transfer themselves into technology-intensive industries and there were no domestic research facilities and development basis to help these companies.

To tackle the situation, the Ministry of Science and Technology integrated and coordinated research institutions in the field of science and engineering to maximize

benefits of R&D investment and the efficiency of research. The economic and social development plan led by technological innovation was an inevitable choice for Korea and with the Technology Promotion and Expansion Council starting in 1982, public consensus for national development led by technology began to build and specific evidence can be found in the introduction of technology-driven business management strategies in private sector, showing strong commitment and passion to technology development.

For these strategic industries and technologies, it was encouraged for each company to set up one research institute. Along with that, the government began to provide public funding for private companies' research centers that had been allowed only for national or public institutes and worked on joint research on national agendas.

The basic technology development direction was summarized in ① Technology-intensive light industry; ② Technology-intensive heavy industry; and ③ Research-oriented high-tech industry and to this end, the government set the strategy to ① nurture and secure highly competent talent; ② encourage productive R&D activities; and ③ localize core technologies.

However with the start of the technology-driven era in 1982, most of technology policies reported to the Technology Promotion and Expansion Council were actually implemented. The reasons why most of the technology policies were able to be implemented since 1982 were, first, the technology-driven policies became a top priority in national agendas. Second, institutions and mechanism were set up to discuss and coordinate these policies efficiently. Third, the Ministry of Science and Technology was able to secure financial resources to implement R&D projects having government-funded research institutions under their wing.

The government initiative to encourage private companies' research included tax and financial incentives, special benefits in military service for researchers and expansion of overseas training, R&D funding, establishment of big enterprise research centers and encouraging SME to join the Industry Technology Research Union, facilitation of purchase plans for new technology-based products and support for new technology investment. The government's tax incentives were extensive including recognition of technology development reserves as uncollectable losses, tax deductions on technology and HR development expenses, exemption of local taxes on site for company research centers, reduction of tariffs on research supplies, exemptions of special consumption taxes on research samples, tax deductions on new technology investments, tax reductions on gains on technology, tax deductions on technology projects and tax deductions for foreign technology experts. The government also established a system to provide government funding for research centers of private companies and industrial technology research associations and expanded financial institutions loan extensions for technology development funding. Hankook Engineering was the first venture capital firm established with a joint investment by the government and private companies with introducing the conditional investment system.

All of these showed technology development activities began to spread across all industries. The government's tax and financial incentives increased and purchasing procedures were improved to promote demand for new technology products. Technology development support policies such as substitutional military service were improved and enhanced and with these support measures, science and technology investments that began to see a dramatic increase entering the 1980s exceeded KRW 1 trillion won in 1985.

Chapter 2. The Establishment and Revision of the Technology Development Promotion Law

1. Enactment and Changes of the Technology Development Promotion Law

1.1. Enactment of the Technology Development Promotion Law

The Technology Development Promotion Law was enacted in 1972 for the purpose of strengthening international competitiveness of enterprise and contributing to national economy development by promoting the development of industrial technology and the introduction and improvement of technology and by disseminating the results. This law was revised nine times and the full text was amended in 2001.

1.2. Content of the Technology Development Promotion Law

First, the Technology Development Promotion Law permitted the individual who introduced foreign technology in a way that the law regulated or in other ways could reserve the technology development reserve fund. Secondly, if the individual who imports products whereby localization is possible by domestic technology and invests a percentage of the revenue from it in technology development, he/she can receive support from the government. Thirdly, it allowed the free transfer of parts of industrial property rights, resulting in research and development toward the individual who conducted the research and development by contact and the exemption of license partly or all.

1.3. Changes of the Technology Development Promotion Law

The Technology Development Promotion law has revised several times to expand targets and the business types that can reserve the technology development reserve funds, the coverage of technology development reserve fund usage and enterprises' technology development system.

2. Technique Innovation Support Systems between 1972~1980

Economic development in the 1960s was led by remarkable industrial development in the successful implementation of the 1st and the 2nd 5-year Economic Development Plan. Science and technology capability was still lagging behind advanced nations and Korea had to survive trade competition getting more intense everyday. In order to encourage private companies that were not very interested in technology development or cost savings to take the lead in industrial technology development, the following policies were implemented (Almanac of Science and Technology, 1971).

First, in the Almanac of Science and Technology 1971, establishment of a framework for joint research was discussed as a way to promote technology development. Next, measures to promote technology introduction and private sector research centers' activities to digest and improve introduced technology. To encourage R&D in private companies and promote the introduction of advanced technology, the yearbook suggested reviews over support measures of the government research funding, joint research among companies and a research union.

In 1973, for proactive and independent research and development, the book discussed measures to encourage assignment of technology development initiatives of private companies to domestic specialized research institutions, promote joint participation of research institutions and industries, focus R&D budget of the government and the Korea Institute of Science and Technology on industrial development directly linked to production and expand technology diagnosis and guideline initiatives from the existing targets of exporters to companies designated for industry optimization and to SME. Also, to facilitate support for R&D activities in the private sector, the yearbook suggested that the industrial technology development budget out of the government research budget should be converted to joint research and the cost had to be covered by the government and private companies in 50:50 (Almanac of Science and Technology, 1973).

In the 1974 Science and Technology Yearbook, it outlined operation of a technology introduction consultation center, and joint research initiatives between the government and private companies and a technology development reserve system.

In the Almanac of Science and Technology 1975, it was reported that the technology introduction consultation center was within the Hongreung Science Complex. It pointed out that the post management system needed to be built by running a circuit consultation body and assessing utilization of introduced technology and possible issues (Almanac of Science and Technology, 1975).

In the late 1970s when technology development capabilities were still weak, companies proactive efforts and extensive introduction of advance technologies were essential and, they needed to transfer from batch introduction where capital and technology were directly linked to a core technology-focused approach for selective introduction.

Since the late 1970's, for industrial technology development, securing independence in the heavy chemical industry was a top priority.

To support construction of company-affiliated research centers, in the Technology Development Promotion Act it was recommended to build or expand research facilities for companies in machinery, ship-building, electronics, electrics, metal and chemical engineering that lacked internal research facilities or to improve existing ones.

Entering 1980, the goal was to advance technology a level up to global standards and establish technology development cooperation to localize plants and go overseas with Korean technology. To support the corporation, loan lending for companies technology development, loan to make business use of research outcomes, technology labor expense loans for industrial facilities and research equipment rentals were provided.

For businesses utilizing outcomes of domestic technology development in business for the first time in the country, tax and financial incentives were provided.

In 1980, as measures to address weak technology competence of SME, it was encouraged to establish industrial technology development unions, implement joint research initiatives of the government and private companies and strengthen technology guidelines.

3. Technique Innovation Support Systems between 1981~1995

In 1981, the Korean government acknowledged the importance of private corperations' independent research centers in order to accelerate industrial technical innovation and thus expanded the support system.

The almanac continues to explain that in 1980, corporations began to take interest in technology development as the government promoted technological drive policies for the second economic leap.

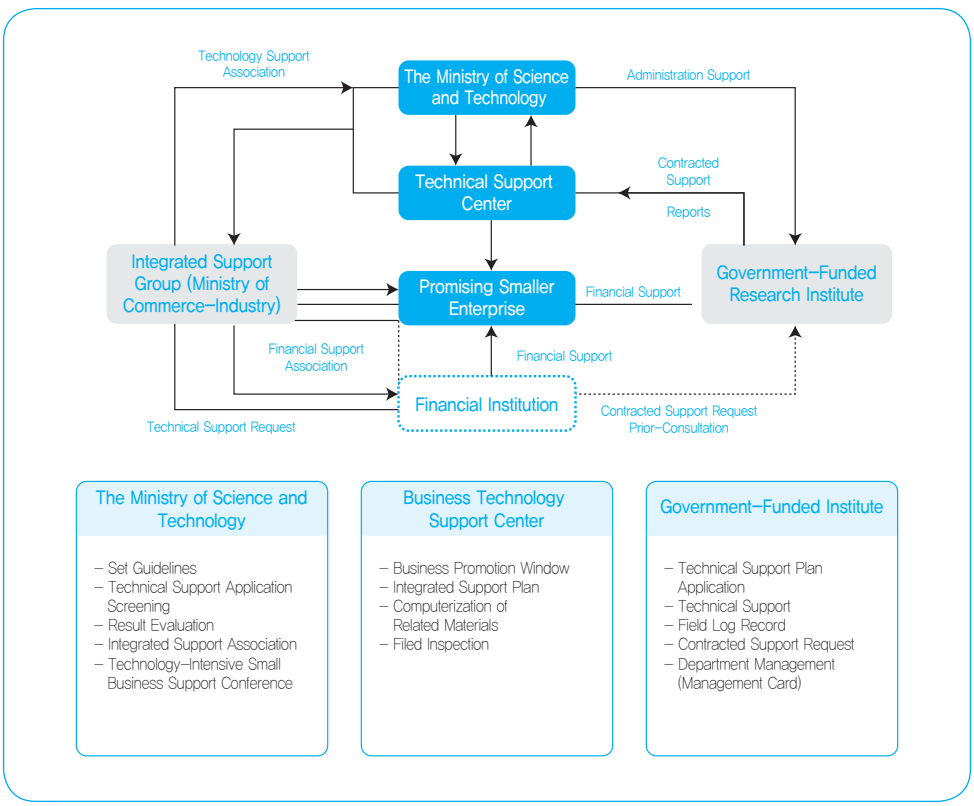
It describes the leading strategies were, firstly, to concentrate national technology development capabilities to accelerate research and development; secondly, to incorporate international technologies to overcome domestic limitations and stabilize the technology application; and thirdly, to establish cooperation systems with industrial universities. The government backed these strategies with taxes and financially. For taxes, Korea increased budget limits for the technology development reserve fund, created tax deduction programs for technology and human resource development and revised tax deduction systems for

research facilities. Financially, the Korea Technology Development Corporation, Korea Development Bank, and the Small and Medium Industry Bank increased technology development funds and the government directly subsidized funds for private corporations. In 1981, the quarterly held National Technology Convention built a procedural system that solved technology tasks in cooperation with industries, universities, researchers and the government, as reported in the almanac (Almanac of Science and Technology, 1982).

Since 1983, government aids have been categorized into corporate, a form of support (tax deduction, financial aids, and common purchase) and development phase (research and development, industrialization and market entering).

Since 1983, the focus was to design and execute polices for smaller businesses to concentrate their technologies to boost technical innovation.

Figure 1 | Promising Small Business Support System



Source: Almanac of Science and Technology 1985.

The support system for industrial technology development improved in its administrative procedure in 1980s. Simplified documents required for technical development funding register and report that started in 1970s, lead to stronger incentives for the funded companies, and improvements of administrative management increased efficiency. Research support also gradually expanded by lowering its recipient company qualifications from 30 employees to 5 employees. Financial support also broadened its beneficiaries from facility funding to R&D investment, which had high risks and a longer period of time to yield profits, and tried to include other industries that were excluded from the Machine Industry Promotion Fund and Electric Industry Promotion Fund (Almanac, 1986). These government efforts yielded visible results. The Technical development fund and technical innovation support were more emphasized in late 1980s and in 1986, financial support for smaller business took a big leap.

In late 1980s, technical innovation focused on tax-deductions and financial support for industrial technology development and technical support for start-up enterprises. The system was continually improved and expanded.

In the late 1980s, support covered an even larger range and more policies were introduced, thereby elevating the importance of technology innovation of smaller enterprises. The goal of small business support was to accelerate the industries by increasing the capabilities of the smaller enterprises through technical innovation. It ensured the transition from price competitiveness due from cheap labor power to technology-based competence, which involved enhancing corporate structures through computerization and automation. To enable information-oriented management, the Korea Technology and Information Promotion Agency was founded to develop computerized systems and implement high-end computerization technologies in enterprises.

Entering the 1990s, tax and financial support advanced according to economical and technological changes. The policies grew to the Technology Development Special Measurement in 1990, the Manufacturing Industry Invigoration Measurement in 1991, and Science and Technology Innovation Holistic Measurements.

The improvements and expansion of the technology innovation support system continued in 1990s, with its direction slightly adjusted with market conditions. Taxation support was revised in 1992 to reduce tax-reductions for regularity investments from 10% to 5%, yet increasing the deduction rate for the increased investment compared to the past 2-year average, from 10% to 25%. This change turned the helm in the direction to which other developed countries headed: from the R&D investment scale to increased amounts of investment.

With constant expansion and change of the technical innovation support system in early 1990s, the focus moved to commercialization of new technologies and market introductions of new products.

In the 1970~80s, the government led an initial R&D investment with taxation and financial aid. In the following two decades, private R&D investment outpaced governmental investment significantly, which was the limit for the governmental science and technology policy. Therefore, domestic conditions were ready to reconsider the governmental role in development support and the role of innovative small businesses were accentuated even more. The policies started to commercialize new technology, provide science technology information services, which was the main infrastructure, supply research human resources with universities, and strengthen demand-oriented technology development and basic sciences research to create synergies and integrate with the private sectors. Also in taxation support, the trend turned to developed countries: from direct financial support to indirect policies and funds through Korea Technology Finance.

Chapter 3. Technology Innovation Support System's Content by Sector

1. Evolution of Tax Incentives

1.1. Background

The first tax support system: In the 1960s, the prehistory of economic development, the labor-intensive industry based on the induction of foreign capital, cheap and skilled work force were key roles of economic growth. The growth policy's key roles were the elimination of absolute poverty and industrialization. At that time, that was busy digesting technique and improvements within introduction of capital goods. The system of tax exemptions for foreign introduction of techniques was the first tax system for support in technique innovation of private introduction. In the 1970s, economic development strategy, strived for industrial structure development, exporting heavy and chemical industry products, and this was pursued by promoting heavy chemical industry.

In the 1960s, industrialization started and the beginning of the tax support system were tax deductions on the expenditure of technology introduction for the technology transferor and foreign companies. Tax incentives including experimental and research expenses were seen as deferred assets and a special depreciation system on research facilities was implemented in the 1960s.

In the 1970s, the tax support system was implemented on the heavy chemical industries. The deduction rate of inland taxes was 100% in 14 key industries during the first three years and 50% in the second two years and customs deductions were 70~100%. In addition, tax deductions on tariffs for imports of facilities and tax deductions on corporate taxes for capital investment were added. By the enactment of the Technology Development Promotion Act (1972), it specified tax incentives such as subsidy support on technology development, financial support and the technology development reserve fund system, support for private enterprises' technology development was expanded. There were several incentives such as deductions for the technology development reserve fund (1972), deductions on investment on assets for new technology corporatization (1974), deductions on income from technology service enterprise (1977) and deductions on technology income (1979).

In addition, the Technical Services Support Act (1973) was enacted to improve the technical level of domestic services and the National Technical Qualification Act (1973) was enacted to systematize the technical qualification standard in key industrial technology fields and to train the outstanding technical manpower.

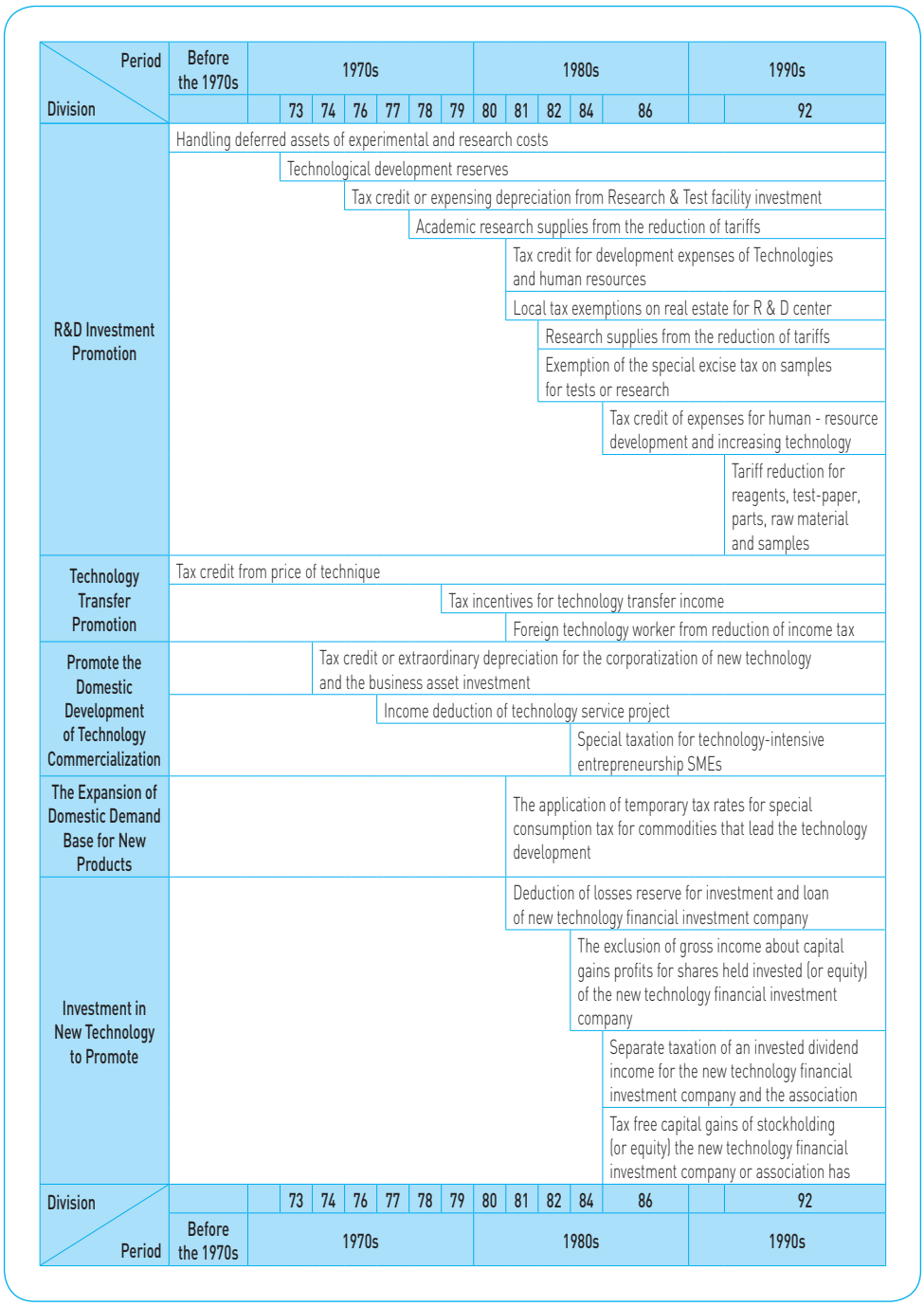
The government implemented several measures to promote the enterprises' technology development and tax support are the most representative measures implemented in several countries. Also, Korea has actively implemented tax support measures on the enterprises' technology innovation since the 1960s.

1.2. Tax Incentives for Technology Innovation before the 1980s

In 1962, the need for the Technology Innovation tax system for industry support emerged, the "Tax Exemption System for Technology Adoption Cost" (Law of Foreign Capital Introduction, paragraph 2, Article 21) was documented in the "Law of Foreign Capital Introduction" established in August 1966.

The goal of the tax system for technology development activities support was to promote industrial technology development and technology development related tax support systems performed by the government were developed to about 20 systems including the deferred processing system of test research cost performed since before the 1970s, the tax break system for technology, depending on company's technological innovation stage, variety of support was provided ([Figure 2]).

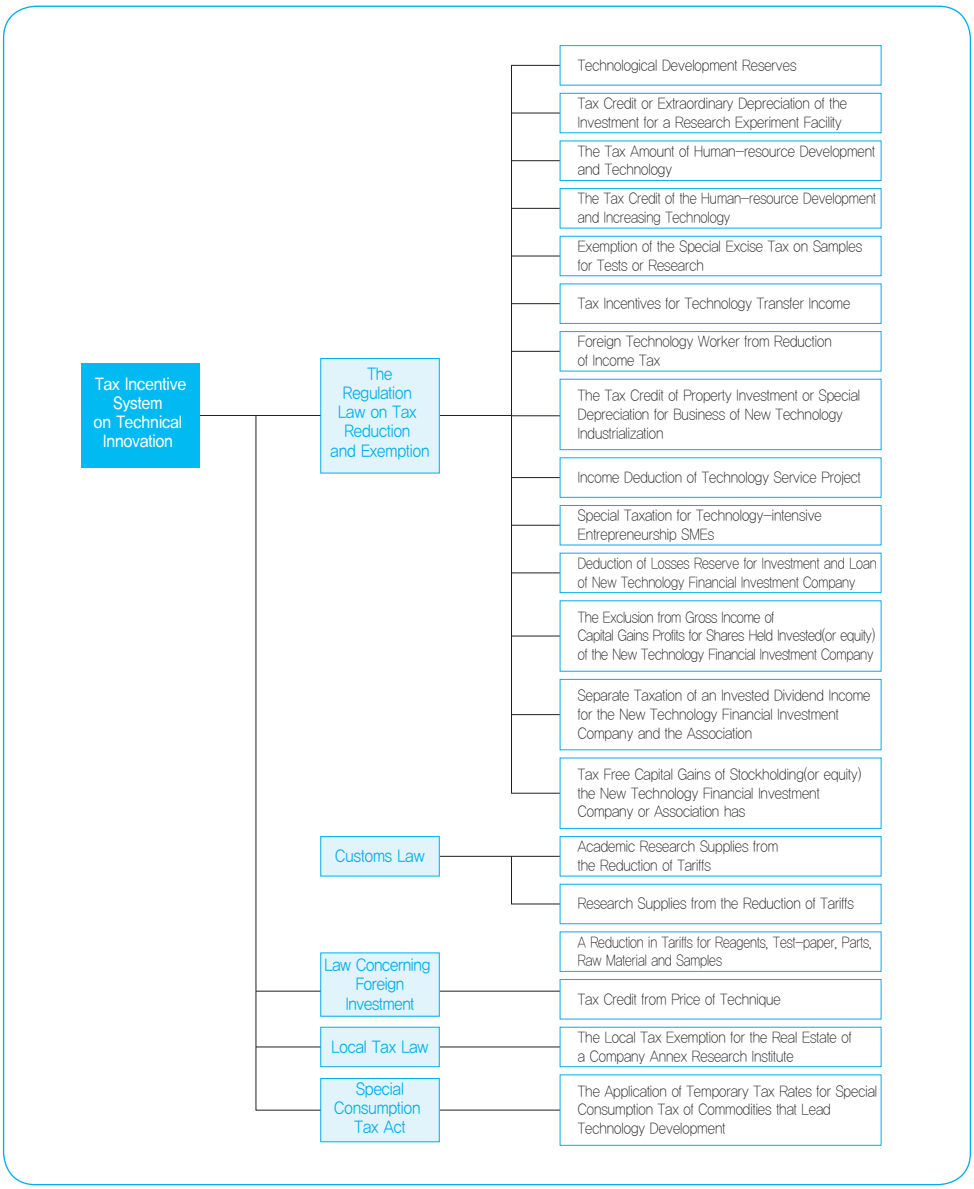
Figure 2 | The Development Process of the Tax System for Technology Development Support



Source: Korea Industrial Technology Promotion Association, 1992.

These various forms of technology development support tax systems for technology innovation, can be summarized as tax break law, customs law, foreign capital Induction law, ground tax law, special consumption tax law and tax relief laws such as separated system name as follows. ([Figure 3] Reference).

Figure 3 | Incentive Systems Related Technology Innovation



Source: Korea Industrial Technology Promotion Association, 1992.

1.3. The Technological Innovation Support System between 1981 to 1997

Economic Environment: In the late 1970s, low capacity utilization and the slowdown of productivity improvements caused by inflation persisted due to the aftereffects of overinvestment in the heavy chemical industry, the comparative advantage for labor due to lost wage increases and a lack of technical skills not followed back on investment. In addition, the Rio Declaration (1992.6) from the UN Conference on Environment and Development (UNCED), Green Round(GR) was accelerating as the framework of multilateral trade negotiations for trade linked to the environment, At the conclusion of UR negotiations, the launch of the WTO (1995.1), Korea joined as the 29th member country of the OECD (1996.12), an era of technology hegemony coming with unlimited global competition due to expediting new trade rules and accelerating the movement of globalization and regionalism, and the need for the maintenance of various government support policy to meet international standards. According to changes in the international environment and accelerated opening in the domestic market, an urgent challenge emerged to secure competitiveness of technology, then the government policy, for the purpose of development and securing of its own technology, focus on policies and institutions for the development of the subject to perform research and development of industry-academia-research.

In the late 1970s private labs began to speed up around large companies and in October 1981, the government introduced a reporting system that recognized 46 private research institutes as R & D centers to promote the technology development of industry.

The tax support system related to company-affiliated research institutes was established and expanded by the enactment of the Regulation Law on Tax Reduction and Exemption (1981.12), for the purpose of introducing the tax support system to promote enterprises' technological innovation.

The "Limit system on total amount of tax reduction and exemption"(Law on Tax Reduction and Exemption Article 88) was introduced to compensate defects such as securing tax revenues by tax reduction. In December 1990, the "Limit system on total amount of tax reduction and exemption" was abolished and "minimum tax" that the individuals and corporate bodies should pay a certain rate of tax for tax-exempt income.

In terms of expansion of the tax support system on technological innovation, "tax exemption system on technology and human resource development expenses" was established in December, 1990.

1.4. Technique Innovation Tax Support Systems after 1998

During this time, the government declared reform in four sectors(government reform, financial reform, business reform and labor reform) and promoted the activation policy of venture enterprises as new growth engines.

Economic Background: In late 1997, the government declared reform in four sectors (government reform, financial reform, business reform and labor reform) and promoted the activation policy of venture enterprises as new growth engines to overcome the foreign exchange crisis

Also the technology tax support system was revised by reducing tax support to secure tax revenue. Tax incentives for large enterprises continued decreasing.

The term "Technical Development Expense" was changed to "Research and Development Expense," and scope had to be specifically defined. During this time, tax benefit systems for technical innovation generally declined but support for small and medium enterprises (SMEs) and ventures were strengthened.

2. Evolution of the Financial Support System

2.1. Background

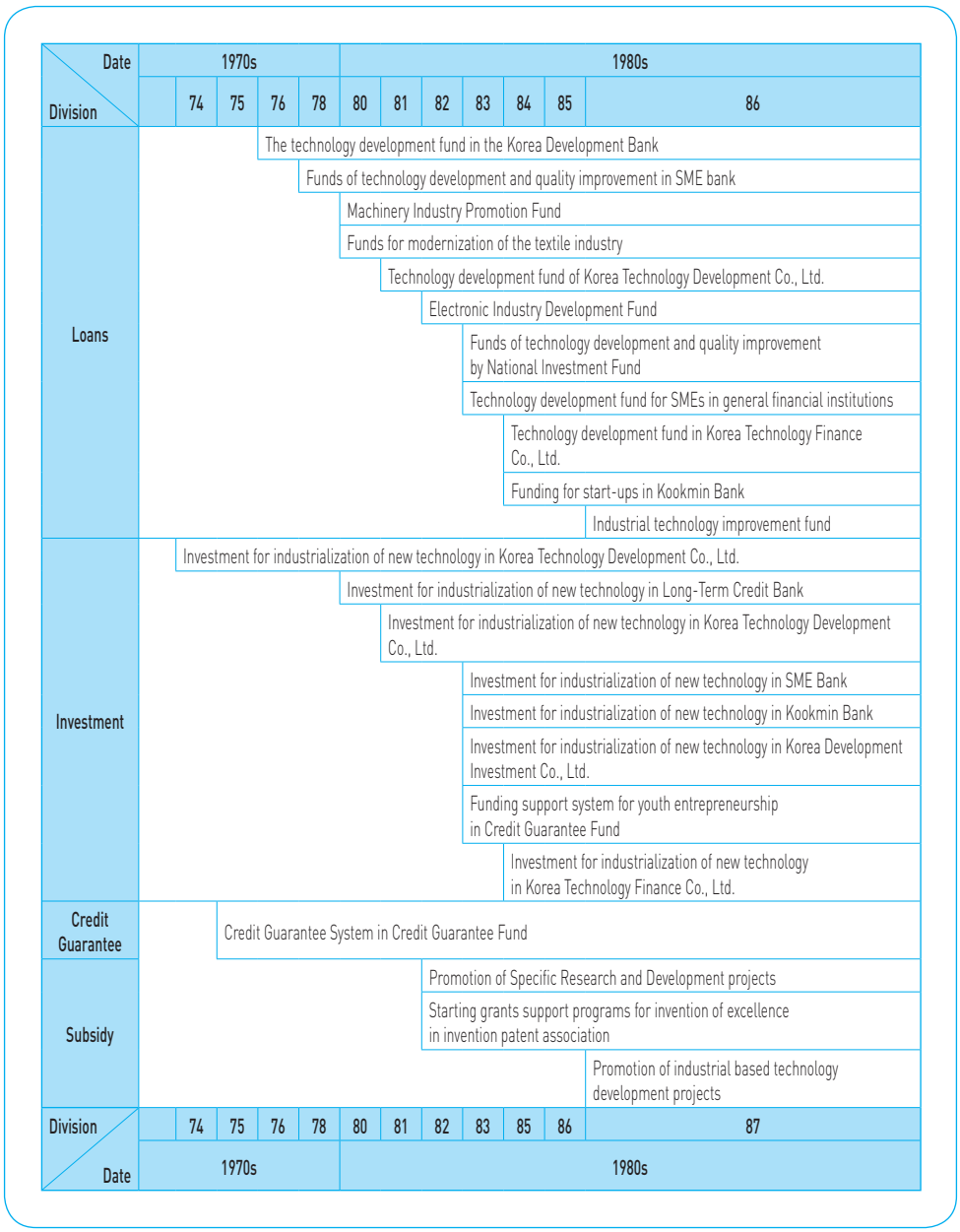
The financial support system for the purpose of supporting enterprises' technology development was introduced in late 1970s. In the era of high economic growth in 1960s and 1970s, the finance policy was widely used as a key measure of industrial policy, but it was only comprehensive support on export financing support or equipment fund support of promising industries, not technology development support.

In this situation, loan support on the technology development fund was introduced in 1976 and loan support on technology development and quality improvement fund of the Small and Medium Business Administration introduced in 1977 were the first finance policies for the purpose of technology development support.

2.2. Enactment and Promotion of Financial Support Related Systems in the 1970s and 1980s

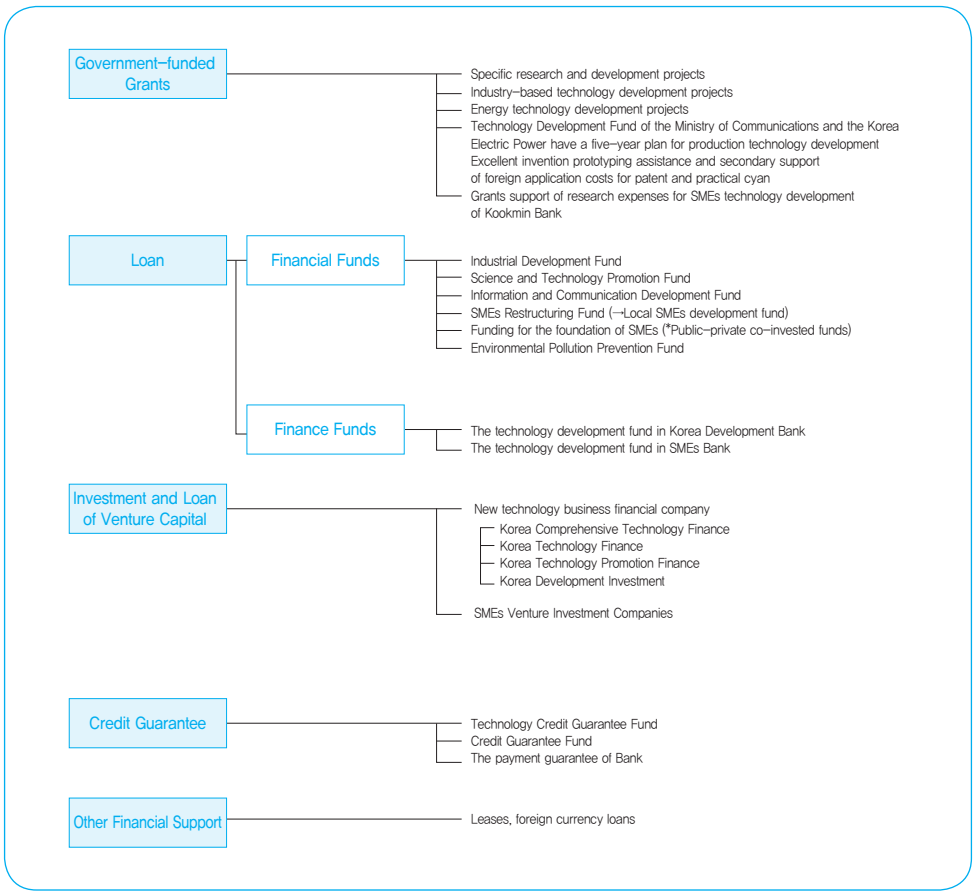
The government started various projects for loan funds to support policies for technology development projects focusing on large companies and at the same time financing support program to support technology development of SMEs.

Figure 4 | The Development Process of Technology Development Financial Support System



Source: Ministry of Science and Technology, 1987.

Figure 5 | The Status of the Technology Development Financial Support System



Source: Industrial Technology Promotion Association.

In the 1980s, the basic foundations were laid out for venture start-up assistance and a support of venture capital(investment support). In 1986, the 'Small and Medium Enterprise Establishment Act' was enacted to support the establishment of a business of a small and medium venture company, according to legislation, the legal basis of investment support and financing assistance was provided by a "SMEs Start-up and Promotion Fund" (today's 'Small and Medium Industry Promotion and industry-based funding') which Small and Medium Industry Promotion Corporation consigned and managed.

In addition, the Industrial Development Fund was established and technology development financing support began the Machinery Industry Development Fund.

In 1989, the 'Special Measures Act of SMEs' management stability and promotes of the restructuring' was established, in accordance with the Law, and the Restructuring Fund of SME was installed and some of these funds were used for the purpose of R&D and commercialization of the company.

2.3. The 1990s: Enactment and Implementation of Systems Related with Financial Assistance

The loan support project of technology development capital of the three national policy banks, namely the Korea Development Bank, the Industrial Bank of Korea, and Kookmin Bank, launched in the 1980s and continued in the 1990s, as the 'Industrial Development Fund' and loan assistance expanded further.

The Science and Technology Promotion Act was amended in 1991, since the Science and Technology Promotion Fund was established in 1993, and the projects-funded and financing projects were implemented for innovative technology development companies. The Promotion Fund of Information and Communication was established for the purpose of project support such as research and development, practical application of information and communication technology, the modernization of information communication equipment, and the projects-funded and financing projects were also performed in 1993.

After the 1990s, support of Technology Credit Guarantee began and support for venture start-ups and venture capital increased. The Credit Guarantee Fund has operated its technology credit guarantee business since 1987 and the Korea Technology Credit Guarantee Fund(today's "Kibo Technology Fund") was established in 1989.

Meanwhile, venture investment increased significantly and support of venture capital became insolvent in the 2000s.

Chapter 4. Performance of Technique Innovation Support System

In chapter four, the size of technology innovation support system's support for private enterprises, expansion of research organizations and private R&D investment, the performance of science and technology and economy are explained.

One of the dynamic forces that Korea developed through the compressed growth of the last 40 years was sustained expansion of research and development investment after the 1980s. Private enterprise's research and development activity expanded by the active 'Promoting research and development organization' policy of the government was, getting bigger than part of the government, taking 77% of the research and development investment.

Korea's proportion of private enterprise R&D investment is higher than other countries such as USA, France, England and Germany which garner 60~70% in R&D investment. Also, Korea has 64% in research manpower.

To calculate the actual benefit rate, pre -tax values of total tax deductions have to be divided by the entire R&D investment of a company. The amount of deduction is the sum of tax deduction on technology and human resources development expenses and tax deduction on investment for research facility and amounted to around KRW 252.6 billion. The pre-tax value was KRW 397.7 billion (2526÷0.365). Total R&D investment of companies in 1995 was KRW 6,465.8 billion, so the actual benefit rate of R&D investment was 6.2%(=2526/64658).

The actual benefit rate of the reserve fund system is calculated by dividing the benefits of companies from the reserve fund system by the whole amount of R&D investment of the companies and that of 1995 is calculated as 6.7%(=4,382/64658). This result is higher than the tax deduction rate toward the expenditure on the technology and human resource development (5%).

Nominal benefit rates of tax deductions are calculated as 7.9% and the reserve fund system is 12%. Enterprises can receive both benefits at the same time, so the total nominal benefit rate is 20.3%, but the nominal benefit rate of the reserve fund system is variable, so the interest rate is also variable. The actual benefit rate of the enterprises is 14.1% and this means that the government support of tax deductions is 14.1% of the amount per unit of R&D investment.

The support target of financial support is innovation-related activities such as R&D, commercialization, and market entry. The benefit probability from financial support that only applied to financial fund is 5%, and including monetary fund is 15.6%.

In section three, the expansion of private enterprises' research organizations and R&D investments will be discussed. During its initial introduction in 1980 to 1985, private research and development organizations established its foundation based on large enterprise. Then, it gained enterprise centered quantitative growth in 2000, riding the wave of venture company establishment and took on new development aspects, which depended on implementing the research and development service declaration system.

The government helped the research and development of private enterprise for their systematic growth through the system of recognition enterprise institute and encouraged the establishment of the enterprise institute.

According to current laws, private research and development organizations in Korea are divided into R&D centers, Industrial Technology Research Associations, Nonprofit Research Corporations, and Commercial Research Corporations. Recently, the growth

of Industrial Technology Research Associations and Nonprofit Research Corporations is stagnant compared to its importance and Commercial Research Corporations are in a nominal state. Only R&D centers have experienced qualitative and quantitative growth, and play a pivotal role.

The Government has supported the R&D of private enterprises since the late 1970s. In 1978, in order to secure its own technology innovation capacity, it encouraged to establish an R&D center by selecting the manufacturer with sales of more than 30 billion won directed by the president. To promote private technology development, starting with the Reserve for technology development in 1973, there were 14,000 enterprise research centers in 2007 compared to 46 in 1981, and was accomplished through various support systems and mitigation requirements for establishing enterprise research centers.

When we look at the effect of the tax support system on the expansion of private R&D investment, the number of organizations that conducted research, the number of researchers, and research funds continuously increased for the 11 years between 1970 and 1980. In 1970, the number of organizations that conducted research increased by approximately 300.0%, the number of researchers by 443.6%, and research funds showed the highest level of increase of 6140.4%. In particular, research funds increased by about 2.9 times between 1973 and 1974. This was in accordance with the time when the Technical Development Promotion Act came into effect in 1974. The Act was established in December 1972 and its Enforcement Decree in September 1973, which meant that the tax incentives provided in the Act started being effective by this time.

The companies' R&D investment drastically increased between 1973 and 1974 and once again between 1976 and 1977. This underpins the interpretation that such increases were associated with the declaration of the Enforcement Decree of the Technical Development Promotion Act (September 22 1973) that included provisions of tax incentives and two amendments of the decree.

Section four deals with the performance of science and technology and the economy. The biggest achievements in industrial technology in the 1970s were seen in heavy chemical industry. The construction of POSCO started in the 1970s and the first phase was completed in 1973 with capacity of 1.03 million tons and the second phase was completed in 1983 to become a steel maker with accumulated capacity of 9.1 million tons. At the time, POSCO was established with support from a leading Japanese steel maker and operation technology was also learned from technology advisors in Japan. Besides POSCO, the auto industry also witnessed remarkable growth as the government built a long term plan to nurture the auto industry with the heavy chemical industry promotion policy and in June 1974, Hyundai Auto released its first proprietary model, Pony, a compact car manufactured with core

technologies such as engine and gear changes introduced from Mitsubishi and designed by an Italian design vendor with 85% local capability.

Also, Polyethylene terephthalate file (PET) developed by KIST in 1977 was another remarkable accomplishment of industrial technology development. At that time, over 20 years passed that PET was first developed and the patent expired but Korea still had to depend on import for its entire domestic demand as it did not have manufacturing know-how. The KIST research team was commissioned by Sunkyung (now SK) for PET film development in 1976, then succeeded in PET chip development and also developed an industrial polymer.

In the 1980s the level of production and peripheral technology were getting closer to the levels of advanced nations. The examples of technology innovation accomplished in the 1980s included development of the DRAM semiconductor, TiCOM, electronic switching system, materials for semiconductor lead frames, localization of VTR head drum, vaccine for type B hepatitis, NMR-CT and localization of nuclear materials.

The development of the DRAM semiconductor was led by a private company. Samsung had a series of successful outcomes, developing 64K DRAM and 256K DRAM respectively in November, 1983 and October, 1984. Then, 4M, 16M, 62M, 256M DRAM, a joint national research project kicked off to develop the technology domestically in cooperation with the industry, academy and research institutes.

Also, in 1990s, as inter-departmental joint research projects gained momentum, core technology development became possible. With leading technology development projects, high definition (HD) digital TV technology was developed in 1994 and in semiconductor, the 64M DRAM prototype was developed in 1993 and 256M DRAM prototype in 1994 and became a global leader with the most advanced technology in the field. Korea became the first to develop large-scale TFT-LCD to set the basis to lead the display market and with information and telecommunication research projects, The CDMA system was developed through a joint technology development initiative with the industry, academy and research. In fine chemistry, medical development was active. In 1999, Sunpla Injection, the anti-cancer drug developed by SK Chemicals was registered as the first domestically developed new drug and with the new medicine and new pesticides development under the leading technology development projects starting in 1992, the technology capability of Korea advanced up to the level of developing improved new drugs and new materials at the stage of materials composition.

When you look at the ratio of patent registrations to applications, in 1970s it was just around 10% and the figure increased to 60.1% in 2012. In 1970, the number of patent applications was 1,846 and it became by 2012, it was 188,915.

Chapter 5. Conclusion

In the 1960s, Korea did not feel the need to develop technology because the country's industry was based on labor intensive ones, but the government started to draw up a variety of inducements to stimulate private enterprises' efforts to develop technology as competitiveness in exporting products based on low wages began to be lost in 1970s and as a result, it was stressed that we should make efforts to increase productivity through learning and improving introduced technology in order to secure market competitiveness.

In the early 1970s, the tax support system was focused on investment in facilities as then economic policies focused on qualitative growth in economy, but in the late 1970s the system changed and it was believed that technological innovation was important along with accelerated restructuring of industries and rapid economic growth.

In the 1980s, the government pushed active technology drive policies and drew up various supporting systems to encourage businesses to innovate technology and expanded subsidies and taxes, financial, information and infrastructure support to make this possible.

In the 1990s, government support to enterprises was banned in principle and the government also reduced direct support, especially support to investment in facilities, to big companies by downsizing the existing industrial policies as South Korea joined the WTO and OECD, but they were accepted as exceptions that the government offered support for technology development or small and venture businesses and for that reason, the government maintained and expanded the fund for research and development and the loan support business. Furthermore, in 1990s technical innovation support system experienced changes from direct support to indirect support and the innovative system that included expanding support systems helped new technology to be commercialized.

It can be said that Korea could learn how to expand research organizations of private companies and how to help them innovate technology and have international competitive power although most of private businesses in developing countries had little interest in technology development by succeeding in developing technical innovation support system focusing tax and financial support systems we had experienced in the 1970s to the early 1990s.

We hope that this study can help a majority of developing countries facing problems like the gap in technology innovation between the government and private companies and poor technical competitiveness of private businesses by fostering a technical innovation support system.

Chapter 1

Preface

1. Overview of the Technique Innovation Support System
2. Background of the Private Companies Technology Innovation Promotion Policy

Preface

1. Overview of the Technique Innovation Support System

The Technique Innovation Support System overview are the artificial policy measures that the government can affect for technological innovation of enterprises. It is being performed through various policy initiatives and institutions. R&D activities expanded and distributed, each department is responsible depending on the role and functions. Mainly depending on a system of finance spending, they are separated by taxation, finance, government research and development project (Contributions Assistance), manpower, purchasing, legal and institutional infrastructure(authentication, standards, testing and evaluation, intellectual property rights), and other indirect support (technology transfer and trade, technical information providing, technical guidance and consultation, etc.)(Shin, 2006, STEPI · KOITA). The 2012 brochure Technique innovation support system (KOITA, 2012. 8) have been divided into field of details, into taxation and finance, human resources, technology, appearance and certification, and procurement.

In this study, we look at the tax incentives and support for the Fund for the financial support system as the most significant affect for private technique innovation activities.

Table 1-1 | Technical Innovation Support System Classification and Information

Classification	Support Information
Tax Support	Reserve funds for R&D and human development, Levels of R&D tax incentives (ex. research and personal development costs, tax credit, etc.) and special exemption for small corporations
Subsidy Support	Supporting contributions and subsidies of participating national R&D programs (special R&D projects, industrial technology development business, industrial R&D infrastructure building program)
Investment /Loan Support	Scientific and technological rising fund, Industrial foundation /base fund, Informatization promotion fund, Technology fund support (commercial bank loans)
Manpower of Technology Support	Technical workforce security and utilization support (ex. technical research personnel system, job placement (utilizing overseas manpower for technique), On-site work program (professor))
Cooperative Research Support	Cooperative research support (ex. joint industry-academia-research technology development project, clustering technology research project (techno-park), promoting and supporting business research cluster, Technology transfer center)
Technology Information Support	Technical information services (internal and external technology information, human power information) through KISTI (Korea Institute of Science and Technology Information) and TIPA (Korea Technology & Information Promotion Agency for SMEs)
Other Support	Industry standard tests for evaluation, Industrial property, Technology assistance of SMEs, Technical and market advance support through facilitating commercialization of new technologies

Source: Presidential Advisory Council on Science & Technology (2004).

2. Background of the Private Companies Technology Innovation Promotion Policy

For industrial technology development, various attempts were made to explore new growth engines in the process of industrialization and find new key drivers of the economy. With the start of the 1st 5-year National Development Plan in 1962, development of science technology also kicked off as part of the national plan to support economic development. In 1967, the Science and Technology Development Promotion Act was enacted and the Ministry of Science and Technology was established to lay out the basic framework to develop science and technology. However, in the 1960s when the needs of technology

development were not so well recognized, it was mostly turn-key based introductions of technology along with the facility and actual development of industrial technology was not executed.

The process of industrialization in Korea can be identified in two ways, the replacement of imported products and production of exports operating in parallel. Technology development was also performed with focus on technology required for strategically important export industries. In the 1960s, the initial stage of industrialization, technological capability was enhanced by repeating the process of working on "Strategic industry designation → strategic technology development → localization of technology → roll out", this was to nurture strategic industries such as energy, fertilizer and cement to replace import and export-driven light industries. During this period, science and technology were largely applied to address issues arising in the field in the process of companies applying technologies to production lines.

Entering the 1970s as industrial structures became more sophisticated and a new development strategy of looking out to the external world was adopted, the policy direction was shifted to an export driven policy including export promotion measures, sophistication of industrial structure going on and nurturing of heavy industries to secure self defense capabilities. As a result, the weight of the heavy chemical industry in the manufacturing sector began to grow, far exceeding that of light industry in many aspects including investment, added value and export. Eventually quantitative easing policies were taken to overcome the crisis of the global oil shock and commodity crisis. However, overinvestments in the heavy chemical industry in the late 1970s caused rampant inflation and Korea lost its competitiveness with rising labor costs. In this situation, technology capability without capital investment soon reached its limitation in global competition and this spilled over to all other industries.

During the 3rd, 4th and 5th 5-year Economic Development Plan in the 1970s, as machinery, steel, shipbuilding and electronic engineering were selected as strategic industries, science and technology began to take the role of improving and enhancing newly-introduced and existing technologies, not just fixing problems in the field. However, as companies were not capable of developing these strategic technologies, the government had to initiate building specialized strategic industrial research institutes in each field of industrial technology and digest and improve newly-introduced technology before rolling it out across the industries. For industrial technology in the 1970s, the basis for self development was set with the enactment of the Technology Development Promotion Act in 1974 and it was the time to prepare strategic development of industrial technology with facilitation of technology introduction and establishment of government-sponsored research institutions. With the enactment of the Support of Specific Research Institutes Act (1973, Law No. 2671), the

Korea Shipbuilding Research Institute, the Korea Electronics Technology Institute, the Korea Institute of Machinery and Materials and the Korea Research Institute of Chemical Technology were established in 1976 and the Korea Institute of Ocean Science and Technology opened in 1978 under the wing of the Ministry of Science and Technology.

In the 3rd 5-year Economic Development, a new policy for technology cooperation was required to digest diversified and sophisticated technologies and the Ministry of Science and Technology adopted 5-year plan for global technology cooperation in 1972. The priority in technology cooperation was set in the order of industrial technology, management and administration technology, public technology and exchanges among scientists in basic science fields and key contents included exploration and introduction of required technology, enhancement of capability to improve and strengthen the technology customized to our situation, strengthened role as a technology donor, permanent installation and stays at science centers overseas, attracting Korean scientists and technology experts staying overseas and active support for Korean scientists' participation in international conferences. Also with "Technology Cooperation Steering Committee" established, it contributed to building a basic framework for national development.

As the policy for heavy chemical industry began to get on track, swift introductions of advanced science and technology became the key agenda to enhance global competitiveness of domestic companies. To this end, the government implemented the first measures to free up technology introduction in 1978 to ensure technology introduction to be handled in standard procedures instead of case-by-case evaluations with the categorization of three types: free pass, semi free pass and case-based evaluation. In 1979, the second round of measures were implemented. The Ministry of Science and Technology opened technology introduction centers to help companies screen technologies during the implementation of the free-up measures and planned to establish the Technology Development Fund.

During the 1960s and 1970s, instead of domestic technology development with internal capital, Korea adopted a growth-oriented strategy with focus on the government's export industry oriented policy with the support of introduction of capital resources from foreign nations, technology introduction and abundant low cost labor and was able to maintain relative competitiveness with labor-intensive products in the global market. This in turn led to remarkable economic growth. However, as the global economy was hit by the recession in the late 1970s, regulations of advanced nations on products exported from Korea were tightened and technology protectionism was strengthened with growing reluctancy in sharing core technology. Under the circumstances, Korean companies faced challenges requiring even greater efforts on development of new products, improvement and enhancement of existing products and streamlining of existing production lines based on the technology basis accumulated until that point.

Signs of revolutionary changes in information technology including semiconductors and computers, new materials technology and machine advancement technology began to appear and leading nations and companies across the world began to invest in development of technology closely related to national security such as semiconductors and computers and "the era of technology protectionism" had arrived. During the time Korea was actively seeking stable growth and opening up its market, it responded to deterioration of global market environments including a global economic recession and tightening up of protectionism with an external oriented growth strategy. However as the situation continued to deteriorate, changes were required to seek breakthroughs and renew its growth engines and promotion and facilitation of industrial technology became even more important.

With the launch of the 5th Republic in the early 1980s, the government adopted an economic and social development plan led by technological innovation in an effort to seek new growth engines for economic development. The reason behind these structural changes were the needs of new economic and social development plan to overcome limitations faced by the measures in the 1960s and 1970s, including the quantitative easing policy and externally oriented development direction focusing on scale up. Along with this, it was required for future-oriented government-led approaches to achieve advancement of industries. As advanced nations became reluctant to transfer technology and global competition for technology was getting fiercer, it was difficult to expect Korea to join the ranks of advanced nations without a technology intense industrial structure and strong support of policy to secure technology competitiveness. Korean companies that had been highly dependent on introduced technology did not have the potential to transfer themselves into technology-intensive industry and there were no domestic research facilities and development basis to help these companies.

To tackle the situation, the Ministry of Science and Technology integrated and coordinated research institutions in the field of science and engineering to maximize the benefits of R&D investment and efficiency of research. The government also set up the Technology Promotion and Expansion Council chaired by the President to define national goals in science and technology and decided and allocated short and long-term investments. The Research Development Council was also set up to serve as a presidential advisory board in key policy measures related to science and technology promotion. The economic and social development plan led by technological innovation was an inevitable choice for Korea and with the Technology Promotion and Expansion Council starting in 1982, public consensus for national development led by technology began to build and specific evidence can be found in the introduction of technology-driven business management strategies in the private sector, showing strong commitment and passion to technology development.

Science and Technology Implementation Plan under the 5th 5-year Economic and Social Development Plan included the government's initiatives to advance domestic technologies up to the level of advanced nations in Large Scale Integration (LSI), micro computers, electronic switching systems, fiber optic communications with investments of KRW 5 trillion 446.5 billion by 1986, setting up and running the Technology Promotion and Expansion Council chaired by the president, globalization of domestic R&D going overseas for investment in new technology, localization of 12 core industrial technologies including semiconductors and aircrafts and nurturing and utilization of private companies research centers.

The basic technology development direction was summarized in ① Technology-intensive light industry, ② Technology-intensive heavy industry and ③ Research-oriented high-tech industry and to this end, the government set the strategy to ① nurture and secure highly competent talent, ② encourage productive R&D activities and ③ localize core technology.

In nurturing highly competent talent, the demand for scientists with medical degrees or PhD degrees was projected to be 83,000 by 1991 and it was expected to run short of approximately 30,000 considering the supply of the time. So a special plan was set up to nurture 2,310 PhDs and 4,500 graduate students by 1991 and to attract 750 research resources studying overseas to invite and stay in Korea and 1,500 more in the short-term. Also to localize core strategic technology that was highly brain intensive and resource saving that had global competitiveness but was difficult for private companies to work alone, an organized move was made to implement it as national R&D projects and the industries included were fine chemistry, semiconductor, computer, machine technology advancement, aerospace technology, high molecule technology, bio industry technology, medical electronic technology and fabric dying technology. For these strategic industries and technologies, it was encouraged for each company to set up one research institute. Along with that, the government began to provide public funding for private companies's research centers that had been allowed only for national or public institutes so the they worked on joint research on national agendas.

It had been challenging to implement policies even after the launch of the Ministry of Science and Technology. However with the start of the technology-driven era in 1982, most of technology policies reported to the Technology Promotion and Expansion Council were actually implemented. The reasons why most of technology policies were implemented since 1982 were, first the technology-driven policies became the top priority in national agendas. Second, institutions and mechanism were set up to discuss and coordinate these policies efficiently. Third the Ministry of Science and Technology was able to secure financial resources to implement R&D projects having government-funded research institutions under its wing.

The government acknowledged a possible crisis in the middle of tightened protectionism and emergence of late coming developing countries in the 1980s, it was actively engaged to settle down a technology development scheme led by companies in the private sector. The government initiative to encourage private companies' research included tax and financial incentives, special benefits in military service for researchers and expansion of overseas training, R&D funding, establishment of big enterprise research centers and encouraging SMEs to join the Industry Technology Research Union, facilitation of purchase plans for new technology-based products and support for new technology investments. The government's tax incentives were extensive including recognition of technology development reserve as an uncollectable loss, tax deductions on technology and HR development expenses, exemption of local taxes on site for company research centers, reduction of tariffs on research supplies, exemption of special consumption taxes on research samples, tax deductions on new technology investments, tax reductions on gains on technology, tax deductions on technology projects and tax deductions for foreign technology experts. The government also established a system to provide government funding for research centers of private companies and industrial technology research association and expanded financial institutions loan extensions for technology development funding. Hankook Engineering was the first venture capital established with the joint investment by the government and private companies with introduction of the conditional investment system.

The Information Technology Center was established under the auspicious of the Korea Institute of Machinery and Materials in 1983 to oversee support from the government-funded research institutions for companies' technology development, served as a bridge between SMEs and government-funded research institutes, assisted exploration of promising SMEs and provided consultation on technology training of companies, testing and inspection, standard correction and technology transfer. The key contents of technology support project for SMEs were to identify 100 promising SMEs every year from 1983 to 1987 to support them, encourage building business and commercial use of research outcomes, especially patents and promote technology concentration through the Korea Institute for Advanced Technology.

Promotion of industrial technology that started in the mid 1970s ignited expansion of R&D investments by private sector companies and company affiliated research centers sprang up as tax incentives for private companies' research centers were expanded in the early 1980s. From 1980 to 1986, the number of research centers in the private sector grew more than 5 times to reach 290 at the end of 1986 and the Industry Technology Research Union that was established in 1982 to serve as a center for cooperative research among companies grew to 28 centers at the end of 1986. Technology development investment by private companies increased 57%, an annual average and the number of research resources at companies grew

33% every year. All of these showed technology development activities began to spread across all industries. The government's tax and financial incentives increased and purchasing procedures were improved to promote demand for new technology products. Technology development support policies such as substitutional military service were improved and enhanced and with these support measures, science and technology investment that began to see a dramatic increase entering the 1980s exceeded KRW 1 trillion in 1985.

Chapter 2

The Establishment and Revision of the Technology Development Promotion Law

The Establishment and Revision of the Technology Development Promotion Law

1. Enactment and Changes of the Technology Development Promotion Law

1.1. Enactment of the Technology Development Promotion Law

The Technology Development Promotion Law was enacted in 1972 for the purpose of strengthening the enterprises' international competitiveness and contributing the national economy development by promoting the development of the industrial technology and introduction and improvement of technology and by disseminating the results. This law was revised nine times and the full text was amended in 2001.

1.2. Content of the Technology Development Promotion Law

First, the Technology Development Promotion Law permitted the individual who introduced the foreign technology in a way that the law regulated or in other ways could reserve the technology development reserve fund. Also, the person who saves the technology development reserve fund could preferentially receive the support, part of long-term low-interest funds formulated for the development of industries. And the person could get tax reduction according to law on tax reduction and exemption.

Secondly, this law included support for the localization of the technology. If the individual importing the products whereby localization is possible by the domestic technology and invests a percentage of the revenue from it in technology development, he/she can receive support from the government.

Thirdly, this law included governmental support related to industrial property rights and licensing. It permitted the free transfer of the part of industrial property rights, which is the result of research and development toward the individual who conducted the research and development by the contact and the exemption of part or all of the license.

Also the Technology Development Promotion law formed the technology development deliberation committee, which consisted of one chairman and less than 14 members under the Ministry of Science-Technology to deliberate the essential particulars about industrial technology development and appropriate technology introductions.

1.3. Changes of the Technology Development Promotion Law

The Technology Development Promotion Law was revised several times to expand the targets and the business types that could reserve the technology development reserve fund, the coverage of technology development reserve fund usage and enterprises' technology development system.

Also the revision aimed to promote the develop industrial technology and introduce and improve technology and it encouraged the construction of its own research facilities and intensified the corporatization of new technology, protection of domestic new technology products and technical guidance of small and medium-sized enterprises. In addition, it promoted the effective technology development activities by complementing and expanding the enterprises' technology development system such as encouraging the export of domestic technology by establishing the industrial technology research association.

Furthermore, certain research projects were selected to develop essential industrial technologies to strengthen international competitiveness and the company-affiliated research institutes and the universities researched by the law. The company-affiliated research institutes and other institutions could be supported by government donations.

Also it was challenging to reward researchers for the research results before, so the law was revised to promote the researchers' willingness to study by providing the financial incentives from the profits generated by research results.

The law was revised to respond to the latest change of conditions of science and technology and improve the limits.

Table 2-1 | Reason and Contents of Enactment and Revisions of the Technology Development Promotion Law

Technology Development Promotion Act			
Date of Enactment/ Revision	Article	Reason for Revision	Contents
1972.12.28	Law No. 2399 (New enactment)	To overcome the restriction of domestic resources, strengthen the industry economy and improve quality of life, the promotion and innovation of technology development for the development of industry is essential. This aims to formulate the technology development system, which enables the research development of industrial technology and introduction and improvement of appropriate advanced technology. Also this aims to induce and promote the innovative development of industrial technology by supporting and fostering technology development.	1. The individual who can reserve the technology development reserve funds - the individual who introduces the foreign technology by the contact for the transfer of technology regulated by the Foreign Capital Inducement Act. - the individual who introduces the foreign technology by other ways 2. The benefits for the individual who reserves the technology development reserve funds. - the individual can preferentially receive support, part of the long-term low-interest funds formulated for the development of industries. - the individual can receive tax reductions according to Law on tax reductions and exemptions. 3. Government support for the localization of technology. - the individual who imports the products whereby localization is possible by the domestic technology and invests a percentage of the revenue from it in technology development, that person can receive support from the government. 4. Government support for industrial property rights and licensing. - free transfer of the part of industrial property rights which is the result of research and development toward the individual who conducted the research and development by the contact is available. - the license can be exempted partly or all towards the licensee. 5. Composition of technology development deliberation committee. - the committee consisted of one chairman and less than 14 members under the ministry of science-technology to deliberate the essential particulars about industrial technology development and appropriate technology introduction.
1977.12.31	Law No. 3095 (Revision of a part)	Will want to induce and compose efficient technology development activities, by complementing and expanding the company's technology development system, such as to promote an independent development of Industrial technology, and digestion and improvement for technologies introduced by expansion of reserve institutions for technology development of enterprises, to encourage the construction of facilities for its own research, to strengthen the industrialization of new technologies, the protection for new domestic technology products and technical guidance of SMEs, to Install Technology Research Association, promotion of the export of other domestic technologies.	1. To expand target sectors that can earn Reserve for technology development, to allow adopters of technology and the operators of the key strategy industry sectors to earn as reserve for technology development. 2. Expand the coverage of usage of technology development reserve funds. 3. To establish provisions of new technology development for importers . 4. To expand targets of long-term and low interest financial support for technology development. 5. To allow protective measures as required such as a certain period of import restrictions for similar products and the regulation of duplication manufacturing for the same item with respect to domestic manufacturers of new technology products. 6. Any person who intends to sign a contract of technology export should report the technique export plan to the Minister of Science and Technology before signing a contract in advance. 7. The matters regarding the establishment of Technology Research Association should be specified.

Technology Development Promotion Act			
Date of Enactment/ Revision	Article	Reason for Revision	Contents
1981.12.31	Law No. 3521 (Revision of a part)	To develop essential industrial technology for international competitiveness, this aims to make a legal basis for the company-affiliated research institutes and universities can research and receive government support.	1. Secretary of the Ministry of Science and Technology selected the research projects to develop skills of key industries and allowed to study with joining the convention with R & D center, university, national and public research institutions, expenses were appropriated to contributions of the government or non-government parties and the technology development cost of companies. 2. Secretary of the Ministry of Science and Technology can provide contributions to an Institute of a company or Industrial Technology Research Union in order to promote specific research and development projects.
1989.12.30	Law No. 4184 (Revision of a part)		1. Changes import regulations and the regulatory systems for redundant manufacturing of the same product to tax incentive systems as means of protecting domestic manufacturers of technical products. 2. Add the corporation in the field of science and technology as research institutions in target organs of specific research and development projects for the convention. 3. Delegate and commit projects of technology development support to organizations or groups prescribed by the Presidential Decree and in this case enable to receive financial support. 4. Strengthen to operate the approval system in the future only for a strategic technology notified in advance, of technology export contract operated by the current reporting system and add penalties provisions for new violations.
1994.01.05	Law No. 4711 (Revision of a part)	The basis for forced earning of company's reserve for technology development was deleted and the Earn Report System of the reserve for technology development was abolished with respect to relaxed economic Administrative regulations, as the result of these liberalization plan to the convenience of the people and enhance support for technology development activities with incorporation of for-profit corporations in the target organs of the Convention for specific research and development projects.	1. Deletion of the basis for forced reserve allocated to a company for technology development. 2. The repeal of the report system of the allocated reserve for technology development. 3. Addition profit corporation to the target organs for convention of the specific research and development project.
2000.01.12	Law No.6125 (Revision of a part)	There was no policy to reward researchers who participated in specialized R&D projects for their research performance so it was difficult to keep them motivated. So it is planned to grant part of benefits earned with the research outcomes to the researchers participating in relevant R&D projects.	Allow to use part of the benefits earned with the research outcome of a certain R&D project to compensate researchers who participated in the project as a reward for their performance.

Technology Development Promotion Act			
Date of Enactment/ Revision	Article	Reason for Revision	Contents
2001.05.24	Law No.6472 (General revision)	The Enactment of Framework Act on Science and Technology, the Special Act on Innovation in Science and Technology was abolished and some of the clauses were redefined and the New Technology and New Product Certification based on domestic new technology were integrated into the New Technology Integration Certification System to proactively respond to changing science and technology environments by improving and supplementing weak and shortcomings of the current system.	1. Integrated into the New Technology Certification System and those who want to be recognized for new technology have to apply to the Minister of Science and Technology and calls for the Minister to establish support measures including financial support for those who manufacture products with new technology. (Article 6 of the Act) 2. Expand the scope of research institutes allowed to participate in specialized R&D projects by including liberal arts research institutes along with science research institutes in the scope to ensure focused development of core industrial technology. (Article 7 of the Act). 3. Ease unnecessary bureaucratic regulations by abolishing pre-reporting requirements for existing export contracts (Delete Article 10-2) 4. Allow cancellations of Certification for those who earned it with unfair or illegal methods (Article 14 of the Act).
2005.12.30	Law No.7809 (Revision of a part)	Establish basis to charge technology loyalty for the use and transfer of the outcome of specialized R&D projects and build a legal basis to allow the use of supplies and equipment generally prohibited for use, manufacture, sell and import only for research purposes. Also supplement requirements for strategic technology export to enhance administrative transparency and improve/supplement weakness and shortcomings in the current system.	1. Build basis to charge technology loyalty (Article 7-3 and 4 of the Act) - Build basis to receive technology loyalty from those who use the outcome of specialized R&D projects and allow to use the received loyalty to compensate researchers participating in the projects and transfer to specialized institutes designated by the presidential decree to use it for promotion of specialized R&D projects 2. Build a legal basis to allow the use of supplies and equipment generally prohibited for use, manufacture, sell and import only for research purposes (Article 9-3 of the Act, newly added) - In case of using supplies and equipment prohibited for use, manufacture, sell and import by other laws or regulations, the head of relevant administrative authorities have to set out the purpose before allowing use. 3. Build basis to supplement or cancel requirements for permit on strategic technology export (Article 13 of the Act) - When allowing export of strategic technology, things to consider need to be specifically defined and where there is possibility for the strategic technology to be leaked to export-limited areas, the effect of the permit has to be suspended or cancelled
2008.12.26	Law No.9219 (Revision of a part)	The current dual punishment system holds the business owner to be punished regardless of the owner fulfilling supervisory/ managerial duty for employees and others and this leaves possibility to run against the principle of liability. So ensure staying true to the principle of liability by exempting the owner from punishment when he/she fulfills duty for employees and others.	Ensure exemption of the owner from punishment when he/she fulfills supervisory/managerial duty for employees and others
2011.05.24	Law No.10708 (Abolition)		1. Build strategic implementation framework including innovation plan (Article 6 newly added, Article 45 and 46) - To respond with more flexibility to rapidly changing market environments and create new growth engines, it is required to actively tap into success experiences held by core talent in the private sector to ensure industrial technology innovation. - To provide specialized support for industrial technology innovation, the Strategic Planning unit has been established at the Korea Evaluation Institute of Industrial Technology and a cooperative framework has been built to allow private experts to participate.

Technology Development Promotion Act			
Date of Enactment/ Revision	Article	Reason for Revision	Contents
2011.05.24	Law No.10708 (Abolition)	To respond to changing market environments and generate new growth engines, the Strategic Planning unit is established to provide specialized support for industrial technology innovation and to prevent unauthorized use of the funds allocated to industrial technology innovative companies, introduce additional penalty on top of the existing one. Also, the New Technology Certification System that is running under the 「Technology Development Promotion Act」 has been integrated with the New Product Certification System under the act to prevent redundant or similar functionalities in an attempt to improve and supplement weakness and shortcoming in the current system.	- The Strategic Planning Unit is formed with the head and about 7 members including a technology development investment manager for key industries. - To ensure the Strategic Planning unit to perform in a fair and responsible manner, ensure Article 45 (Recognizing the Member as Government Employees in Applying Penalty) and Article 46 (Confidentiality) to members of the unit and members of the Korea Evaluation Institute of Industrial Technology and the Korea Institute for Advancement of Technology are also recognized as government employees in applying penalty. The confidentiality responsibilities are applied regardless of whether they are currently in the position or resign. 2. Expand the scope of industrial technology development projects (Article 11-1-⑦) - To respond to growing research needs in the service sector, brand and business model are added in the scope of industrial technology development projects 3. Introducing penalty for using the funds for purposes other than research (Article 11-2-④ ⑤ ⑥ ⑦, Newly added) - In case of unauthorized use of the funds such as embezzlement, punitive measures such as prevention on participating in R&D activities or repayment of the funds have been applied but unauthorized use of the research funds still remains rampant. - When the funds are used for purposes other than research, it is allowed to charge up to 5 times of the amount used as penalty. - When punitive measures such as limitations on participation or repayment of the funds, the Minister of Knowledge and Economy shall notify the head of the institutions, the relevant research supervisors or researchers belong and details of limitations on participation or repayment of the funds. 4. Integration of the New Technology Certification and New Product Certification (Article 15-2, Article 16, Article 16-2~16-5, Article 17-1 and Article 43-2 Newly Added) - The New Technology Certification System and New Product Certification System running under the 「Technology Development Promotion Act」 have many similarities, so they need to be integrated for efficient operation. - With abolishment of 「Technology Development Promotion Act」, the new technology certification, effective period of the certification and extension of the period, mark of the certification and cancellation of the certification were transferred and redefined in the Act. Also punitive measures are introduced for those who earned the certification in untruthful or illegal ways. Also the system has been improved to ensure the payment of fees for new product certification too and new policy has been added to define regulation on raising objections and result notifications. 5. Add technology talents with physical disorders in the scope of targets for industrial technology resources nurturing promoted by the Ministry of Education, Science and Technology (Article 20-1-⑧). 6. Build basis to dispatch researchers at institutes affiliated with the Korea Research Council for Industrial Science and Technology to SMEs and mid-sized companies for the long-term (longer than 3 years) and ensure the ratio of resources dispatched to SMEs is higher than the level designated by the Minister of Knowledge and Economy (Article 34-2 Newly added).

2. Technique Innovation Support Systems between 1972~1980

Economic development in the 1960s was led by remarkable industrial development in the successful implementation of the 1st and the 2nd 5-year Economic Development Plan and from the 3rd round of the 5-year plan from 1972 to 1976, research & development, exports increased and the establishment of the heavy chemical industry were selected as key strategies to move out of consumer goods-oriented light industry and to go to heavy chemical industry. Science and technology capabilities were still lagging behind advanced nations and Korea had to survive the trade competition getting more intense everyday. In order to encourage private companies that were not very interested in technology development or cost savings to take the lead in industrial technology development, the following policies were implemented (Almanac of Science and Technology, 1971).

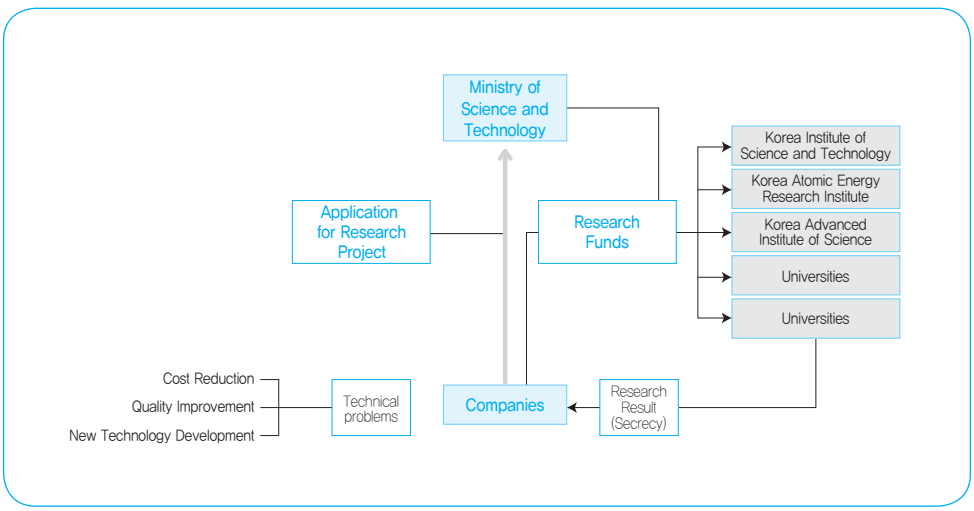
First in the Almanac of Science and Technology 1971, establishment of a framework for joint research was discussed as a way to promote technology development. At that time most of Korean companies were SMEs and did not have strong enough foundations for technology development. Considering the situation, the yearbook called for the needs of joint investment by association of SMEs and the government. Along with that, the yearbook also discussed a scheme where the government might grant exclusive rights to the company in the first 2~3 years and tax exemptions after development in stronger cooperation with the company when there was a request by the company and after that period, the government could transfer the technology taking loyalty (Almanac of Science and Technology, 1971).

Next, in the Almanac of Science and Technology 1972, there were measures to promote technology introduction and private sector research centers' activities to digest and improve introduced technology. As the nation's technology development competence was still weak and not very accomplished during this time, the target was to introduce existing advanced technology to digest and improve except for key technologies that had to be developed on our own. To encourage R&D in private companies and promote introduction of advanced technology, the yearbook suggested review over support measures of government research funding, joint research among companies and research unions. It also said it was required to make practical use of research outcome with various new technology or patents and to this end, the book discussed establishment and nurturing of a science and technology foundation (tentative) (Almanac of Science and Technology, 1972).

In 1973, for proactive and independent research and development, the book discussed measures to encourage assignment of technology development initiatives of private companies to domestic specialized research institutions, promote joint participation of research institutions and industries, focus R&D budget of the government and the Korea

Institute of Science and Technology on industrial development directly linked to production and expand technology diagnosis and guideline initiatives from the existing targets of exporters to companies designated for industry optimization and to SMEs. Along with that, to facilitate support for R&D activities in the private sector, the yearbook suggested that industrial technology development budget out of the government research budget should be converted to joint research and the cost had to be covered by the government and private companies in 50:50 (Almanac of Science and Technology, 1973).

Figure 2-1 | Research and Development Initiatives Implementation



Source: Science and Technology Annual (1973).

In the 1974 Science and Technology Yearbook, it outlined operations of the technology introduction consultation center, joint research initiatives between the government and private companies and the technology development reserve system. The Technology development reserve system was designed to encourage private companies to actively invest in new technology development by allowing companies to include expected expenses for technology development as an uncollectable loss in advance of calculating gains and losses in an effort to allow them to accumulate a technology development fund. Specifically, companies that introduced technology in the year based on introduction agreements could choose one out of the payment, the payable or 5% of income of the year or during the taxable period to include as an uncollectable loss and companies that did not introduce technologies were also allowed to include 5% of income of the year or during the taxable period as a uncollectable loss. Technology development reserves reported by companies were known to exceed KRW 3 billion as of November, 1974 (Almanac of Science and Technology, 1974).

Table 2-2 | Saving Amount of Technology Development Reserve Funds

(Unit: million won)

	Numbers	Saving amount	Categories		
			Technology Development	Technology Information	Technology Training
Machinery	9	22	16	2	5
Chemical Engineering	28	1,314	1,085	105	125
Textile	32	999	620	63	317
Resource	1	32	22	1	9
Electric Electronic	5	443	303	65	75
Metal	3	290	159	26	105
Total	78	3,101	2,205	256	236

Source : Science and Technology Annual (1974).
Original Source : Ministry of Science and Technology.

In the Almanac of Science and Technology 1975, it was reported that the technology introduction consultation center (within Hongreung Science Complex) that opened in 1974 provided around 970 cases of consultation on how to introduce advanced technology in one year, gaining positive feedback from companies and it pointed out that the post management system needed to be built by running a circuit consultation body and assessing utilization of introduction technology and possible issues (Almanac of Science and Technology, 1975).

Building on the role of the Korea Institute of Science and Technology to consult mostly on technology introduction, in 1976, the Technology Introduction Center opened within the institute to perform ① an assessment on accumulated overseas technology information ② review guidelines and coordination to select the right technology and ③ a feasibility review on technology introduction to serve as a bridge between research institutes and companies. Also financial support measures were discussed to allow companies to accumulate parts of loyalty in the account of technology digestion and improvement funds in an effort to encourage companies to absorb research activities into their territory (Almanac of Science and Technology, 1977).

The technology development reserves started with the enactment of the 「Technology Development Promotion Act」 in 1972 and was used for technology development, technology information and technology training and more than 70% was invested in technology development, showing companies' commitment to technology development growing

stronger (Almanac of Science and Technology, 1976). In the technology development reserves, more than KRW 10 billion was accumulated by 135 companies by 1976 (Almanac of Science and Technology, 1977) and KRW 16 billion by 150 companies in 1977 (Almanac of Science and Technology, 1978) and from 1976 to facilitate the business use of new technology developed domestically, technology development funding to lend at low interest rate over the long term was established (Almanac of Science and Technology, 1977). The industries allowed to accumulate the reserves under the Technology Development Promotion Act were manufacturing, construction, mining, machinery, information processing and defense industry and they were allowed to accumulate the reserves within 20/100 of income of the year (Almanac of Science and Technology, 1980).

The Technology Development Promotion Act was revised in 1977 and the key revisions included firstly, expansion of target industries to provide tax and financial incentives for technology development and strengthening measures to make technology development as mandatory initiatives for technology introducers and key strategic industries. Secondly, it was revised to expand the scope of using technology development reserves to digestion and improvement of introduced technology and construction of research facilities and including research facility builders and new technology business players in the scope of beneficiaries of low rate long-term technology development lending. Thirdly, it allowed protection measures for products made with new technology domestically developed and fourthly, addressed technology issues commonly suffered by SMEs and introduce advanced technology in the same field in the batch it was allowed to establish 「Industry Technology Research Union」 (Almanac of Science and Technology, 1978).

In the late 1970s when technology development capability still remained weak, companies proactive efforts and extensive introduction of advance technology were essential and to this end, they needed to transfer from batch introduction where capital and technology were directly linked to core technology-focused approach to selective introduction. It was also targeted to increase technology loyalty against exports from 0.3~0.6% to 1% during the 4th development plan and to 2%, the range of advanced nations during the 5th development plan and to facilitate the process it was proposed to simplify complex procedures(Almanac of Science and Technology, 1978). In 1978, as the first phase of technology introduction free-up, introduction of technology was freely passed for the industries such as heavy chemicals and leading export industries and in 1979, most of the industries were open for technology introduction except for special areas such as nuclear energy and defense industry and those likely to be developed domestically.

In industrial technology development, since the late 1970s, securing independence in the heavy chemical industry was a top priority. In 1978, the Technology Development Promotion Act was enhanced to strengthen tax and financial incentives and in cooperation

with other departments including the Ministry of Commerce, Industry and Energy, 208 companies were selected to give strong recommendations for technology development. Also in the private sector, the private research institution establishment council was set up. With the government policy to encourage large enterprises to build their own research centers, 15 enterprises already built private research centers and 47 were in progress in 1978. Also systematic support was provided such as a system to make it easy to invite foreign experts and protection measures for competitive new Korean products were taken to limit import of similar products or prevent redundant manufacturing (Almanac of Science and Technology, 1979).

As a measure to promote industrial technology development, technology development 「Circulation Fund」 was set up to provide the technology development fund directly to companies, key players in manufacturing and production and ensure them to tap into research centers under the responsibility of those companies in an effort to directly link research and production and to increase investment efficiency. Also to secure resources, the government was directly involved in negotiations with World Bank and a pre-feasibility review was conducted with UNDP funding (Almanac of Science and Technology, 1979).

To support the construction of company-affiliated research centers, in the Technology Development Promotion Act it was recommended to build or expand research facilities for companies in machinery, shipbuilding, electronics, electrics, metal and chemical engineering, that lacked internal research facilities or had to improve existing ones. Tax incentives for the companies who accepted and acted on the recommendation included ① recognizing the reserves used for research facilities as an uncollectable loss ② temporary tax deductions for construction of affiliated research institutions ③ special deductions for test and research labs and for financial incentives, priority loan at low rates in the long-term was provided as technology development funding for the construction of research facilities and purchasing of research supplies (Almanac of Science and Technology, 1980).

Entering 1980, it was aimed to advance technology to global standards and a establish technology development corporation to localize plants and go overseas with Korean technology. The capital of the technology development corporation was around KRW 15 billion jointly supported by the government and the private sector and it grew to KRW 45 billion when government lending was included. To support the corporation, loans for companies' technology development, loans to make business use of research outcomes, technology labor expense loans for industrial facilities and rentals of research equipment were provided. As financial support other than the ones for the technology development corporation, low rate long term venture capital loans extended by the Korea Development Bank and the Industrial Bank of Korea were expanded (Almanac of Science and Technology, 1980).

For the cases of utilizing the outcome of domestic technology development in business for the first time in the nation, tax and financial incentives were provided. First, for tax incentives, 8/100 or 10/100 of the investment made for machines used directly to make business use of new technology (when domestically manufactured machine was used) was deduced from corporate taxes or income tax. Second, as financial incentives, new technology business players took top priority in receiving technology development funds provided by the Korea Development Bank every year since 1976 (Almanac of Science and Technology, 1980).

As a measure to address weak technology competence of SMEs, in 1980 it was encouraged to implement the establishment of a industrial technology development union, implementation of joint research initiatives of the government and private companies and strengthening of technology guidelines. In an effort to address common problems suffered by SMEs, it was promoted to establish an industrial technology development union in the same or relevant industries to facilitate exchange of technology information and sharing of research facilities. Also with the joint research initiatives between the government and private sector that started in the early 1970s, efforts were made to address technology challenges of SMEs.

3. Technique Innovation Support Systems between 1981~1995

Korean government acknowledged the importance of private corporations' independent research centers in order to accelerate industrial technical innovation and thus expanded the support system from 1981.

The Almanac of Science and Technology of 1982 stated the background of the expansion of technology development support was "due to the pursuit of growth outside of technology studies in the course of rapid economic development in 1970s," which indicated increased demand of technological growth in 1980 compared to quantitative growth in 1970s. The almanac continued to explain that in 1980 corporations began to take interest in technology development as the government promoted technological drive policies for the second economic leap.

It described the leading strategies were, firstly, to concentrate national technology development capability to accelerate research and development; secondly, to incorporate international technologies to overcome domestic limitations and stabilize the technology application; and thirdly, to establish cooperation systems with industrial universities. The government backed up these strategies with taxes and in financial aspects. As to tax,

Korea increased the budget limit for the technology development reserve fund, created tax deduction programs for technology and human resource development and the revised tax deduction system for research facilitations. In the financial aspect, Korea Technology Development Corporation, Korea Development Bank, and Small and Medium Industry Bank enlarged technology development funds and the government directly subsidized funds for private corporations. In 1981, the quarterly held National Technology Convention built procedural system that solved technology tasks under cooperation of industries, universities, researchers and the government, reported the almanac (Almanac of Science and Technology, 1982).

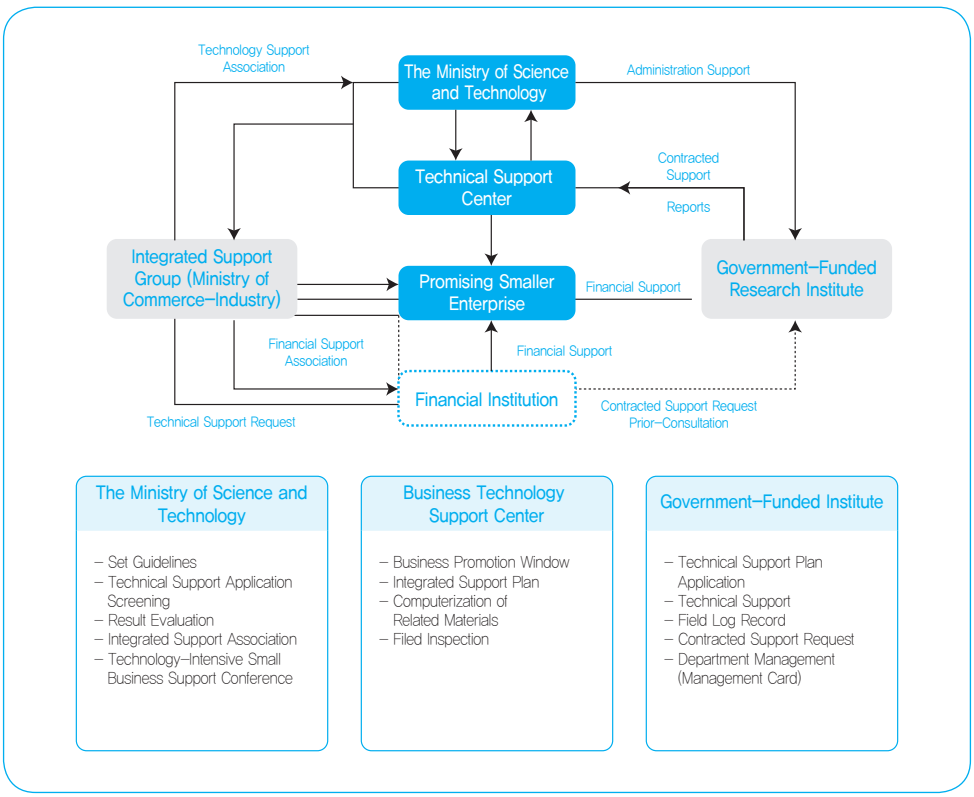
Private corporate research centers used expanded financial aid. The government supplied increased corporate subsidies in 1981 and the following year, including military exemptions on science Bachelor degree researchers to procure enough research manpower for corporate research centers. Local tax deductions and, which had been previously advantages of governmental research facilities, were also applied for corporate research institutes and tax-deductible research facilities were granted to private facilities. Private research was given opportunities to participate in governmental research and development projects. These efforts yielded an important turning point for private companies to build research facilities.

The broadening of such support continued in 1983 with the standard of military exemptions for private research centers and industrial technology research associations lowered, the list of research goods was stretched, and the tax-deduction rate was raised for tax-deductible items. The government also adjusted the common purchase process, which had run against new product developers, to select the bidder based on holistic analysis of price, quality and efficiency in order to motivate technical innovation. Since 1983, government aid was categorized into corporate size, form of support (tax deduction, financial aids, and common purchase) and development phase (research and development, industrialization, and market entering). In this process, the Korean government reflected the need for structure adjustments that had been previously difficult for smaller companies and venture enterprises (Almanacs; 1983, 1984). In the regards to supporting smaller companies, Korea built the Enterprise Business Incubator Center in the Korea Machinery Research Institute to encourage promising small and medium-size firms to enhance their technology, provided technical guidance, and strengthened the association between enterprises and governmental research institutes (Almanac, 1984).

Since 1983, the focus was on designing and executing policies for smaller businesses to concentrate their technology to boost technical innovation. One of the government efforts to promote smaller enterprises was for the Ministry of Science and Technology to open nine projects to foster and provide technical guidance to promising companies. This included discovering promising businesses and to provide high-end technology through

specialists to facilitate technology-intensive companies. The specific projects were not limited to technical guidance by sending out government-associated researchers for long-terms, inauguration and operation of a Development Laboratory in a Enterprise Business Incubator Center in 1985 on joint contracts for high-price test equipment, and quality certification or performance evaluation test by government research institutes for products of smaller businesses (Almanac, 1985).

Figure 2-2 | Promising Small Business Support System



Source: Almanac of Science and Technology 1985.

The support system for industrial technology development improved in its administrative procedure in 1980s. Simplified documents required for technical development funding register and report that started in 1970s, lead to stronger incentives for the funded companies, and improvements of administrative management increased efficiency. Research support also gradually expanded by lowering its recipient company qualifications from 30 employees to 5 employees. Financial support also broadened its beneficiaries from facility funding to R&D investment, which has high risks and a longer period of time to yield profit,

and tried to include other industries that are excluded from the Machine Industry Promotion Fund and the Electric Industry Promotion Fund (Almanac, 1986). The purchase Support System for R&D was first established in 1984 as the Mid-term Purchase Sampling System, which notifies during the purchase planning stage the size, quantity and price of items to be purchased, to give manufacturing businesses time needed for R&D and manufacturing, and to promote planned production and technical development. These government efforts yielded visible results: private R&D investment remarkably increased in the 1980s. The number of corporate research centers rose from 53 in 1981 to nearly six times to 291 in 1986, and the number of industrial technical research associations increased from 11 in 1982 to 28 in 1986. The technical development fund and technical innovation support were more emphasized in the late 1980s; following 1986, financial support for smaller business took a big leap. Support for the Small and Medium Enterprise Establishment Act, enacted in 1986, offered the foundation on which smaller enterprise start-up investment companies were built to invest in technology-intensive businesses and invested KRW 200 million in 1986 and 500 million in 1987 each (Almanac, 1986).

In the late 1980s, technical innovation focused on tax-deductions and financial support for industrial technology development and technical support for start-up enterprises. The system was continually improved and expanded. The industrial technology development support system was improved by revising the Technology Development Promotion Act, Regulation Law on Tax Reduction and Exemption and Customs Law, which specified qualifications of the technical development fund and lowered the enterprise size criterion on smaller businesses. A wider range of technical/human resource development and research equipment took advantage of tax deductions. The Industrial Development Act led to the addition of governmental funds to industrial technology development in 1987. In the same year, the emergence of the Korea Cast Technology Research Association and the Korea Welding Technology Research Association contributed to shooting common technical problems of smaller businesses (Almanac, 1987).

The Technical Innovation Support System pressed on improvement. It lowered major military exemption criteria, and the number of researchers, decreased from 30 to 10 people. It was further supported with tax support by removing the technical development preparation fund and technical/human resource development from the list of total tax support maximum limits. Research associations could receive loans on technology credit and take advantage of tax-deductions on research materials by revising the Law on New Technology Business Financial Support. The Enterprise Business Incubator Center and its high-price equipment was utilized by smaller businesses only through the open labs. In 1988, the first local Business Incubator Center was built in the Gwangju Hanam industry complex. The Domestic New Technology and Products Protection System, which had been run from

1978 and regulated import, had to be revised due to conflicts caused in international trades (Almanac, 1988).

In late 1980s, support covered an even larger range and more various policies were introduced, thereby elevating the importance of technology innovation of smaller enterprises. The Technology Credit Guarantee Fund, created in 1989, began to serve new technology entrepreneurs and industrial technology research associations. The goal of smaller business support was to accelerate the industries by augmenting the capabilities of smaller enterprises through technical innovation. It ensured the transition from price competitiveness due to cheap labor power to technology-based competence, which involved enhancing corporate structure through computerization and automation. To enable information-oriented management, the Korea Technology and Information Promotion Agency was founded to develop computerized systems and implement high-end computerization technology in enterprises. The Ministry of Science and Technology established the Korea Research and Development Commercialization Agency to take charge of patent development of new technology and bridging new technology information. Furthermore, smaller businesses were encouraged to enter international markets. The government reinforced technical support for local research complexes, provided loans for technology partnership and training, and deducted taxes on international joint research. In the late 1980s, technical support was varied in its form and methods to bring smaller business technical innovation to more local and international stages (Almanac, 1989).

Entering the 1990s, the tax and financial support advanced according to economical and technological changes. The policy grew to the Technology Development Special Measurement in 1990, Manufacturing Industry Invigoration Measurement in 1991, and Science and Technology Innovation Holistic Measurements. The tax-deductions on technology/human resource development also broadened its range from post-Bachelor degree researchers to all researchers, extended the deduction terms from 4 years to 5 years, and increased the special deduction on new technology commercialization from 30% to 50%. On corporate research centers and research associations, the scholarly research materials were deducted in tax from 65% to 80%, including research samples, components, materials and reagents. In the financial aspect, the Science and Technology Promotion Fund was established based on the Science and Technology Promotion Act in 1992. Present financial institutes, including the Korea Development Bank, prioritized outstanding technology innovative enterprises and expanded the Korea Technology Development Corporation into the Korea Technology Banking Corporation to increase financial support. The military exemption of researchers raised its standard from Bachelor's degrees to Masters degrees. Military exception was stretched from business with 30+ research experts to 10+ in 1987, and to 5+ small research centers in 1990 (Almanac 1991).

The improvement and expansion of the technology innovation support system continued in the 1990s, with its direction slightly adjusted to market conditions. Taxation support was revised in 1992 to reduce tax-reductions for regularity investments from 10% to 5%, yet increasing the deduction rate for the increased investment compared to past 2-year average, from 10% to 25%. This change turned the helm in the direction to which other developed countries headed: from the R&D investment scale to the increased amount of the investment. Further, technology ventures and commercialization were considered even more important; among initial commercialized projects, businesses that are officially credited for new technology enterprises could take advantage of a 90% special deduction rate (from 50%). Policies were legislated to accelerate fast-changing industries such as info-communications industries. In addition, the Korea Technology Banking Corporation launched R&D Commercialization Agency to promote commercialization of new technologies (Almanac, 1992).

With constant expansion and changes in the technical innovation support system in the early 1990s, the focus moved to commercialization of new technologies and market entrance of new products. The Almanac of Science and Technology of 1993 pointed out that "the United States has excellent R&D capability of universities and governmental research centers and application and commercialization ability of enterprises, yet lacks the efficient association system and thus inevitably does not achieve good enough results compared to Japan in the competition," which called for agile commercialization of new technologies. Accordingly, the Five-Year New Economy Plan on R&D strategies 1) established the technology innovation Business Incubator Center and commercialization special agencies in associated research centers and universities, 2) promoted using patented technology by giving incentives to Cross-License contracts between corporations, 3) procured new technology products demand by implementing the Korea Good Technology mark, to commercialize developed technologies and create demand for new products. The R&D Commercialization Agency signed contracts with 15 associated universities; and discovered commercialization tasks, consulted on technology transfer, freely shared holding technology, and helped building businesses with the technologies. Local Business Incubator Centers were built and the National Technical Information Service was established to form expert management support and information network and provide related information (Almanac 1993).

On UR round in 1993 led to GATT in January 1995, which changed the environment of technical innovation support in the mid-1990s. The Almanac 1994 recorded the background for policy-making for industrial technology development as the GATT and its protection of intellectual property rights greatly impacted domestic enterprises which was highly dependent on major technologies transferred from developed countries and made the

technology transfer highly challenging. Thus, it become the next task to improve Science Technology capabilities to compete in the new infinite competition, which highlighted the need for technology development of private corporations (Almanac, 1994).

The changing polices, in turn, were attributed to the sizable growth in R&D investment in the 1980s. In the 1970~80s, the government led initial R&D investments with taxation and financial aids. In the following two decades, private R&D investment outpaced governmental investment multiple times over, which was the limit for the governmental science and technology policy. Therefore, domestic conditions were ready to reconsider the government's role in development support and the role of innovative small businesses was even more accentuated. The policies started to commercialize new technology, provide science technology information services which were the main infrastructure, supply research human resource with universities, and strengthened demand-oriented technology development and basic sciences research to create synergies and integrate with private sectors. Also in taxation support, the trend turned to that of developed countries: from direct financial support to indirect policies and funds through Korea Technology Finance.

Chapter 3

Technology Innovation Support System's Contents by Sector

1. Evolution of Tax Incentives
2. Evolution of the Financial Support System

Technology Innovation Support System's Contents by Sector

1. Evolution of Tax Incentives

1.1. Background

The first tax support system: In the 1960s, the prehistory of economic development, the labor-intensive industry based on the induction of foreign capital, cheap and skilled work force were key roles of economic growth. The growth policy's key roles were the elimination of absolute poverty and industrialization. At that time, that was busy digesting technique and improvements within introduction of capital goods. The system of tax exemptions for foreign introduction of techniques was the first tax system for support in technique innovation of private introduction. In the 1970s, economic development strategy, strived for industrial structure development, exporting heavy and chemical industry products, and this was pursued by promoting heavy chemical industry.

In the 1960s, industrialization started and the tax support system's beginning is the tax deduction on the expenditure of technology introduction for the technology transferor, the foreign companies. And the tax incentives including experimental and research expenses as deferred assets and the special depreciation system on research facilities was implemented in the 1960s.

In the 1970s, the tax support system was implemented in the heavy chemical industries. The deduction rate of inland taxes was 100% in 14 key industries during first 3-year and 50% in second 2-year and that of customs was 70~100%. In addition, tax deduction on tariffs in the case of imports of facilities and tax deductions on corporate taxes of capital

investment was added. To promote exports of heavy and chemical industry products, income taxes from exports or corporate taxes were deducted by 50%. Several tax incentives was carried out such as financial support, inland tax deductions, tariffs deductions, tariffs deductions in the case of import of facilities and corporate tax deductions in the case of capital investment in the heavy chemical industries. By the enactment of the Technology Development Promotion Act (1972), it specified the tax incentives such as subsidy support on technology development, financial support and technology development reserve fund system, the support on private enterprises' technology development to be expanded. There were several incentives such as deductions on technology development reserve fund (1972), deductions on investment on the assets for new technology corporatization (1974), deductions on income from technology service enterprises (1977) and deductions on technology income (1979).

The Technology Development Reserve Fund System is for inducing the enterprises' investment on technology development indirectly by spending profits for technology and manpower development within four years. The expense for technology development could be decreased and this expense could be included in deductible expenses.

In addition, the Technical Services Support Act (1973) was enacted to improve the technical level of domestic services and the National Technical Qualification Act (1973) was enacted to systematize the technical qualification standard in key industrial technology fields and to train the outstanding technical manpower.

In 1977, the protection system on domestic new technology product manufacturers, Technology export report system, establishment of industrial technology research association and Income tax deduction system on technology service enterprise was introduced by the revision of the Technology Development Promotion Act. Special import measures on safeguard goods were implemented to support technology acquisition. In 1978, the Ministry of Commerce and Industry implemented exceptional measures to the import of facilities and materials needed by the private research institutes.

The government's intervention is needed in technology development investment because technology development (R&D) Investment's payback period is longer and uncertainty is higher than other investments. The government implemented several measures to promote the enterprises' technology development and tax support are the most representative measures implemented in several countries. Korea also has actively implemented tax support measures on enterprises' technology innovation since the 1960s.

1.2. Tax Incentives for Technology Innovation before the 1980s

In the early stages of Tax Incentives for Technology Innovation, since the establishment of "the first five-year plan of economic development" in 1962, the need for a Technology Innovation tax system for industry support emerged. The "Tax Exemption System for Technology Adoption Cost" (Law of Foreign Capital Introduction, paragraph 2, Article 21) was established in the "Law of Foreign Capital Introduction" established in August 1966. This system was the pioneer of technology innovation tax system for private enterprise.

The "Tax Break Law" was enacted on December 20, 1965, and tax break regulations distributed in various legal forms was the first integrated regulation by a single law. Reduction and exemption in the early stage of the introduction of the Tax Break Law were in the form of the simplest tax exemptions and did not have the purpose of the current industry support system. While "the first and second five-year plan of economic development" promoted, to support the localization policies of government, it was the tax support for the machinery investment tax credit (6%) of specific industries(steel, chemistry, machinery, shipbuilding, automotive, electronics, and heavy industry). In order to promote the technology development of industry, the "Special Depreciation System for the Study Facility" and "System of Loss Inclusion for Test Research Cost" was introduced.

The goal of the tax system for technology development activities support is to promote industrial technology development and meanwhile, technology development related tax support systems performed by the government were developing to currently about 20 kinds of systems including deferred processing system of test research costs performed since before the 1970s, the tax break system for technology, depending on company's technological innovation stage, variety of support was made([Figure 3-1]).

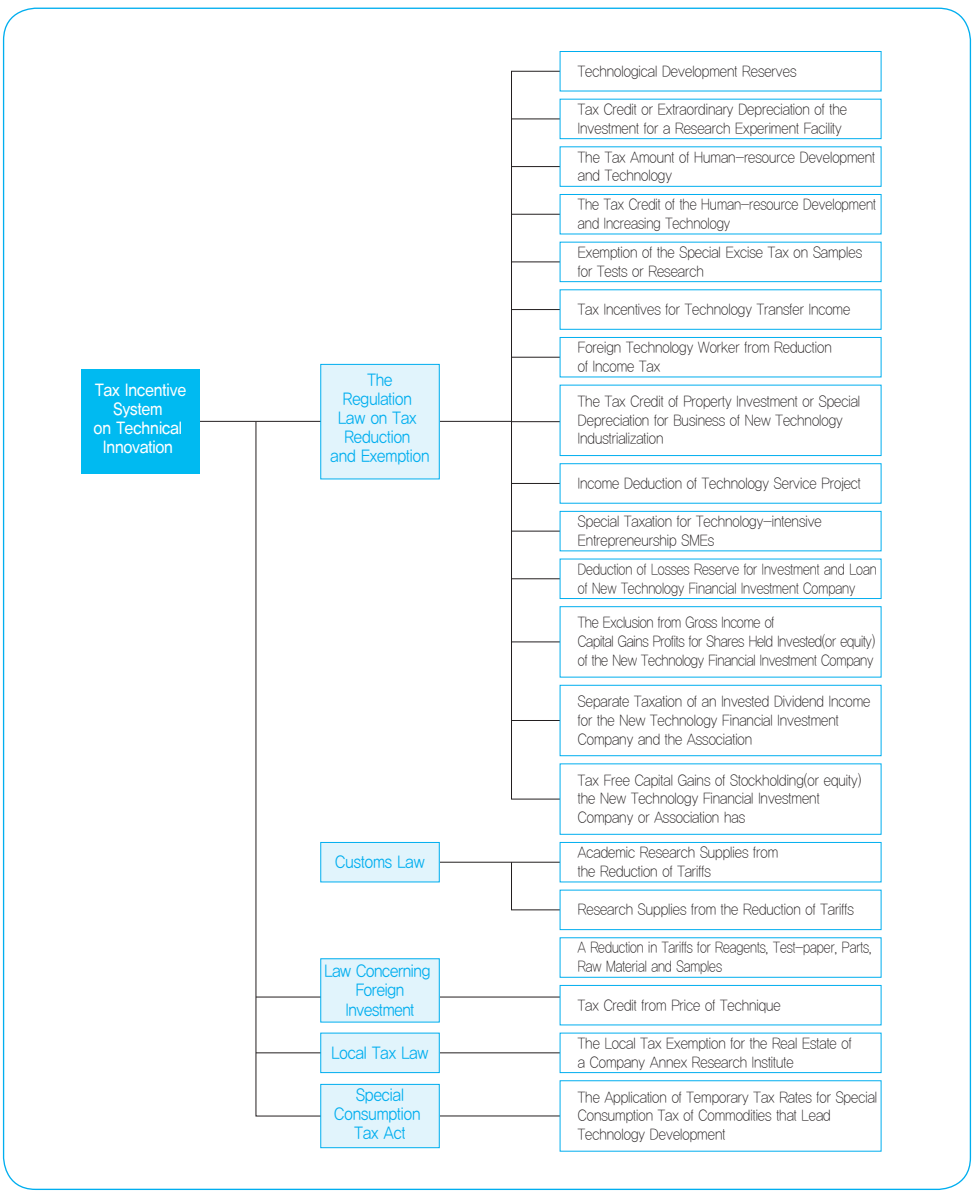
Figure 3-1 | The Development Process of the Tax System for Technology Development Support

Division \ Period	Before the 1970s	1970s							1980s					1990s	
		73	74	76	77	78	79		80	81	82	84	86		92
R&D Investment Promotion	Handling deferred assets of experimental and research costs														
		Technological development reserves													
				Tax credit or expensing depreciation from Research & Test facility investment											
						Academic Research Supplies from the reduction of tariffs									
									Tax credit for development expenses of Technologies and human resources						
									Local tax exemptions on real estate for R & D center						
											Research supplies from the reduction of tariffs				
											Exemption of the special excise tax on samples for tests or research				
													Tax credit of expenses for human - resource development and increasing technology		
															A reduction in tariffs to reagents, test-paper, parts, raw material and samples
Technology Transfer Promotion	Tax credit from price of technique														
								Tax Incentives for Technology transfer income							
									Foreign technology worker from reduction of income tax						
Promote the Domestic Development of Technology Commercialization			Tax credit or extraordinary depreciation for the corporatization of new technology and the business asset investment												
					Income deduction of technology service project										
												Special taxation for technology-intensive entrepreneurship SMEs			
The Expansion of Domestic Demand Base for New Products									The application of temporary tax rates for special consumption tax for commodities that lead the technology development						
Investment in New Technology to Promote									Deduction of losses reserve for investment and loan of new technology financial investment company						
												The exclusion of gross income about capital gains profits for shares held invested (or equity) of the new technology financial investment company			
													Separate taxation of an invested dividend income for the new technology financial investment company and the association		
													Tax free capital gains of stockholding (or equity) the new technology financial investment company or association has??		
Division \ Period		73	74	76	77	78	79		80	81	82	84	86		92
	Before the 1970s	1970s							1980s					1990s	

Source: Korea Industrial Technology Promotion Association, 1992.

These various forms of the technology development support tax system for technology innovation, can be summarized as tax break law, customs law, foreign capital Induction law, ground tax law, and special consumption tax law as tax relief laws such as separated system name as follows ([Figure 3-2] Reference).

Figure 3-2 | Incentive Systems Related Technology Innovation



Source: Korea Industrial Technology Promotion Association, 1992.

The "Technology Development Promotion Act" was enacted on December 28, 1972, and various support systems were introduced to support technology innovation activities of private companies. In the 1970s, the national technology innovation system was operating mainly government-funded research institutions, and research and development activities of private companies were minimal.

As Technology Innovation Tax Incentives, the "Reserve for Technology Development Earning System" was established. According to oil shocks over the two rounds in 1973 and 1979, the economic downturn in developed countries and protectionist policies were a threat to our economy of devotion to the export drive policy. The Government ran into a limit that the international competitiveness for domestic industries of vulnerable technology could not be enhanced, In this background, the government recommended the establishment of private institutions from manufacturer that generated more than 30 billion won in sales. In February 1979, in order to enable them, the "Private research institute Promotion Council" (Korea Industrial Technology Association predecessor) was launched.

1.3. Technological Innovation Support Systems between 1981 to 1997

Economic Environment: In the late 1970s low capacity utilization and the slowdown of productivity improvement caused by inflation persisted due to the aftereffects of overinvestment in the heavy chemical industry, the comparative advantage for labor due to wage increases and a lack of technical skills not followed back on investment. In addition to the Rio Declaration (1992.6) of UN Conference on Environment and Development (UNCED), Green Round (GR) was accelerating as the framework of multilateral trade negotiations for trade linked to the environment. At the conclusion of UR negotiations, the launch of the WTO (1995.1), Korea joined as the 29th member country of the OECD (1996.12), era of technology hegemony coming with global unlimited competition due to expedited new trade rules and accelerating the movement of globalization and regionalism, and the need for the maintenance of various government support policy to meet international standards. According to changes in the international environment and accelerated opening in domestic market, an urgent challenge emerged to secure competitiveness of technology, then the government policy, for the purpose of development and securing of its own technology, focus on policies and institutions for the development of the subject to perform research and development of industry-academia-research.

In the late 1970s, private labs began to accelerate around large companies and in October 1981, the government introduced a reporting system that it recognized 46 private research institutes as R&D centers and the technology development of industry was promoted. In February 1991, to support systematic research institute, reporting and administrative duties of R & D Center were charged to corporations of the Korea Industrial Technology Association. After this, the number of private institutions was 1,000 (1991.4), 2,000 (1995.2), 3000 (1997.12) and spread rapidly. Local tax exemptions system for real estate of R & D centers were established by revisions of the "Province Tax Law" in October 1981.

The tax support system related to company-affiliated research institutes was established and expanded by the enactment of the Regulation Law on Tax Reduction and Exemption (1981.12) for the purpose of introduction of the tax support system for the promotion of enterprises' technological innovation. The related system, were the "tax exemption system on technology and human resource development expenses" (Law on Tax Reduction and Exemption Article 17), "tax exemption or special depreciation system on capital investment for research and human resource development" (Law on Tax Reduction and Exemption Article 18 Section 2), "exemption system on income from technology" (Law on Tax Reduction and Exemption Article 19), "special consumption tax exemption system on samples for tests and research" (Law on Tax Reduction and Exemption Article 75), "tax exemption system on income from technology" (Law on Tax Reduction and Exemption Article 19), and "income deduction system of foreign technician" (Law on Tax Reduction and Exemption Article 1 Section 2).

The "Limit system on total amount of tax reduction and exemption" (Law on Tax Reduction and Exemption Article 88) was introduced to compensate defects such as securing tax revenues by tax reduction. The "Limit system on total amount of tax reduction and exemption" regulated the total amount of tax reductions and exemptions such as limit amounts of inclusion in deductible expenses, limit amount of exemption on income and limit amount of tax deductions to maintain the neutrality and equity of tax policy. This law had subsisted before the introduction of "minimum tax" by the revision of the 「regulation law on tax reduction and exemption」 on December, 1991. The target of the limit system on total amount of tax reduction and exemption are reserve funds by the law and special depreciation costs and it was restricted below 50% of gross income. "Tax reduction on expenditure on the technology and human resource development" was excluded to promote technology development of private enterprises on December, 1988 and this drastically expanded the technology development tax support.

On December, 1990, the "Limit system on total amount of tax reduction and exemption" was abolished and "minimum tax" that the individuals and corporate bodies should pay a certain rate of tax of tax-exempt income. The minimum tax rate of 12% was applied without distinction of big companies, small and medium-sized businesses.

In terms of expansion of the tax support system on technological innovation, the "tax exemption system on technology and human resource development expenses" was established in December, 1990. In this law, the exemption rate on small and medium-sized enterprises expanded from 10% to 15% to differentiate from the larger companies and the exemption rate on-the-job training expense was expanded to 15% regardless of business scale. Also, this law included the expansion of support for "customs reduction and exemption system on products for research". In September, 1990, the support target expanded to complete charge departments of research and development and 'high technology software' (reduction rate 100%) was added to the target for customs reduction which had been applied during 1990.9~1995.6. The customs reduction rate was drastically expanded from 65% to 80% (for high technology software, 100%, 1992.1).

In August, 1995, the "income tax deduction system for the field technology human resource (including researchers) in the capital goods industries" was established. The target was the field technology human resources of small and medium-sized enterprises related to the capital goods industries and the support contents were differentiated by the years of service (<Table 3-1>).

Table 3-1 | Differential Deduction by the Years of Service

Continuous Service Year	Deductible Limit
3 years~under 7 years	10% of salary (wage)
7 years~under 12 years	20% of salary (wage)
More than 12 years	30% of salary (wage)

Source: Taeyoung Shin(2006), A Comprehensive Appraisal of Policy Support Programs for Technological Innovation.

The tax reduction rate on the capital investment on facilities for research and testing was established in December, 1981. It was maintained at 8% (for domestic equipment, 10%) and reduced to 5% (domestic equipment, 10%) since December, 1993. The special depreciation rate was adjusted to 50% (1981.12) → 90% (1982.12) → 50% (Domestic 70%) and abolished in December, 1996.

1.4 Technique Innovation Tax Support Systems after 1998

The period after 1998 can be explained as "Overcoming foreign exchange crisis (1998~2002)". At the time, the government declaimed reform in four sectors (government reform, financial reform, business reform and labor reform) and promoted the activation policy of venture enterprises as new growth engines.

Economic Background: In late 1997, the government declaimed reform in 4 sectors (government reform, financial reform, business reform, and labor reform) and promoted the activation policy of venture enterprises as new growth engines to overcome the foreign exchange crisis.

Also the technology tax support system was revised by reducing tax support to secure tax revenues. Specifically, the「Tax deduction system on field technical manpower in the capital goods industry」was abolished in December, 2000 and the tax deduction rate on technology acquisition expenditure was reduced from 5% to 3% for big companies (1998.12) and from 15% to 10% (1998.12), 10% to 7% (2001.12) for SMEs.

Table 3-2 | Tax Credit System on Equipment Investment of R&D and Human Resource Development

Separation		Tax Credit (amount of investment)	Special Depreciation (original cost)
1981.12	Research & Test Facilities	8% (domestic 10%)	50%
	Vocational Training Facilities		
	New Technology Enterprising Facilities	6% (domestic 10%)	
1982.12	Research & Test Facilities	8% (domestic 10%)	90%
	Vocational Training Facilities		
	New Technology Enterprising Facilities	6% (domestic 10%)	50%
1986.12	Research & Test Facilities	8% (domestic 10%)	90%
	Vocational Training Facilities		
	New Technology Enterprising Facilities	3% (domestic 10%)	30% (domestic 50%)
1992.12	Research & Test Facilities	8% (domestic 10%)	90%
	Vocational Training Facilities		

Separation		Tax Credit (amount of investment)	Special Depreciation (original cost)
1992.12	New Technology Enterprising Facilities	3% (domestic 10%)	50% (domestic 90%)
1993.12	Research & Test Facilities	5% (domestic 10%)	50% (domestic 70%)
	Vocational Training Facilities	3% (domestic 10%)	30% (domestic 50%)
	New Technology Enterprising Facilities		
1996.12	Research & Test Facilities	5% (domestic 10%)	abolition
	Vocational Training Facilities	3% (domestic 10%)	
	New Technology Enterprising Facilities		

Source: Taeyoung Shin(2006), A Comprehensive Appraisal of Policy Support Programs for Technological Innovation.

Tax incentives for large enterprises continued to decrease. In December 1998, overlapping applications of the Research and Human Resource Development Reserve System and the Research and Human Resource Development Cost Tax Deduction System became ineffective, and large enterprises were excluded from the application of the sum-total based calculation under the Research and Human Resource Development Cost Tax Deduction System (December, 2000). In December 2002, the deduction rate of the sum-total based calculation under the Research and Human Resource Development Cost Tax Deduction System decreased from 50% to 40%.

Table 3-3 | Recent Amendments in the Research and Human Resource Development Cost Tax Deduction System

	Increased Amount Based Calculation		Sum Total Based Calculation	
	Small and Medium Enterprises	Large Enterprises	Small and Medium Enterprises	Large Enterprises
1998	(Expenses in the year – average expenses in the last 2 years) × 50%		15% of sum total expenses	5% of sum total expenses
1999~2000	2 years ⇒ 4 years			
2001~2002	Expenses ⇒ Occurred amount		Expenses ⇒ Occurred amount	Eliminated
After 2003	-	50% ⇒ 40%	-	-

Source: Taeyoung Shin(2006), A Comprehensive Appraisal of Policy Support Programs for Technological Innovation.

The Regulation Act on Tax Deduction and Exemption, which was supposed to last for five years, was superseded by the Restriction of Special Taxation Act, which became a permanent law, in December 1998. In accordance with this Act the "Tax Deduction Sunset System" was introduced, under which each provision on tax deduction and exemption should provide a time limit (ex. 1 year, 2 years, 5 years…) (so called the "Sunset Provision") and the effects of such deductions and exemptions should be evaluated at the time of sunset. A 5-year sunset period was applied to the Major Technical Innovation Tax Benefit Program, which remained effective until the end of December 2003.

The term "Technical Development Expense" was changed to "Research and Development Expense," of which scope should be specifically defined. In line with this change, the "Technical Development Reserve" and the "Tax Deduction for Technical and Human Resource Development Expenses" were changed to the "Research and Human Resource Development Reserve" and the "Tax Deduction for Research and Human Resource Development Expenses," respectively.

In those days, tax benefit systems for technical innovation generally declined but support for small and medium enterprises (SMEs) and ventures was strong. The tax deduction rates of the "Research and Human Resource Development Facility Investment Tax Deduction" were integrated to 5% (April, 1998), which then increased to 10% (December, 2001) and decreased to 7% (December, 2002). The SMEs' obligation to have reserves under the "Business Rationalization Reserve System," which was considered an obstacle that affected the effectiveness of the tax benefit programs, was abolished in December, 2000. The subjects of the Research and Human Resource Development Reserve System and the "Tax Deduction for Research and Human Resource Development Expenses" were expanded to all industries except for a few such as real estate and consumer services (December, 2000).

For changes in technical innovation support programs after 2003, i.e., after the nation overcame the financial crisis (1998~2002), the "Expenses to Obtain Certification on SMEs' Integrated Information Management System" became subject to the Research and Human Resource Development Reserve System and the Tax Deduction for Research and Human Resource Development Expenses in December 2002. In addition, the Business Rationalization Reserve System was abolished, and the sunset period for the Major Technical Innovation Tax Benefit Program, which was supported to expire at the end of December 2003, was extended to the end of December 2006. In the Technical Revenue Tax Deduction Program, Tax Deduction for Revenues from Technical Transfer (Article 12-1 of the Restriction of Special Taxation Act) expired at the end of December 2005, while Tax Deduction for Expenses for Technology Acquisition (Article 12-2 of the Act) remained.

Table 3-4 | Sunset Periods under the Restriction of Special Taxation Act

Sunset Period	Area	Applicable Programs
1 Year	○ Systems that are supposed to expire by end 1999 under the previous Act. - Effective periods under the previous act should be guaranteed.	- Exemption of special value added tax for debt redemption of financial institutes. - New provisions on other organizational reform support.
2 Years	○ Among support systems for specific industries, areas that may cause equality issues. ○ Support systems that need to make flexible responses according to economic conditions. ○ Areas of which tax deduction rates need to be reviewed following changes in capital gain and other tax rates. ○ Areas where the effects of tax benefits and the level of support need to be continuously reviewed in consideration of budget.	- Income tax deduction for field working employees in capital goods industries. - Tax deduction for capital investment. - Exemption from capital gains tax and special value added tax. - Tax exemption for fuel for agriculture and fishery, zero tax rate for agricultural and fisheries equipment.
5 Years	○ Areas that need long term support to strengthen the growth potential of the national economy. ○ Areas where the effects of support take in a long term. ○ Indirect tax benefit systems.	- Support programs for technical and human resource development, support programs for SMEs and farming and fishing houses. - Reserve systems. - Indirect tax exemption such as value added tax, special consumption tax.
Exempted from Sunset	○ Tax benefit systems for which setting a sunset period is inappropriate may be exempted from the sunset provision.	- Tax exemption for interest incomes from international financial transactions. - Support programs for reorganization of insolvent financial institutes under the Act on the Structural Improvement of the Financial Industry. - Tax exemption for stock transfer margins and specific indirect taxes.

Source: Finance and Economy Committee (1998).

Also, the Non-Taxation System for Incomes from Research Activities was newly established, which was supported to expire at the end of 2006 and applicable to researchers in SMEs and ventures, for whose incomes applied for non-taxation rate of 15% (2004), 10% (2005), and 5% (2006).

The minimum tax rate was decreased in December, 2003, to 10% for SMEs, 13% for large enterprises whose tax base was less than 100 billion KRW, and 15% for large enterprises whose tax base was 100 billion KRW or more (in 2004, a minimum tax rate of 15% was applied regardless of their tax bases). Account items exempted from the minimum tax rate were specified: For SMEs, the total amount of R&D investment; for large enterprises, labor costs of core researchers such as ones with a masters or doctorate degrees. <Table 3-5> shows the summary of the decrease and abolition of technical innovation tax benefit programs between 1998 and 2006.

Table 3-5 | Recent Examples of the Decrease and Abolition of Technical Innovation Tax Benefit Programs

Year	Change
1998	Exclusion of the overlapping application of the Research and Human Resource Development Reserve System and the Research and Human Resource Development Cost Tax Deduction System (April 1998) Decrease of tax deductions for technology acquisition expenses (December, 1998) - Large enterprises: 5% to 3% - SMEs: 15% to 10%
2000	Abolition of the sum total based calculation applied to large enterprises under the Research and Human Resource Development Cost Tax Deduction System (December, 2000) Abolition of the income tax deduction system for field working employees in capital goods industries (December 2000) Decrease of the limit of public research institutes' inclusion of contributions to charges against revenues (100% to 50%)
2002	Decrease of the deduction rate for large enterprises under the Research and Human Resource Development Cost Tax Deduction System (50% to 40%) (December, 2002) Decrease of tax deduction rate for capital investment for research and human resource development (10% to 7%) Abolition of special consumption tax exemption for test and laboratory samples (December, 2002) Decrease of income tax deduction rate for SMEs' technology acquisition (10% to 7%) (December, 2002)
2005	Abolition of tax exemption for incomes from technical transfers (December, 2005)
2006	Abolition of the Research and Human Resource Development Reserve System (effective in 2007)

Source: Taeyoung Shin et al., 2006.

Table 3-6 | The Historical Process of Development of Incentive System for Technical Innovation

Division	1960s 5 6	7 8 9	1970s 0 1 2 3 4 5 6 7 8 9	1980s 0 1 2 3 4 5 6 7 8 9	1990s 0 1 2 3 4 5 6 7 8 9	2000s 0 1 2 3 4 5 6	Grounds Law and Trend of Changes
Promotion of R&D Investment		Process of cost of testing and research as deferred assets (1967. 11~1994. 12)					◦ Corporate Tax Law §17 ⑩
		The special depreciation of research facilities (1967. 12~1981. 12)					◦ Corporate Tax Law Enforcement Decree §44 ② (1967.12~1970.1) ◦ Corporate Tax Law Enforcement Decree §51 ① (1970.1~1981.12)
			Earning of reserve for research and human resource development (1972. 12~up to now)				◦ Reserve for technology development (1972.12~2000.12) - Technology Development Promotion Act §3 and Act on Regulation of Tax Reduction and Exemption 4-9 (1972.12~1998.12) - Restriction of Special Taxation Act §9 (1999.1~2000.12) ◦ Reserve for research and human resource development (2001.10~up to now) (Restriction of Special Taxation Act §9)
				Tax credit for development costs of research and human resource (1981. 12~up to now)			◦ Technology and human resources development expenses (1981.12~1988.12) - Act on Regulation of Tax Reduction and Exemption §17 (1981.12~1998.12) - Restriction of Special Taxation Act §10 (1999.1~2000.10) ◦ Reserve for research and human resource development (2000.10~up to now) (Restriction of Special Taxation Act §10)
Support for the Obtain of Research and Development Supplies				Tariff Reduction on Goods for Research and Development (1982. 12~up to now)			◦ Act on Regulation of Tax Reduction and Exemption §83 ① (1981.12~1988.12) ◦ Customs Law §28-5 ⑧ (1989.1~2000.12) ◦ Customs Law §90 ① (2001.1~up to now)
				Exemption of the acquisition tax for automobile imported for research and development (2005. 1~up to now)			◦ Local Taxes Act. §284 ⑤
				Applying the tentative tax rate to special excise for leading goods in technology development (1981. 12~2001. 12)			◦ Special Excise Tax Law §1-2
				Exemption of the special excise tax on samples for tests or researches (1981. 12~2001. 12)			◦ Act on Regulation of Tax Reduction and Exemption §75 (1981.10~1993.12) ◦ Act on Regulation of Tax Reduction and Exemption §103 (1994.1~1998.12) ◦ Restriction of Special Taxation Act §109 (1999.1~2001.12)
Support for the Expansion of Research and Development Facilities				Tax credit for Investment on facilities related with development of research and human resource (1981. 12~up to now)			◦ Tax credit or special depreciation for investment facilities related with research and human resource development (1981.12~1992.12) - Act on Regulation of Tax Reduction and Exemption §18 ② (1981.12~1993.12) - Act on Regulation of Tax Reduction and Exemption §10 ② (1994.1~1998.12) ◦ Tax credit for investment facilities related with the research and human resource development (Restriction of Special Taxation Act §11) (1999.1~up to now)

Division	1960s 5 6 7 8 9	1970s 0 1 2 3 4 5 6 7 8 9	1980s 0 1 2 3 4 5 6 7 8 9	1990s 0 1 2 3 4 5 6 7 8 9	2000s 0 1 2 3 4 5 6	Grounds Law and Trend of Changes
Support for the Expansion of Research and Development Facilities			Exemptions of the local tax on a real estate for R&D center (1981. 10~up to now)			◦ Local Taxes Act. §110-3 ③ (Exemption of acquisition tax), §128-2 ③ (Exemption of registration tax), §184-2 ③ (Exemption of property tax) (1981.10~1994.12) ◦ Local Taxes Act. §282 (1995.1~up to now)
Promotion of Technology Transfer			Tax credit for the cost of technology acquisition (1981.12~up to now)			◦ Tax exemption for technological income (Act on Regulation of Tax Reduction and Exemption §19)(1981.12~1993.8) ◦ Tax reduction for technological income (1993.8~2005.12) - Act on Regulation of Tax Reduction and Exemption §11 (1993.8~1998.12) - Restriction of Special Taxation Act §12 (1999.1~2005.12) ◦ Tax credit for an amount of technology acquisition (2006.1~up to now) (Restriction of Special Taxation Act §12 ②)
		Exemption of tax in exchange of a technology adoption (1966.8~up to now)				◦ Foreign Capital Inducement Act §21 ② (1966.8~1973.3) ◦ Foreign Capital Inducement Act §24 ② (1973.3~1997.1) ◦ Foreign Investment and Foreign Capital Inducement Act §24 (1997.1~1999.5) ◦ Restriction of Special Taxation Act §121-6 (1999.5~up to now)
			Exemption of income tax for foreign engineers (1981.12~up to now)			◦ Act on Regulation of Tax Reduction and Exemption §21 (1981.12~1993.12) ◦ Act on Regulation of Tax Reduction and Exemption §15 (1994.1~1998.12) ◦ Restriction of Special Taxation Act §18 (1999.1~up to now)
			Special exemption of a taxation for foreign engineers (2002.12~up to now)			◦ Exceptions to Tax Laws Act §18-2
Support for the Research Manpower			Income tax credit for technical personnel in capital goods industrial sites (1995.8~2000.12)			◦ Act on Regulation of Tax Reduction and Exemption §15-2 (1995.8~1998.12) ◦ Restriction of Special Taxation Act §19 (1999.1~2000.12)
			Tax exemption of income tax from research activity costs (2003.12~up to now)			◦ Income Tax Act §20
			Temporary tax credit for a cost of overseas assignment (2003.12~2005.12)			◦ Restriction of Special Taxation Act §10-2
Basic System of Tax Support		Comprehensive limit system for tax relief (1981.12~1990.12)				◦ Act on Regulation of Tax Reduction and Exemption §88 (1981.12~1990.12)
				Minimum tax (1993.12~up to now)		◦ Act on Regulation of Tax Reduction and Exemption §118 (1991.1~1998.12) ◦ Restriction of Special Taxation Act §132 (1999.1~up to now)
			Earning reserve for business rationalization (1981.12~2002.12)			◦ Act on Regulation of Tax Reduction and Exemption §91 (1981.12~1993.8) ◦ Act on Regulation of Tax Reduction and Exemption §123 (1993.8~1998.12) ◦ Restriction of Special Taxation Act §145 (1999.1~2002.12)
			Sunset system for tax relief (1998.12~up to now)			◦ Restriction of Special Taxation Act §9~§12 and §18 etc.
Date	5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6 7 8 9	0 1 2 3 4 5 6	
	1960s	1970s	1980s	1990s	2000s	

Source: Taeyoung Shin et al., 2006.

2. Evolution of the Financial Support System

2.1. Background

The financial support system for the purpose of supporting enterprises technology development was introduced in the late 1970s. In the era of high economic growth in the 1960s and 1970s, the finance policy was widely used as a key measure of industrial policy, but it was only comprehensive support on export financing support or equipment fund support of promising industries, not technology development support.

In this situation, the loan support on technology development fund introduced in 1976 and loan support on technology development and quality improvement fund of the Small and Medium Business Administration introduced in 1977 were the first finance policies for the purpose of technology development support.

Since 1970, as enterprises have tried their own R&D, the finance policy changed. The government depended on foreign technology introduction and imitation strategies in the 1970s. However, the strategies changed to digestion and improvement of introduction technique by implementing its own R&D.

The government promoted the establishment of research institutes of large companies for product development and production process improvement through tax support. Most large companies established their own research institutes to develop their own technology innovations.

2.2. Enactment and Promotion of Financial Support Related Systems in the 1970s and 1980s

The pioneer of finance policy whose clear purpose is a support of company's technology development was the industry bank and the business of technology development capital loan support began in 1976 and the Small Business Administration's Support Project of small business development and quality improvement financing started in 1977. According to these projects technology development capital loan projects of specialized banks, such as the Industry Bank and Small Business Bank were in progress, and that was very beneficial to technology development of big enterprise and SMEs in financing. In the 1980s, the support project of the National Bank, a specialized bank for small merchants and industry workers, also began providing capital loans for technology development.

In 1980, to strengthen government funding for strategic industries, the Machinery Industry Development Fund, the Electronic Industries Development Fund, the Textile Industry Modernization Fund were installed and in 1986 to support specific industries, such

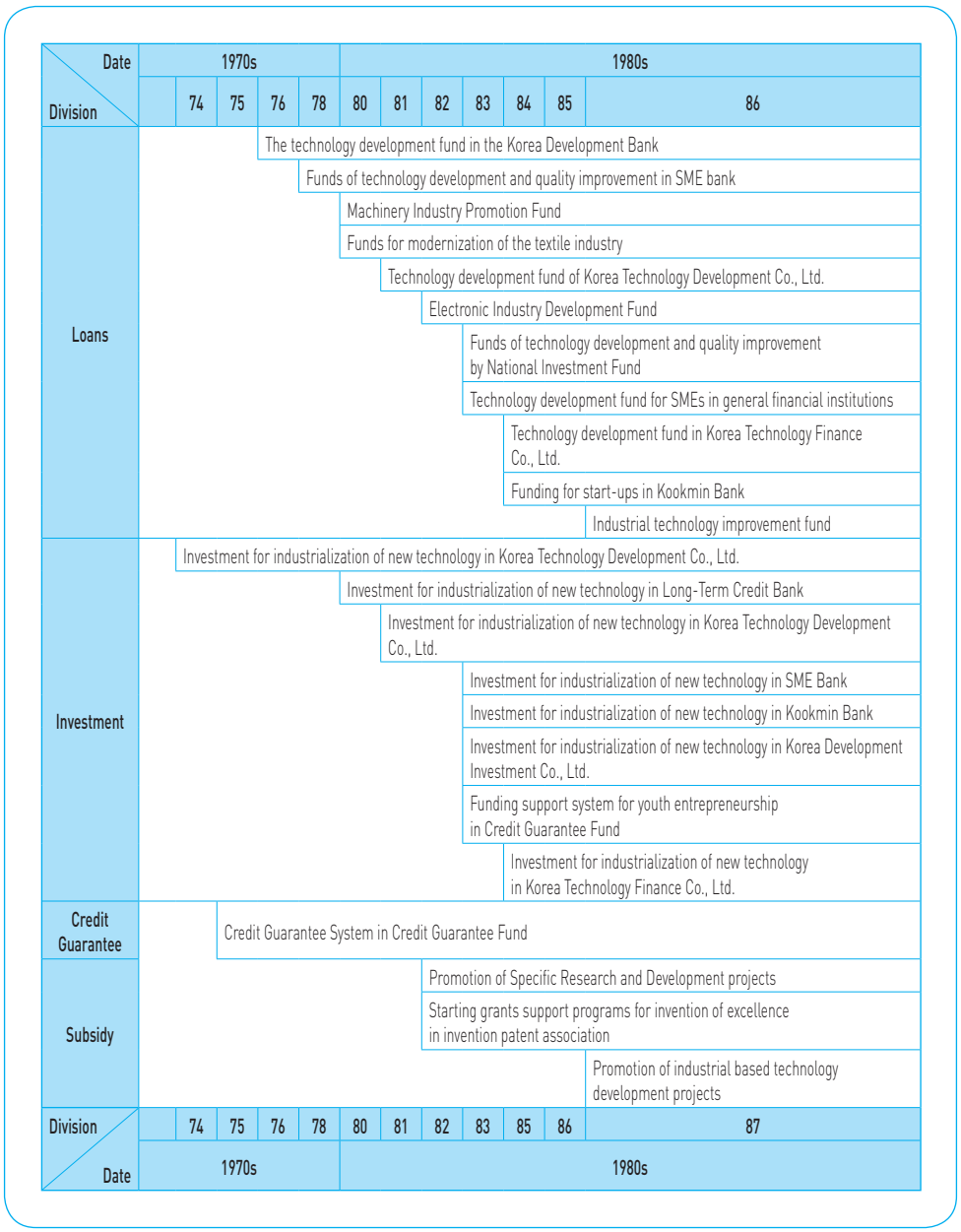
as the Promotion Act of Machinery Industry, Electronics Industry Promotion Act, individual laws were abolished and instead of these, as the Industrial Development Act enacted, three existing Fund Industrial Development Funds such as the Electronic Industry Development Fund, the Machinery Industry Promotion Fund and the Textile Modernization Fund was incorporated. The Industry Development Funds (today's 'Industrial Technology Fund') are managed by the Ministry of Commerce and Industry and was utilized as a contribution or loans, a part of the financing support used as funding for prototype development and advanced industrial technology development of large and small businesses, played a role in financing innovations.

The Financed Petroleum Business Fund composited since the oil shocks of the 1970s, since 1986, for companies that develop machinery and components, the technology development financing support, the 'Industrial Technology Advancement Funds' was enforced, but this project was discontinued in 1991, after the disappearance of oil business funds.

Since the 1970s the government supported finances for imports of overseas facilities and exports of companies' deferred payment. Since the 1980s, some of the "National Investment Fund" supported the development of companies using this fund, because the 'National Investment Fund' which some companies used the technology development fund was also provided by the Law of National Investment Fund established in 1974 in order to supply the necessary investment funds for development of the heavy chemical industry such as non-ferrous metals, steel, shipbuilding, machinery, chemical, and electronics.

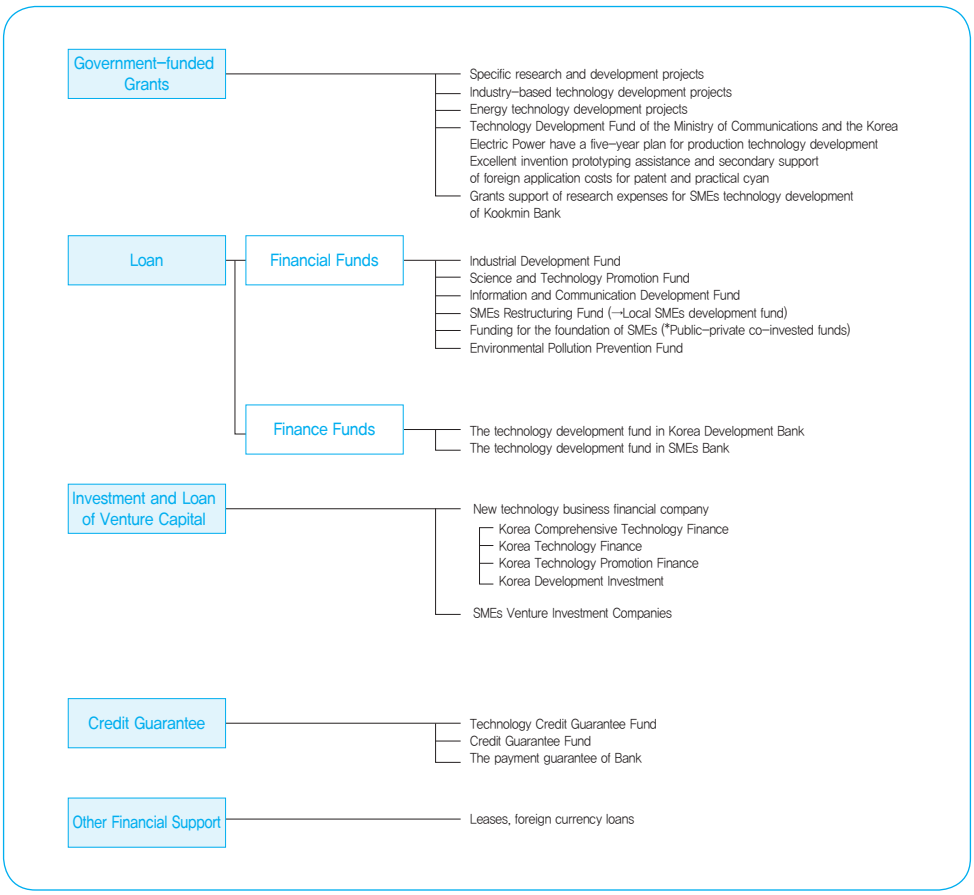
The government started various projects of loan funds to support policies of technology development projects focusing on large companies and at the same time financing support programs to support technology developments of SMEs. In accordance with the 'Special measures act of management stability and promotion for restructuring of SME' established in 1989, the SME Restructuring Fund was installed, and some of these funds were used for research development and commercialization of the enterprise.

Figure 3-3 | The Development Process of Technology Development Financial Support System



Source: Ministry of Science and Technology, 1987.

Figure 3-4 | The Status of Technology Development Financial Support System



Source: Industrial Technology Promotion Association.

In 1980, some representative significant changes were starting the establishment of a business support policies and the establishment of a venture capital company. First, the Small and Medium Enterprise Establishment Act was established and it established venture capital companies. In the 1980s, the basic foundation for an assistance of a venture start-up and support of venture capital (investment support) was laid out. In 1986, the 'Small and Medium Enterprise Establishment Act' was enacted to support the Establishment of a business of a small and medium venture company, according to the legislation, the legal basis of investment support and financing assistance was provided by a "SMEs Start-up and Promotion Fund" (today's "Small and Medium Industry Promotion and Industry-based Funding") which Small and Medium Industry Promotion Corporation consigned and managed.

Table 3-7 | The Performance of Capital Supply for Technology Development

(Unit: 100 million won)

	~1986	1987	1988	1989	1990
Direct Support (grants)	391	589	852	1,156	1,539
Policy Finance	1,119	1,807	2,248	1,989	2,371
General Finance	4,550	1,459	1,930	2,150	2,220
Venture Capital Investment and Loan	3,276	1,520	1,724	1,787	3,175
Credit Guarantee	480	480	638	1,273	1,350
Total	9,816	5,855	7,392	8,355	10,635

Annotation 1. Performance of the general commercial banks is excluded in the financing support of financial institutions.
2. Support for technology development-related business only in the performance of financial support.

Source: Industrial Technology Promotion Association and Industrial Technology White Papers, Each year.

In addition, on the basis of the law, the SMEs Venture Investment company was founded in 1986, around the late 1980s and dozens of Venture Investment companies and four New Technology Projects Financial Companies were established and put in charge of the development of the venture capital industry in Korea.

Related to the establishment of the new technology projects finance companies, until 1984, four venture capital firms including the Korea Technology Development Corporation (KTDC: Today's KTB), the Korea Development Investment Corporation (KDIC), and the Korea Technology Finance Corporation (KTFC) were established with Korea Technology Advancement Corporation (KTAC) launched in 1974. These organizations were the first to fill the role of venture capital, for the purpose of the commercialization of the Korea Institute of Science and Technology (KIST)'s achievements of research and development.

The new technology Business Finance Companies Act was enacted at the end of 1986, and these four companies were registered as new technology financial companies. By the end of 1990, these new technology financial companies played pivotal roles, leading the development of the venture capital industry in Korea.

In late June, 1992, looking at Korea's venture capital company, there were four new technology projects financial companies such as the Korea Engineering Finance Co., Ltd., the Korea Technology Finance Ltd, the Korea Development Investment Corporation, the Korea Technology Development Agency Ltd. and 53 venture Investment companies for SMEs, since 1974, and the results they supported are in the <Table 3 -8> below.

Table 3-8 | Support Performance of Investments and Loans in the New Technology Projects Financial Company

(Unit: 100 million won, %)

	1974~85	1986	1987	1988	1989	1990	1991	Cumulative Total
New Technology Business Financial Company	2,314	983	1,071	1,226	1,404	2,111	2,201	11,310
Investment	203	146	162	195	211	376	243	1,536
Loan	2,111	837	887	922	979	1,090	1,391	8,217
Lease	-	-	-	-	47	481	463	964
Factoring	-	-	22	109	167	164	131	593
SMEs Venture Investment Companies	-	90	231	561	732	1,064	898	3,576
Total	2,314	1,073	1,302	1,787	2,136	3,175	3,099	14,886

Annotation 1. Performance of the support of new technology projects financial company are approved-standards.
2. Funds of Investment Association are excluded.

Source: Korea Technology Finance Co., Ltd, Venture Finance, Spring Issue, 1992.

The Industrial Development Fund was established and technology development financing support began, the Machinery Industry Development Fund, the Electronic Industry Development Fund, and the Textile Industry Modernization Fund were installed in 1980. and parts of the Funds were supported by financing projects. In 1985, the individual laws to support specific industries were abolished such as the Promotion Law of Machinery Industry, the Electronics Industry Promotion Law. To replace these laws, the Industrial Development Act was enacted at the same time, as three major Funds: the Electronic Industry Development Fund, the Machine Industry Promotion Fund and the Textile Modernization Fund were integrated into the Industrial Development Fund. A part of the loan support of the Industrial Development Fund (today's industrial technology fund) organized by the Ministry of Commerce and Industry performed the role of techniques innovative financing by being used for financial support for prototype development and the development of state-of-the-art industrial technology of SMEs and large companies.

Since 1986, the loan support of Industry Technology Improvement Capital, financed the technology development fund for the company to perform the development of machinery and components materials in the name of Industrial Technology Improvement Funds with resources of surplus funds of Petroleum Business Funds. But in 1991, the project was discontinued in accordance with the disappearance of surplus funds of oil business funds.

The National Investment Fund was installed by the National Investment Fund Law enacted in 1974 and in order to supply the necessary investments fund for development of heavy and chemical industries such as steel, non-ferrous metals, shipbuilding, machinery, chemical, and electronics, since the 1970s, the government purchased equipment for company and financed export of deferred payments with using this fund. Since the 1980s, financing by National Investment Fund was supported for the purposes of company technology development.

In 1989, the 'Special Measures Act of SMEs' management stability and promotes of the restructuring' was established, in accordance with the Law, Restructuring Fund of SME was installed and some of these funds were used for the purpose of R&D and its commercialization of the company.

2.3. Enactment and Implementation of Systems Related to Financial Assistance in the 1990s

The loan support project of the technology development capital of the three national policy banks, namely the Korea Development Bank, the Industrial Bank of Korea, and Kookmin Bank, launched in the 1980s and continued until the 1990s. and the existing 'Industrial Development Fund' loan assistance program expanded further. Support of the technology development capital loan by the Industrial Development Fund expanded further in accordance with promotion of the "Capital Goods Industry Development Plan" in 1995 and at the same time increasing the support limit per item, the support was also expanded from the past focused SMEs in the direction of including even mid-sized businesses. Since 1997, the mission to support projects of not product development but state-of-the-art industrial technology development of the Industrial Development Fund was supported with crossing over to the Industrial Technology Development Fund. Based on the reorganization of loan supports of SME Restructuring Fund launched in the 1980s, the loan assistance of the technology development capital by the same fund persisted in a state transferred to local SMEs adjustment funds in 1995.

The Science and Technology Promotion Act was amended in 1991, and since 1993 the Science and Technology Promotion Fund was installed, the projects-funded and financing projects were performed for innovative technology development companies. The Promotion Fund of Information and Communication was established for the purpose of project support such as research and development and practical application of information and communication technology, the modernization of information communication equipment, the projects-funded and financing projects were also executed in 1993.

Since 1987, the existing Credit Guarantee Fund, performed technology credit guarantee services and through amendments of the 'New Technology Businesses Financial Assistance Act', as the Technology Credit Guarantee Fund was installed in 1989, its services started in earnest. In 1994, the Technology Credit Guarantee Fund introduced the assurance system of special treatments for technology, and in 1995 designated to an evaluation facility of business feasibility for patent technology. In 1997, the Technology Credit Guarantee Fund opened Korea's first Technology Evaluation Center and since 1999, performed Assurance systems of Technology Assessment.

After the 1990s, support from the Technology Credit Guarantee began and support for venture start-ups and venture capital were rising. The Credit Guarantee Fund has operated its technology credit guarantee business since 1987 and the Korea Technology Credit Guarantee Fund (today's "Kibo Technology Fund") was established in 1989. The Korea Technology Credit Guarantee Fund introduced the Excellent Technology Preferential system in 1994 and was designated a patent technology feasibility rating agency in 1995. It opened Korea's first technology assessment center in 1997 and implemented a technology assessment guarantee system in 1999.

When the KOSDAQ market opened in 1996, support for venture start-ups and venture capital, was available to recovered funds invested into the venture capital investment partnership through the market. Since 1998, the opening of the KOSDAQ market contributed to the growth of venture enterprise investments in a country with the explosive influx of venture capital funds.

In August 1997, the "Act on Special Measures for the Promotion of Venture Businesses" was enacted and the confirmation system of venture business was first introduced. Special treatment measures were performed for companies confirmed as ventures for loan and credit guarantee support.

Also since 1998, several funds of other ministries' such as the Small and Medium Enterprise Establishment and Promotion Fund (today's "Small And Medium Enterprise's Promotion And Industrial Development Fund"), but also the Informatization Promotion Fund (today's "Information and Telecommunication Promotion Fund"), the Industrial Foundation Fund, the Science and Technology Promotion Fund, and the Culture Industry Promotion Fund were allowed to support the association of investment composed by private venture capital companies. Since 1999, the support of venture capital investment association increased significantly.

Meanwhile, venture investments increased greatly and support of venture capital became insolvent in the 2000s. The venture capital investment increased significantly with the rapid growth of the information and communication industry between 1999 and 2000. The

venture investment showed overheating aspects and was called the 'Venture Bubble'. Also negative recognition toward the whole venture capital industry spread because of moral laxity such as 'Blind investment' in 2000.

The KOSDAQ market cooled down in 2001, and the rate of return decreased and the expected earning rate of the venture capital investment association's fund also decreased. As a result, the criticism of public opinion deepened. In 2001, the government introduced the 'Venture Company P-CBO Guarantee System' to solve the financial difficulties of venture companies caused by the venture investment bubble burst. The government supported 2,212 billion KRW P-CBO credit to 808 venture companies through the Technology Credit Guarantee Fund from May to December, 2001. However, as the fund supported the venture companies whose credit status was weak, the Technology Credit Guarantee Fund became insolvent with the expiration of P-CBO since 2004.

Chapter 4

Performance of the Technique Innovation Support System

Performance of the Technique Innovation Support System

1. Overview

One of the dynamic forces that Korea developed through the compressed growth of the last 40 years was sustained expansion of research and development investment after the 1980s. Private enterprise's research and development activity expanded by the active 'Promoting research and development organization' policy of the government was, getting bigger than part of the government, taking 77% of the research and development investment. Korea's proportion of private enterprise R&D investment is higher than other countries such as USA, France, England and Germany which garner 60~70% in R&D investment. Also, Korea has 64% in research manpower.

2. Size of Support from Technology Innovation Framework Private Companies

2.1. Benefits for Companies with Introduction of Tax Incentives

2.1.1. Actual Benefit Rate

For the size of tax deduction provided for companies as tax incentives, the data for entire companies was not available so only the size of tax deduction in 1995 for companies with affiliated research centers was laid out in <Table 4-1>. However, it would be safe to assume that the amount represents the size of deduction for almost all companies as companies with affiliated research centers performed most of research and development in Korea. The total amount of tax reductions for companies was marked in the second row from the bottom

in <Table 4-1>. The last row of <Table 4-1> shows pre-tax value of the tax deduction amount. Applying 36.5%, the rate of corporate tax, the pre-tax value of tax deduction for x is calculated as x/(1-0.365).

The actual benefit rate is based on the actual amount of tax deduction for companies. Actual benefit rates means pre-tax value of total tax deduction for the company, divided by total R&D investment of the company.

To calculate the actual benefit rate, pre-tax value of total tax deduction has to be divided by total R&D investment of a company. The amount of deduction was the sum of tax deduction on technology and human resources development expenses and tax deduction on investment for research facility and amounted to around KRW 252.6 billion. Pre-tax values were KRW 397.7 billion (2526÷0.365). Total R&D investment of companies in 1995 was KRW 6,465.8 billion, so the actual benefit rate of R&D investment was 6.2% (=2526/64658) and it was calculated assuming the sum of technology and human resource development and research facility investment as the total R&D investment. Statistics of R&D investment were based on science and technology activities survey but to assess the actual benefit rate more precisely, it has to be based on technology and human resources development investment expenses defined by the tax law.

Table 4-1 | Benefits from Technology Development Support System for Corporate Research Centers

(Unit: million won, No. of companies)

Category		1992	1993	1994	1995	1996
Tax Deduction on Technology and HR Development Expense		111,577 (461)	138,303 (474)	226,689 (604)	211,454 (614)	320,214 (680)
Tax Deduction on Investment on Research Facility		22,142 (166)	21,615 (189)	44,359 (251)	40,896 (248)	34,503 (251)
	Special Deduction	28,091 (53)	26,420 (46)	9,176 (21)	430 (12)	678 (8)
Tariff Deduction on Research Supplies		12,028 (182)	8,220 (154)	23,097 (155)	31,700 (-)	37,100 (-)
Exemption of Special Consumption Tax on Research Samples		430 (33)	1,019 (23)	6,539 (26)	1,420 (20)	758 (21)
Exemption of Local Tax in Real Estate for Research Facility		6,701 (61)	2,899 (46)	6,640 (80)	14,556 (62)	12,316 (72)

Category		1992	1993	1994	1995	1996
Tax Deduction on Investment to Make Business Use of New Technology		247 (10)	521 (8)	13,529 (23)	-	-
	Special Deduction	413 (5)	127 (3)	0 (1)	-	-
Total		181,629	199,124	330,029	300,456	405,569
Pre Tax Income		285,496	313,581	519,730	473,159	638,691

Note: ( ) means the number of companies.

Data: Plan and Achievement of Company-affiliated Research Center.

Source: Lee, Won-young and others (1998).

It is difficult to assess the exact gap between R&D investment expenses in the science and technology activities survey and the technology and HR development expenses defined by tax law, but in general the latter is expected to be a bit higher than the former and this makes the actual benefit rate calculated here mildly underestimated.

The total amount of tax incentives for companies other than other tax incentives was around KRW 47.7 billion and the actual benefit rate for the incentives calculated in the same formula is 1.2% and the other tax incentives here include tariff exemption on research supplies, exemption of special consumption tax on research samples and local tax exemption on real estate for research facilities.

2.1.2. Actual benefit rate of the Reserve Fund System

The amount of reserves and expenditures of technology development reserve funds is shown in <Table 4-2>. This data is only for the companies that own research institutes because of the limitation of data.

Table 4-2 | Technology Development Reserve Funds Saving Results of the Companies which Own Research Institute

(Unit: 100 mil. won, number of companies)

	The Amount of Reserve Funds				The Amount of Expenditure			
	'93	'94	'95	'96	'93	'94	'95	'96
Large Companies	5786 (158)	6939 (138)	15163 (160)	11436 (171)	3479 (171)	2478 (126)	9997 (154)	8651 (156)
Small and Medium Enterprises	961 (250)	1337 (294)	1107 (311)	1834 (328)	519 (222)	704 (219)	815 (262)	1081 (259)
Total	6747 (408)	8275 (432)	16271 (471)	13270 (486)	3998 (393)	3182 (345)	10822 (416)	9732 (415)

Source: Lee, wonyoung et al.(1998).

The actual benefit of reserve fund system is calculated based on the interest rates of the savings period. Considering the savings period, 3-year, the amount of expenditure is from the amount saved three years before. <Table 4-3> shows the benefits of the companies from the reserve fund system.

Table 4-3 | The Benefits of Companies from the Reserve Fund System

(Unit: 100 mil. won)

	1993	1994	1995	1996
The Benefits of the Companies	1,619	1,289	4,382	3,941

Source: Lee, Wonyoung et al.(1998).

Actual benefit rates of the reserve fund system is calculated by dividing the benefits of companies from the reserve fund system by the total R&D investment of the companies and 1995 is calculated as 6.7% (=4,382/64658). This result is higher than the tax deduction rate toward the expenditure on the technology and human resource development (5%).

2.1.3. Benefit Rate by the Type of Tax Deduction

<Table 4-4> shows the nominal benefit rate and actual benefit rate of tax support. Theses tax supports included whole tax deductions on the expenditure of technology, human resource development and investments in research experiment equipment. However, for nominal benefit rate, to figure out whether the enterprises chose general tax credits or increased tax credits was difficult, the benefits of tax deductions on the expenditure of technology and human resource development were excluded in calculation of nominal

benefit rates. The enterprises can choose more profitable systems between tax deductions based on the total amount and based on the increased amount, the tax deductions based on the increased amount increases the nominal benefit rate of the enterprises. If the tax deduction based on the increased amount is included, the nominal benefit rate could be higher than the figure presented in <Table 4-4>.

Table 4-4 | Benefit Rate and Actual Benefit Rate of Tax Support

	Nominal Benefit Rate	Actual Benefit Rate
Tax Reduction	7.9	6.2
Technology Development Reserve Fund System	12.4	6.7
Other Systems except Tax Reduction and Technology Development Reserve Fund System	-	1.2
Total		14.1

Source: Lee, Wonyoung et al.(1998).

The nominal benefit rate of tax deduction is calculated as 7.9% and the reserve fund system is 12%. Enterprises can get both benefits at the same time, so the total nominal benefit rate is 20.3%, but the nominal benefit rate of the reserve fund system is variable, so the interest rate is also variable.

The market interest assumed in this table is 12% and the current interest rate is much higher than this, so the nominal and actual benefit rate seems higher than these figures presented in <Table 4-4>.

The actual benefit rate of the enterprises is 14.1% and this means that government support by the tax deduction is 14.1% of the amount per unit 1 of R&D investment. The gap between nominal and actual benefit rates is larger in the reserve fund system and is smaller in tax deductions because tax deductions based on increased amounts and deductions carried forward. The benefit from tax deductions based on increased amounts are excluded in the calculation of the nominal benefit rate, whereas it is included in the calculation of the actual benefit rate. The reason the gap between nominal and actual benefit rate is larger in the reserve fund system than tax deduction is first, the technology development reserve fund is not allowed to be being carried forward and second, the reserve fund has minimum taxes for large companies.

2.2. Enterprises' Benefits from the Introduction of Financial Support Systems

1.2.1. Technology Development Support Policy Finance

Policy finance has an effect that lowers the cost of technology innovation by the interest rate gap by supplying finance with a low interest rate. For finance of technology development support, a lower interest rate than the market interest rate is applied. Policy finance corrects market failure because of banking practices such as secured transaction or credit allocation.

Table 4-5 | Conditionalities of Support Systems

	Use	Loan Period	Interest Rate
Science and Technology Promotion Fund	Research Fund	within 7 years (term of a loan: 3 years)	6% (large companies 7%)
Technology Development Fund of Industry Development Fund	R&D commercialization	within 5 years (term of a loan: 2 years, 3-year repayment by installment)	6.5%
Technology Development Fund of Information Communication Fund	Research Fund · equipment · operation	within 5 years (term of a loan: 2 years)	6.0~6.5%
Technology Development Fund of Small and Medium-sized Enterprises Structural Adjustment Fund	Technology · operation	within 10 years (term of a loan: 3 years)	Bank Rate
Korea Development Bank -Technology Development Fund -Manufacturing Development Fund	facility · operation facility · operation	within 8 years (term of a loan: 3 years)	11.8~12.8 8.0
Industrial Bank Technology Development Fund	Research Fund · equipment · operation	(3~10 years)	8.0~8.5
Kookmin Bank Technology Development Fund	facility·operation	(3~10 years)	8.0~8.5

Source: Lee, Wonyoung et al.(1998).

The condition of loan by fund differs based on each support system's purpose, loan terms, and interest rate. The interest rate in the case of financial funds is lower than financial capital. <Equation 1> shows that enterprise benefit was received from offering lower interest rates due to the policy of financial benefits. During the financial year under company policy benefits *(r-α)* was converted to present value. Substantive benefit of companies received political finance support are the difference between market interest rate and political financial. In view of the above, and expression was derived.

$$(r-\alpha)\sum_{i=1}^{n}=1[1/(1+r)^{i}]$$

'r' is the market interest rate. 'a' is the interest rate policy loans. 'n' is the support period. Equivalent to applying the discount rate is the market interest rate and can vary from company. The greater difference between the market interest rate and the policy interest rate, the larger support effect is. The longer period of support is, the larger the support scale is. <Table 4-6> is assuming that 13% of market rates, policy loans interest rates(α), support period(n) on the results is given different values.

Table 4-6 | The Effect of Financial Support Policies

(Unit: %)

a \ n	1	2	3	4	5	6	7	8	9	10
5	7.1	13.3	18.9	23.8	28.1	32.0	35.4	38.4	41.1	43.4
6	6.2	11.7	16.5	20.8	24.6	28.0	31.0	33.5	35.9	38.0
7	5.3	10.0	14.2	17.9	21.1	24.0	26.6	28.8	30.8	32.6
8	4.4	8.3	11.8	14.9	17.6	20.0	22.0	24.0	25.7	27.1
9	3.5	6.7	9.4	11.9	14.0	16.0	17.7	19.2	20.5	21.7
10	2.7	5.0	7.1	8.9	10.6	12.0	13.3	14.4	15.4	16.3
11	0.2	3.3	4.7	6.0	7.0	8.0	8.9	9.6	10.3	10.8
12	0.1	1.7	2.4	3.0	3.5	4.0	4.4	4.8	5.1	5.4

*supposition: r = 13%.

Source: Lee, Wonyoung et al.(1998).

The support target of financial support are innovation-related activities (R&D, commercialization, and market entry). The benefit probability from financial support is estimated at the rate of scale financial support per cost of innovation activities. About the performance of financial support in 1995, total financial support fund size is 5,435 hundred million won, and scale of the financial capital is 14,075 hundred million won.

Innovation R&D costs are estimated to be approximately 2.5 times, total amount of R&D investments of private companies in 1995 were 64,528 hundred million won. It was applied to the estimated rate of technological innovation cost per R&D cost (Yun munseop and Jang jinqyu(1997)); technological innovation was estimated to 163,362 hundred million won.

Table 4-7 | Configure Item of Expenditure of the Innovation Cost

	R&D	Design and Pilot Production	New Plant Investment	External Technology Acquisition Costs	Marketing of New Products	Education and Training	etc.
Ratio (%)	39.5	15.5	28.6	6.0	3.8	2.4	4.3

Source: Yoon, Munseop and Jang, Jingyu(1997).

<Table 4-8> shows the chance to benefit from financial support (the rate of policy funds per innovation cost). The benefit probability from financial support that only applied to financial fund is 5%, and including monetary fund is 15.6%. Estimates of the scale of financial funds due to the deficiency of statistical data, fund based on industry support (ex. non-investment) rather than technology development support was included in <Table 4-8>. So benefit estimated probability of financial funds was somewhat overrated.

Table 4-8 | Chance to Benefit from the Financial Support

(Unit: 100 million won, %)

	Chance to Benefit	Amount
Financial Fund (B)	5.0	6,768
Monetary Fund (C)	10.6	17,396
Sum	15.6	24,164

Source: Lee, Wonyung & Jang, Jingyu(1998), Evaluation of Government Supports for Industrial Innovation and Policy Implications.

3. Expansion of Private Sector's Research Organizations and R&D Investment

3.1. Expansion of Private Sector's Research Organizations

The government helped research and development of private enterprise for their systematic growth through the system of recognition enterprise institutes and enticed the establishment of enterprise institutes.

In their initial introduction phase in 1980 to 1985, the private research and development organization established the foundation based on large enterprise. Then, it gained enterprise centered quantitative growth in 2000, riding the wave of the venture company establishment and took on new development aspects depending on implementation of the research and development service declaration system. In 1985~1987, R&D institutes of SMEs increased significantly by easing the requirements, but was depressed temporary due to the financial crisis.

According to current laws, private research and development organizations in Korea are divided into R&D centers, Industrial Technology Research Associations, Nonprofit Research Corporations, and Commercial Research Corporations. Recently, the growth of the Industrial Technology Research Association and Nonprofit Research Corporation was stagnant compared to its importance and the Commercial Research Corporation is in a nominal state. Only the R&D centers experienced qualitative and quantitative growth, and a pivotal role.

3.2. Enterprise Research Institute

The Government has supported the R&D of private enterprises since late 1970. In 1978, in order to secure its own technology innovation capacity, it urged to establish R&D centers by selecting manufacturers whose generated revenues are more than 30 billion won, as directed by the president. Also, economic growth was stagnant due to the changing external environment (the second oil shock and the Middle East construction market decline).

The Council for the promotion of private research institute establishment was founded in 1979 and in 1982, was reorganized into the Korea Industrial Technology Association and continues today. The enterprise research institute was established in 1982, and began to be promoted as a research and development project in the wake of growth. The Ministry of Science implemented a particular research and development project of the Technology Development Promotion Act before the end of 1981 to amend the agency's participation in a research and development project. The Enterprise Institute was founded and the

Enforcement Decree stipulates the requirements for corporate reporting and research institute recognition system were introduced. In late 1981, before the act of implementation of a particular research and development project, the Ministry of Science amended the Technology Development Promotion Law, which included the enterprise research institute among the participation agencies of a particular research and development project, and defined the establishing requirements. Also, the Enterprise Research Center Report and an authorization system introduced an enforcement decree.

To promote private technology development, starting with reserves for technology development in 1973, the enterprise research center numbers rose to 14,000 in 2007 compared to 46 in 1981, through various support systems and mitigation requirements for establishing enterprise research centers. Technical and human resources for R&D tax credit, enterprise research centers for the local tax exemption system for real estate, special tax rate application for the goods leading technology development, income tax exemption system for foreign technicians, tax exemption system for the technical income, investment tax deduction system for new technology business investment, and the tax deduction system for technical service business was amended and supplemented in 1981. Duty exemption system for the research articles, and special tax exemption system for research samples were established in 1982. Since the financial crisis in 1997, companies promoted a major restructuring in R&D sections such as cutting investments in R&D, downsizing research manpower, and eliminating future research projects. However, the SME sector established the high technology-based small venture with the government's small venture development policy. Small venture institutes were established mainly by ex-researchers, starting from this point, it went on quantitative growth. There were reductions in the number of research staff (small enterprise: Bachelor of science degrees: 10 → 5; venture company: 2) and relaxation the qualifications of dedicated research personnel (Bachelor degree or higher → Bachelor (2 years experience required)) in Mitigation establishing requirements of R&D center.

Table 4-9 | The Establishment of Enterprise Research Institute by Year

	1981	1983	1988	1993	1998	2003	2006	2007.06
SME · Venture	-	9	322	1,113	2,960	8,927	12,398	13,542
(%)	-	(7.4)	(53.3)	(65.9)	(78.7)	(91.0)	(93.0)	(93.6)
Big Companies	53	113	282	577	800	883	926	932
(%)	(100)	(92.6)	(42.7)	(34.1)	(21.9)	(9.0)	(7.0)	(6.4)
Total	53	122	604	1,690	3,760	9,810	13,324	14,474

Source: Korea Industrial Technology Association.

Through the growth of the enterprise research center, there were problems that marked a decline of the portion of doctorate degrees compared to enterprise research center, small-scale of the enterprise research center, and metropolitan concentration of enterprise research center.

3.3. Industrial Technology Research Association

The Industrial Technology Research Association was established in 1977 to mobilize resources and provide distribution functions for the result of collaboration to solve project related issues to derive mutual collaboration during technology development.

Thus, the independent operating system that was not affected by individual companies is maintained and can join university union members so that it could facilitate cooperation between industry and academia. In 2006, 72 research associations were established and have been active to date. They include: 13 associations in machinery and metal; 24 in electrics and electronics; 8 in software; 3 in chemical engineering; and 24 in other fields.

These industrial technology research associations are intended to promote joint research among companies and serve as an intermediary that connects players in joint research with each other and facilitates the establishment of joint research groups. However, they have so far been mere contract agents that file applications for government-funded R&D projects on behalf of their member companies. Only a few research associations are playing active roles, for example the Nano Technology Research Association, the Korea Drug Research Association, and the Korea Association of Robotics.

3.4. Not-for-profit Incorporated Research Institutes

In science and technology fields, not-for-profit corporations are established and operated pursuant to Article 32 of the Civic Act and the Act on the Establishment and Operation of Public-Service Corporations. As of 2003, 22 not-for-profit corporations are registered to the Minister of Science and Technology.

Table 4-10 | Status of Non-profit Corporation Established Research Institutions (2003)

	Company Name	Founding Year	Main Research Field
1	Korea Foundation for the Advancement of Science & Creativity(KOFAC)	1967	Science technology culture business fostering and support
2	Korean Institute of Chemical Engineers(KICHE)	1970	
3	Korean Research Institute for Theoretical Physics & Chemistry	1978	Research on Physical and Chemical theory
4	The Geological Society of Korea	1979	Academy research funds support
5	MOGAM Biotechnology Research Institute	1984	Research on Vaccines, New drugs, and Diagnostics reagent
6	Kihun Science Technology Foundation		
7	Korean Liver Foundation		Research funding on science-related society
8	Research Institute of Industrial Science & Technology(RIST)	1987	Research on Steel, New materials, and management of Economic
9	Korea Cancer Research Foundation(KCRF)	1988	Research funds for medical scientist
10	Production Engineering Institute	1990	
11	Haedong Science and Culture Foundaton	1991	Research funding on electronic technology organizations
12	Korean Cell Line Bank		Medical science related research grant
13	Korea Interfacial Science and Engineering Institute(KISEI)		Interfacial engineering(Environmental, Materials, Recycling) research
14	Surkgok Institute of Observational Science & Technology	1995	
15	Ilcheon Genomic Medicine Institute		Medical science related research grant
16	Dongchon Science Research Foundation	1996	
17	Korea Research Institute of Jungshin Science		Research on Mental science, Medical science
18	The Hantaan Life Science Foundation		Domestic research fund supporting in Korea
19	(KITI)	1997	Control and measurement technology education (commissioned education)
20	Bong-eun Foundation	1998	
21	Korea Institute of Brain Science(KIBS)	1999	Research on Medicine, Brain Engineering, and Psychology
22	Sejong Science & Technology Institute	2001	

Source: 40-year history of Science and Technology.

Not-for-profit incorporated research institutes can have an independent operational scheme and are eligible to apply for most funds designed to support technical development. Both natural and juridical people can establish a not-for-profit incorporated research institute. But funds contributed to a not-for-profit incorporated research institute cannot be included in charges against revenues, and if dissolved, the remaining assets must be reverted to state coffers or bestowed or distributed to public corporations for free. They are also subject to the limits of investment from other corporations under credit management regulations, and companies have to bear additional expenses to hold a separate organization. There are only four organizations that have an exclusive research institute and have the institute conduct R&D activities: the Research Institute of Industrial Science and Technology; Mogam Biotechnology Research Institute; the Korea Interfacial Science and Engineering Institute; and the Korea Institute of Brain Science. Other corporations simply provide research funds and commissioned education in medicine-related fields and do not conduct substantial R&D activities.

3.5. Expansion of Private Enterprises' R&D Investment

3.5.1. Tax Incentives' Effects on the Expansion of Private R&D Investment

There are many reasons for the government to give incentives to private investment in technical development, but the fundamental reason is external economics caused by attracting investment in technical development (Lee, 1984). While the effects of technical innovation goes beyond the developer itself and spreads all over the industry, the level of investment in technical development determined in consideration of the company's profit maximization is less than the social optimum. Therefore, the marginal cost of such investments should be lowered through incentive systems. Requisites to be satisfied to ensure investment promotion effects may have questionable issues, and insufficient consideration of the effects of incentive systems may result in contradictory outcomes. Therefore it is necessary to continuously analyze and improve tax incentive systems across industries and enterprises in an integrative manner.

To analyze the effectiveness of tax incentives, a study conducted time series analysis and regression analysis of companies' R&D activities for 11 years between 1970 and 1980 (Noh, 1983). The time series analysis was intended to understand whether the government's implementation of new policies or changing the existing policies led to significant changes in the subjects the government intended to change and whether such changes remained effective over time and were established as a new pattern. The regression analysis was based on the assumption that companies' investment in R&D is associated with the size of their manufacturing and the effectiveness of tax incentive systems and aimed to identify

the effects of the variable of tax incentives on the dependent variable of increases in R&D investment.

<Table 4-11> shows changes in companies' R&D activities. For the 11 years between 1970 and 1980, the number of organizations that conducted research, the number of researchers, and the amount of research funds continuously increased. Compared to that of 1970, the number of organizations that conducted research increased by approximately 300.0%, the number of researchers by 443.6%, and research funds showed the highest level of increase, 6140.4%.

Table 4-11 | Trend of R&D Activities in Enterprises

Classification / Year	Number of Enterprises Did Research	Number of Researchers	Research Funds (1,000 won)
1970	107	1,159	1,324,859
1971	118	952	1,298,555
1972	133	1,149	2,136,524
1973	167	1,405	3,420,575
1974	242	2,552	9,799,140
1975	303	2,655	12,342,663
1976	278	3,258	15,141,241
1977	311	3,896	41,714,940
1978	291	4,304	53,802,040
1979	305	4,405	59,294,755
1980	321	5,141	81,351,926

Source: Ministry of Science and Technology(1981).

As <Table 4-11> shows, there were big upward leaps in the number of organizations, the number of researchers and research funds between 1973 and 1974. In particular, research funds increased by about 2.9 times between 1973 and 1974.

This was in accordance with the time when the Technical Development Promotion Act became effective in 1974. The Act was established in December 1972 and its Enforcement Decree in September 1973, which meant that the tax incentives provided in the Act started being effective by then.

Table 4-12 | Scale of Manufacturing and Science and Technology Investment

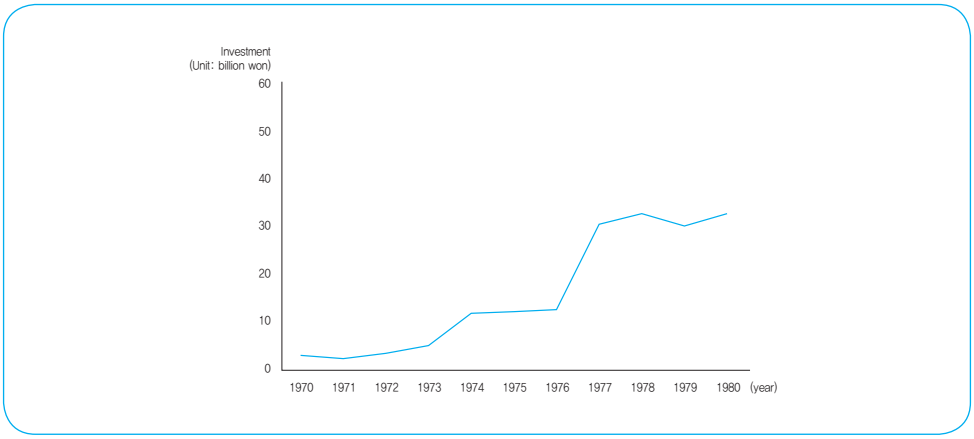
(in 1975 constant market prices)

Year	Science and Technology Investment (Unit: 1,000 won)	Scale of Manufacturing (Unit: 1 billion won)
1970	3,140,830	1,135.63
1971	2,744,028	1,349.42
1972	3,905,912	1,538.19
1973	5,526,555	1,987.76
1974	12,215,999	2,301.13
1975	12,342,663	2,590.35
1976	12,862,938	3,176.64
1977	30,468,175	3,633.58
1978	32,578,211	4,386.92
1979	30,102,168	4,818.01
1980	32,810,858	4,763.84

Source: Noh, Hwajung (1983).

This underpins the judgment that a drastic increase in companies' R&D investment was associated with the effect of the implementation of new policies. To understand whether such an increase in R&D investment were a nominal increase attributable to inflation or a substantial increase, the author converted companies' R&D investment to constant prices as of 1975, as shown in <Table 4-12>. [Figure 4-1] shows a diagram of investment in science and technology summarized in <Table 4-12>. As [Figure 4-1] shows, companies' R&D investment drastically increased between 1973 and 1974 and once again between 1976 and 1977. This underpins the interpretation that such increases were associated with the declaration of the Enforcement Decree of the Technical Development Promotion Act (September 22 1973) that included provisions on tax incentives and two amendments of the decree. To understand Korean companies' R&D investment after the oil shock in 1973, the author investigated R&D investment of companies, research institutes and universities back then. As shown in [Figure 4-2], R&D investment of research institutes and companies significantly increased between 1973 and 1974. Although that of universities showed drastic fluctuations of upward and downward changes, most upward changes accorded with that of research institutes and companies or followed them at an interval of a year. This demonstrates that the social atmosphere in those days had significant influence on the increase of R&D investment.

Figure 4-1 | R&D Investment of Enterprises



Source: Noh, Hwajung (1983).

Even if considering the influence of these historic events, the conclusion that distinct upward changes in R&D investment after 1974 was associated with the effects of the tax incentives would remain valid.

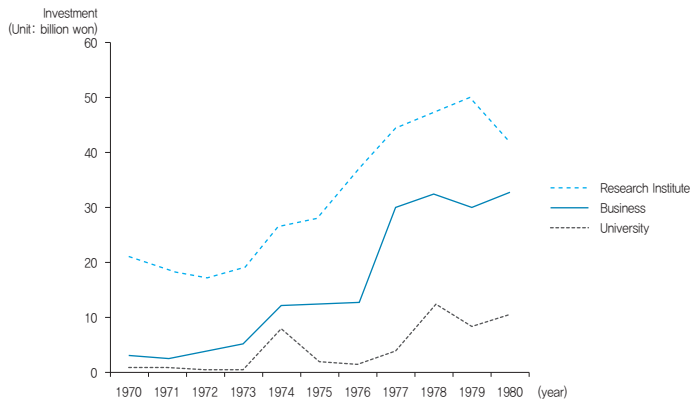
Table 4-13 | Trend Research Activities by Organization

(in 1975 constant market prices, Unit : 1,000 won)

Classification / Year	Research Institutes	Universities	Enterprises
1970	20,984,783	879,839	3,140,830
1971	18,587,143	1,209,028	2,744,028
1972	17,446,539	637,245	3,905,912
1973	19,131,265	592,806	5,526,555
1974	27,254,320	8,128,985	12,215,999
1975	28,139,243	2,181,819	12,342,663
1976	37,195,541	1,680,924	12,862,938
1977	44,318,439	4,004,152	30,468,175
1978	47,274,721	12,439,421	32,578,211
1979	49,857,037	8,394,983	30,102,168
1980	42,135,893	10,446,842	32,810,858

Source: Noh, Hwajung (1983).

Figure 4-2 | Research Institutes, Companies and Universities Compared to the R&D Investment



Source: Noh, Hwajung (1983).

Noh (1983) also tried to evaluate the accomplishments of the tax incentive systems using a multiple regression model. The model had basic assumptions that increases in companies' R&D investment can be demonstrated by the size of their manufacturing and the effects of tax incentives and that the remaining part of such increases after deducting the contribution of the size of the manufacturing can be demonstrated by the effects of the tax incentives. Introducing a policy variable of tax incentives to verify a dependant variable of increases in R&D investment may lead to the exclusion of other important variables that may be associated with this policy variable from the evaluation model, thereby increasing the likeliness that the influence of the independent variable in the model could be overestimated. To verify this doubt, the author has set the following recession models.

$$\text{Model 1: } \ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 X_2 + \epsilon$$

Y : R&D investment of enterprises (in 1975 constant prices)

X_1: scale of manufacturing (in 1975 constant prices)

X_2: variable number (support or not about tax)

$$\ln \hat{Y} = -5.16002 + 1.84476_1 \ln X_1$$
$$(-4.55732)(12.8183)$$
$$R_1^2 = 0.9481,\ Adj\, R_1^2 = 0.9423,\ F(1,9) = 164.31$$

Model 1 had significance at a significance level of 0.05. In this model, changes in the size of manufacturing demonstrated more than 94% of changes in companies' investment in science and technology and showed that both policy variables of manufacturing size and tax incentives had significant influence on changes in R&D investment.

Model 2: $\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$

Y : corporate R&D investment(in 1975 constant prices)

X_1 : scale manufacturing(in 1975 constant prices)

X_2 : variable number(regulations enacted tax support) ; from 1974 to 1976 is X_1=1, the rest is X_2=0

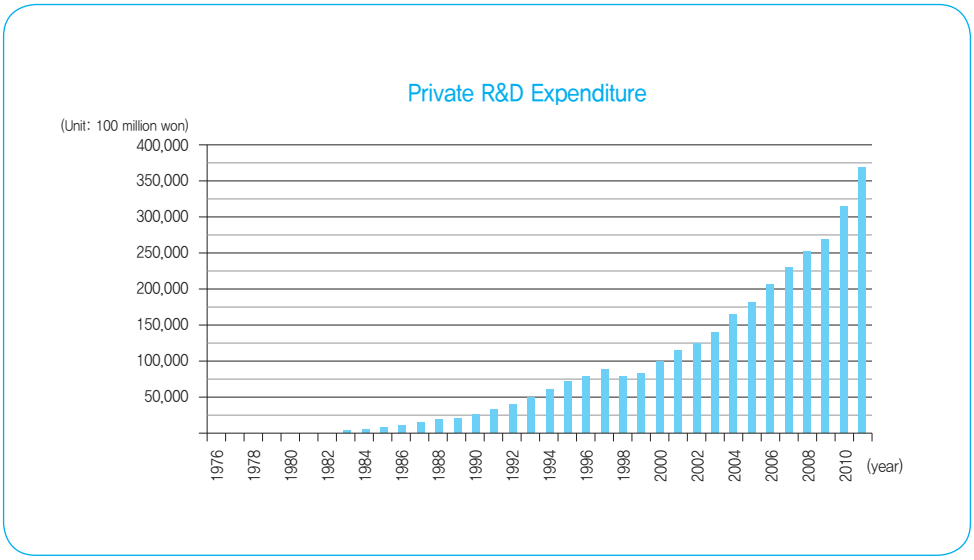
X_3 : variable number(tax support amendment proceeding and revision)

Model 2 divided the time span of the tax incentive variable into: 1970~1973 that was before the establishment of the Technical Development Promotion Act; 1974~1976 that was after the establishment of the act; and 1977 and afterwards when the act was largely amended. From this model, the author inferred that the establishment of legislation on tax incentives and its amendment respectively contributed to increases in R&D investment.

3.5.2. Expansion of Private R&D Investment

In 1976, private R&D investment was 21.4 billion won in Korea and it increased steadily to above 100 billion won in 1980, 268.7 billion won in 1982, and 451 billion won in 1983. Private R&D investment has increased greatly and was above 36 trillion won in 2011. Most of the growth rates of private R&D investment per year are above 10%.

Figure 4-3 | Private R&D Investment by Year



Source: NTIS (National Science & Technology Information Service).

4. Science & Technology and Economic Achievements

4.1. Achievements of Science and Technology over Time

The biggest achievements in industrial technology in the 1970s were seen in the heavy chemical industry. The construction of POSCO started in the 1970s and the first phase was completed in 1973 with capacity of 1.03 million tons and the second phase was completed in 1983 to become a steel maker with an accumulated capacity of 9.1 million tons. At the time, POSCO was established with the support of a leading Japanese steel maker and operation technology was also learned from technology advisors in Japan. Other than POSCO, the auto industry also witnessed remarkable growth as the government built a long term plan to nurture the auto industry with the heavy chemical industry promotion policy and Hyundai Motors was the one running the business most fitting for the policy. In June 1974, Hyundai Motors released its first proprietary model, Pony, a compact car manufactured with core technology such as engine and gear changes introduced from Mitsubishi and designs from an Italian design vendor with 85% of local capability. In 1976, Pony began to be exported to Latin America, the Middle East and Africa and became the first Korean car to be exported to overseas markets.

In 1977, Polyethylene terephthalate file (PET) was developed by KIST and was another remarkable accomplishment of industrial technology development. At the time, over 20 years passed that the PET file was first developed and the patent expired but Korea still had to depend on imports for entire domestic demand as it did not have manufacturing know-how. The KIST research team was commissioned by Sunkyung (now became SK) for PET film development in 1976 and succeeded in PET chip development and also developed an industrial polymer. Based on this Sunkyung, kicked off construction of a factory but there were conflicts as another local company worked on PET production with turn-key basis technology introduction from a Japanese company. Eventually, the Technology Development Evaluation Committee designated the technology as targets for new technology to be locally developed and concluded that introduction of foreign technology by other companies should be banned for the next four years.

In the 1980s the level of production and peripheral technology were approaching the levels of advanced nations but in core technology and high technology, a wide gap remained. In the 1980s Korea made extensive efforts to facilitate technology concentration on existing industries and nurture high-tech industries at the same time. The trend was also reflected on export items as products of heavy chemical industries increased and high-tech products were also added.

Until the 1970s the focus was on how to introduce and utilize technology from advanced countries. However in the 1980s, Korea entered the stage of developing technologies required with active investment. The examples of technology innovation accomplished in the 1980s included development of DRAM semiconductor, TiCOM, electronic switching system, materials for semiconductor lead frames, localization of VTR head drum, vaccine for type B hepatitis, NMR-CT and localization of nuclear materials.

Development of the DRAM semiconductor was led by a private company, Samsung Electronics. Samsung made a series of successful outcomes, developing 64K DRAM and 256K DRAM respectively in November, 1983 and October, 1984 to narrow the gap with advanced nations down to five years. It also succeeded in developing 1M DRAM 4M DRAM in July, 1986 and February, 1988 rapidly catching up to the market leaders. As the leading companies strengthened their protection measures, Samsung was once sued over patent infringement. In an effort to respond to the trend, for 4M, 16M, 62M, 256M DRAM, a joint national research project kicked off to develop the technology domestically in cooperation among the industry, academia and research institutes.

Development of the electronic switching system (TDX) was led by government-funded research institutes in a 15-year long project that went from 1977 to 1991. The TDX development team was organized within the Electronics and Telecommunications Research Institute (ETRI) and members of a switching gear manufacturer, the Postal Office and Korea Telecom were dispatched for joint research. ETRI developed TDX-1 (1984) and TDX-1A (1988) to be utilized for farming and fishery communities based on the technology introduced from overseas and a private manufacturer was in charge of developing TDX-1B by improving TDX-1A. ETRI supervised the development of large-volume switching gear, TDX-10 with the joint research team. The TDX project took gradual steps to go through a mid-volume switcher to large volume one, after selecting a model to make largest benefits in long-term perspectives. It was also worth paying attention that productive competition was encouraged among manufacturers in close cooperation among experts from the industry, academia and research.

Localization of nuclear fuel was led by the government through the Korea Atomic Energy Research Institute and it was planned to perform the entire process of nuclear fuel cycle, not dependent on foreign technology and the major target was heavy water fuel using natural uranium and light water fuel using low-enriched uranium. For heavy water nuclear fuel, a prototype was developed in 1983, based on the model of fuel provided by Canada and verification test was performed and test loading succeeded in 1984. In June 1987, the plant for mass production was expanded and with the success of design and construction of the conversion plant and test drive, the entire process of heavy water nuclear fuel was localized. For light water nuclear fuel, the target was to localize the entire process except for enrichment related to non proliferation. With this target, nuclear design and processing technology was developed with KWU of West Germany in 1985 and in 1988, the actual production kicked off with operation of fabrication plant with annual capacity of 200 tons.

In the 1990s, Korea almost caught up with advanced nations in fabrication and manufacturing and tried to differentiate with technology intensive products. With the attempt, Korea succeeded in entering into the market of high-tech products like semiconductors, mobile telecommunications and visual displays. However, as it still lagged behind in design and system and core component and materials technology, there were limitation to scale up and diversify demand for high-tech and high value-added products.

According to the survey of the Korea Institute of S&T Evaluation and Planning 1999, in electronics, information and telecommunication technology, Korea reached 71.1% of capacity with about 2.6-year gap with the top technology levels in the world and in materials and processing, it has reached 70.8%. The areas with the lowest technology capability were environment and earth sciences at 60.6% capacity with 6.5-year gap with global leaders. In general, it was reported that the gap was minor in fields with relatively short history (e.g.

electronics, telecommunication, semiconductor, S/W and biotech) while the gap was wider in fields of long history (basic science and mechanical engineering) and macro science (aviation, airspace, ocean).

Yet, the 1990s was the time to see significant achievements in various fields. As inter-departmental joint research projects gained momentum, core technology development became possible. Leading technology development projects, such as high definition (HD) digital TV was developed in 1994 and semiconductor, 64M DRAM prototype was developed in 1993 and 256M DRAM prototype in 1994 to become the global leader with the most advanced technology in the field. With the development of next generation flat panel display, Korea became the first to develop large-scale TFT-LCD to set the basis to lead the display market and with information and telecommunication research projects, the CDMA system was developed through a joint technology development initiative among the industry, academia and research. With this success, Korea launched the world's firist CDMA-based digital telecommunication service. With these large-scale research and development projects, companies could reduce the risk in the process of securing core technology and the joint approach of industry, academia and research allowed well-organized moves of various knowledge and resources of the nation.

In fine chemistry, medical development was active. In 1999, Sunpla Injection, the anti-cancer drug developed by SK Chemicals was registered as the first domestically developed new drug and with the new medicine and new pesticide development under the leading technology development projects starting in 1992, the technology capability of Korea advanced up to the level of developing improved new drug and new materials at the stage of materials composition.

In the field of aerospace, satellite development was pursued to achieve technological independence and multi-purpose satellite (Arirang 1), Science Rocket (1, 2, 3-step model) and Science Satellite (Uribyol 1, Science Satellite 1) were developed and technology localization was also pursued. In the field of aviation, advanced jet trainer was developed in technology cooperation with advanced nations and in the private sector, Bandi, a small aircraft was developed.

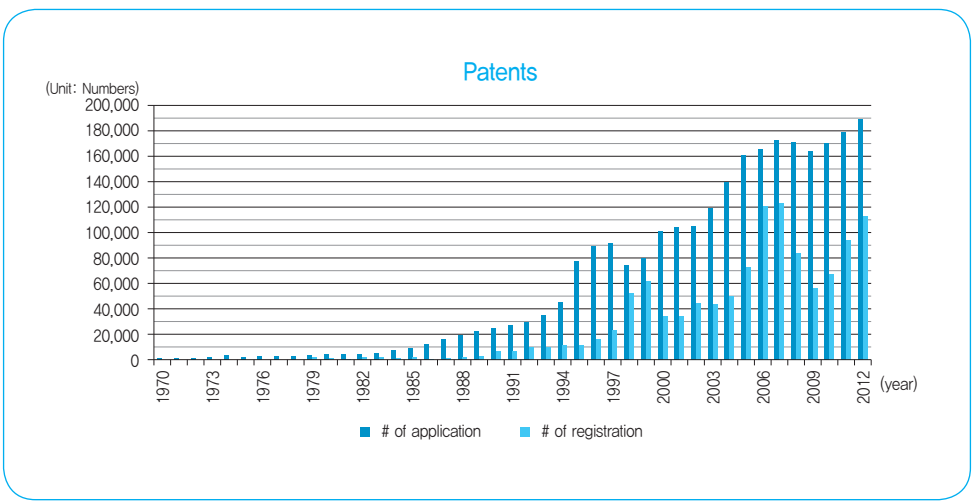
In the automotive field, Korea became technologically independent in engine building, the core part of automobile fabrication. In 1991, Hyundai Motors developed the Alpha engine, entirely by domestic technology and it was applied to build domestic cars. In the steel industry, entering the 1990s, as advanced nations became even more reluctant to transfer technology, a joint research among the industry, academia and research was formed to develop fundamental technologies and this facilitated new steel processing technology

development including smelt reduction steel making technology and as a result, in the 2000s Finex technology, strap casting technology and minimal technology were developed to fabricate steel sheets with an electric furnace to produce multiple items in small volume.

4.2. Achievement of Patent and Technology Trade

In 1970, the number of patent applications was 1,846, but only 266 applications were registered and that is 14.4% of the total number. In 1980, there were more than 5000 patent applications, in 1985, there were more than 10,000, in 1988 more than 20,000, in 2000 more than 100,000 and in 2012 the number of patent applications amounted to 188,915. When you look at the number of registration of patents, the statistical data shows that in 1978 the number was 427, but after only one year, in 1979, it amounted to 1,419 and it means that the quality of patents was increased during that period. In addition, the figures show that the number of registration of patents was also continuously increased and it was over 2,000 in 1982 and the number sharply increased from 3,972 in 1989 to 7,762 in 1990 and after 2006, when it was more than 100,000, the number had decreased in some years but in 2012 it amounted to 113,467. When you look at the ratio of registration of patents to application of them, in 1970s it was just around 10% and in 1998 and 1999 the ratio skyrocketed to about 70%, but after that, the figure fell again and in 2012 it was 60.1%.

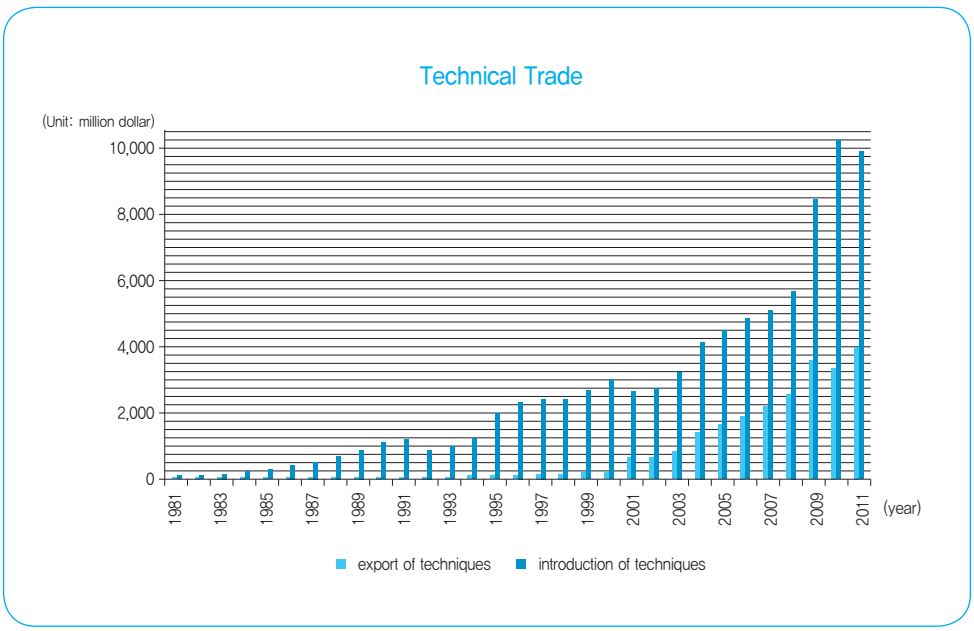
Figure 4-4 | Statistical Data Regarding Number of Patent Applications and Registrations



Source : NTIS (National Science & Technology Information Service).

When we analyze data about technology trade, we can understand in detail the economic activities of South Korea involved with technology like spending for purchasing license necessary to introduce technology into the country and exports from selling technology and the details are as follows. When you look at the progress of technology per year, the income from exportation of technology was just $11 million in 1981 while spending for the introduction of technology was $100 million. In recent years, both the spending and exports were on the rise and the expenditure for introduction, which had been increased by about 90% from 1981, was $10.2 billion in 2010 and $9.9 billion in 2011 and exports, which had been increased by about 340% from 1981, was $4 billion in 2011. When you examine trade balances of South Korea, you can see that the technology trade deficit was on the decline from $95 million in 1981 to about $5.8 billion in 2011.

Figure 4-5 | Spending for Introduction of Technology and Revenue from Export of Technology



Source : NTIS (National Science & Technology Information Service).

Chapter 5

Conclusion

Conclusion

In the 1960s, we didn't feel the need to develop technology because South Korea's industry was based on labor intensive ones, but the government started to draw up a variety of inducements to stimulate private enterprises' efforts to develop technology as competitiveness in exporting products based on low wages began to be lost in 1970s and as a result, it was stressed that we should make efforts to increase productivity through learning and improving introduced technology in order to secure market competitiveness.

In the early 1970s, the tax support system was focused on investment in facilities as then economic policies gave weight to qualitative growth in economy, but in the late 1970s the system changed and it was believed that technological innovation was important along with acceleration of restructuring of industries and rapid economic growth.

However, the government concentrated on fostering strategic industries and cultivating export markets focusing investment in facilities as it had been totally dependent on introducing and imitating foreign technologies until the 1970s and after that, until the late 1970s, most major companies didn't divide development organizations and policy and financial support of the government for businesses was provided only to support foreign funds to introduce some technology from other countries.

Since the late 1970s, the government has expanded the supporting system for technology development and the industrial world raised its awareness of technology development, as a result of which showed that the industrial circles' activities for developing technologies seemed to be gradually vibrated from then and this atmosphere greatly contributed to strengthen the abilities of private businesses to innovate technology after the 1980s.

Lee (2009) attempted an empirical analysis to concluded that Korean government R&D subsidies to Korean private firms are inducing, rather than crowding out, private sectors' industrial R&D activities in most of Korean industries but this phenomenon happened only after the financial crisis in 1997~1999. Before the crisis only a small number of traditional industries such as the steel industry and shipbuilding industry showed that the Korean government R&D induced private firms' R&D expenditures.

In the 1980s, the government pushed active technology drive policies and drew up various supporting systems to encourage businesses to innovate technology and especially expanded subsidy and tax, financial, information and infrastructure support to do so. The tax supporting policy in the 1980s focused on promoting competition through neutrality of taxation and firmly constructing market economy systems and it changed the supporting system from the way to focus on some particular industries to the way to provide support depending on functions, which made it possible for companies to be provided tax support regardless of category of business or business scale as long as they performed functions like investment in facilities or technology development.

In the 1980s, the government changed its policy to focus on perfectly learning and improving introduced technology through self-developed technology, calling for large companies to establish technical service institutions for developing products and improving production process and to help them, the government started to offer tax benefits to them and a majority of these large companies started to invest in technology development in earnest as in response to government actions, they established laboratories on their own. The government pushed forward a financial policy business in two directions and one is a loan support business to help large companies develop technology and the other is a support for small and medium enterprise establishment and venture capital support.

In the 1990s, government support to enterprises was banned in principle and the government also sharply reduced the direct support, especially support to investment in facilities, to large companies by downsizing the existing industrial policies as South Korea joined the WTO and OECD, but it was accepted as exceptions that the government offered support for technology development or small and venture businesses. For that reason, the government maintained and expanded the fund for research and development and the loan support business. Furthermore, in the 1990s, the technical innovation support system saw changes from direct support to indirect support and innovative system including expanding support systems that helped new technology to be commercialized. Major companies didn't need to heavily depend on government financial policies since they could raise equipment funds themselves through commercial banks that were partly privatized, nonmonetary

institutions and direct finance from foreign countries. From the early 1990s, the most surprising qualitative improvement in technology finance was to set up the science and technology promotion fund, informatization promotion fund and to start to offer technology credit guaranty.

#Case 1) WooJin INC

WooJin Inc is a small and medium-sized business which generated revenues of 4.4 billion won in 2007 and 11 billion dollars in 2010 since 1980 when it was established. This company has concentrated its energy on the research and development field, and focused on research in domestic key industries including the steel industry, semiconductor industry and nuclear industry since 1987 in which it set up the first measurement technology laboratory. WooJin has made an investment in the R&D field (research and development field) amounting to 5.8% of the total sales since 2007. Its major technical field is measurement field and new material field.

1. Measurement Field
- development of TMS (Tele Meter System) data logger and monitoring software - development of device to measure thickness of slag for molten metal - development of digital measuring instrument for molten metal - development of NIMS (NSSS (Nuclear Steam Supply System) Integrated Monitoring system) - development of a digital indicator of safety class for nuclear station. - development of digital M/A Station for nuclear station.
2. New Material Field
- development of high damping alloy (It is included in ferro-alloy and a new kind of alloy which can convert outside vibrational energy into thermal energy through phase change of metal) - development of high silicon cast iron with acid proof preventing various corrosion responses by making efficient oxide film.

As for WooJin, it can be a significant opportunity for growth to succeed in developing a measuring instrument system used for nuclear reactors with the Korea Hydro & Nuclear Power Co., Ltd. through research and development in the long term in order to devise a new business plan during the foreign exchange crisis. In particular, with the governmental technology development project with an option to purchase deciding buyers in public in advance, WooJin can succeed in developing a new measuring instrument in nuclear reactor field thanks to funding for research and development.

In addition, while we were forced to import the measuring instrument system for nuclear reactor in the past, now we can domestically produce complete parts through research and development over the long term, helping our company take a new leap forward. Although it is very difficult to succeed in the field of nuclear reactors, once a company produces positive results, it is expected to have high profit margins in a sustainable way when it can gain other companies' trust in the long term and reach a certain level of technology, and this field calls for companies to try to develop technology to maintain quality and in this situation WooJin has made efforts to do so and grown rapidly. While we are doing our best to improve our research and development for business continuously, we have limits to pioneer new markets as a small and medium-sized business only with this company's technical development.

Therefore, we plan to find new business items while cooperating with public enterprises including Korea Hydro & Nuclear Power Co., Ltd. in research and development and the governmental technology development project with an option to purchase. Moreover, we are scheduled to make progress in development of technology through strategic partnership with POSCO.

#Case 2) SeHwa Electronics

SeHwa Electronics has dealt with an order of 'development of touch window using four wire resistance' from LG Electronics for 12 months (from December 2007 to November 2008). Through this process, it was provided support funds of 247 million won from the government. Before this task was completed, the touch window using resistance method used for mobile cellular phone from LG Electronics had to be entirely imported from foreign countries and lagged behind developed countries like Japan in producing technology by more than five years.

Through this project, LG Electronics called for SeHwa Electronics to develop new touch window products used for mobile cellular phone that would apply and combine touch screen basic technology, integrated flat window and touch screen. In the process, a variety of core processes were utilized: technology to design electrode pattern, to etch metallic oxide dealt with ITO deposition and to print high detailed patterns. In addition, the company had to materialize simpler product structures by combining adhesive tape bonding technology, UV printing and bonding technology, CNC detailed-operating technology.

SeHwa Electronics proceeded this task to develop these technologies. Through this project, LG Electronics could reduce costs by using domestic parts and jumped to the same level of quality and productivity of industrialized countries, as a result of which the major company had competitive pricing and quality compared to developed countries. SeHwa Electronics also turned over 34.4 billion won for four years (from 2008 to 2011) and secured technology with the same product. Moreover, this company added a new production line and created about 100 new jobs.

It can be said that we could learn how to expand research organizations of private companies and how to help them innovate technology and have international competitive power. Although most private businesses in developing countries had little interest in technology development by succeeding in developing technical innovation support system focusing tax and financial supporting system we had experienced in the 1970s to the early 1990s. Until now, this study has shown that what background South Korea had regarding technical innovation support system, how this system went on annually, what support the government offered through technical innovation support system in detail, how much innovation private companies could get from this system and how much scientific and technological achievement we could obtain during the 1970s to the early 1990s. We hope that this study can help many developing countries facing problems like the gap in technology innovation between the government and private companies and poor technical competitiveness of private businesses by fostering a technical innovation support system.

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