



OECD Reviews of Innovation Policy

Industry and Technology Policies in Korea



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Foreword

This review of Korea's Policies for Industry and Technology was requested by the Korean authorities, represented by the Ministry of Trade, Industry and Energy (MOTIE), and was carried out by the OECD's Directorate for Science, Technology and Industry (DSTI) under the auspices of the Committee for Industry, Innovation and Entrepreneurship (CIIE).

The review draws on a background report commissioned by MOTIE and on the results of interviews with major stakeholders in Korea's industrial and technology policy system. The purpose of this review is to analyse Korea's industrial and technological capabilities and policies in comparison with those of other countries, and to provide policy recommendations for Korea.

The review was drafted by Alistair Nolan (Structural Policy Division, DSTI, OECD), Jinhyuk Choi (Structural Policy Division, DSTI, OECD) and Minjung Kang (Structural Policy Division, DSTI, OECD) under the supervision of Dirk Pilat (Deputy Director, DSTI, OECD). Valuable inputs were provided by independent experts, namely Ken Warwick (former Chair of the OECD's Committee on Industry, Innovation and Entrepreneurship), Nicholas Vonortas (Professor of Economics and International Affairs George Washington University) and Stefan Kuhlmann (Professor, Foundations of Science, Technology and Society, University of Twente). Valuable comments and guidance were also provided by Andrew Wyckoff (Director, DSTI, OECD) and Nick Johnstone (Head, Structural Policy Division, DSTI, OECD).

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The review benefited from consultations with a number of Korean government ministries and institutions, including (in alphabetical order), The Federation of Korean Industries (FKI), Korea Research Council of Industrial Science and Technology (ISTK), Korea Federation of Small and Medium Business (Kbiz), Korea Development Institute (KDI), Korea Evaluation Institute of Industrial Technology (KEIT), Korea Institute for Advancement of Technology (KIAT), Korea Institute for Industrial Economics and Trade (KIET), Korea Institute of Science and Technology Evaluation and Planning (KISTEP), Korea Research Council of Fundamental Science and Technology (KRCF), Korea Venture Capital Association (KVCA), Korea Venture Investment Corporation (KVIC), Ministry of Science, ICT, and Future Planning (MSIP), Ministry of Strategy and Finance (MOSF), Samsung Economic Research Institute (SERI), Small and Medium Business Administration (SMBA), and the Science and Technology Policy Institute (STEPI).

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Abbreviations and acronyms

ANR	Agence Nationale de la Recherche (French National Research Agency)
AplusB	Academy plus Business programme
ARPA-E	Advanced Research Projects Agency-Energy
AWS	Austria Wirtschaftsservice
BA	Business accelerators
BIS	Department for Business, Innovation and Skills
BMVIT	Austrian Federal Ministry for Transport, Innovation and Technology
CEO	Chief Executive Officer
CIHR	Canadian Institutes of Health Research
CIT	Corporate Income Tax
CPB	National Bureau of Economic Analysis (Netherlands)
DAPA	Defence Acquisition Programme Administration
DFG	German Research Foundation
DOE	US Department of Energy
EIS	Enterprise Investment Scheme
EPC	Excellent Performance Certification
ERC	Engineering Research Centre
ETRI	Electronics and Telecommunications Research Institute
FFG	Austrian Research Promotion Agency
FhG	Fraunhofer Society
FKI	The Federation of Korean Industries
FOA	Funding opportunity announcement
FOF	Fund of Funds
FTT	France Technology transfer
GP	general partner
GPP	Excellent Procurement Product
GPRA	Government Performance and Results Act
GRIs	Government Research Institutes
GS	Good Software
GSA	US General Services Administration
HCI	heavy and chemical industries
ICT	Information and communications technology
ILO	Industry Liaison Offices

IP	Intellectual property
IPR	Intellectual property rights
ISTK	Korea Research Council of Industrial Science and Technology
ITN	Innovation Transfer Network
KAERI	Korea Atomic Energy Research Institute
KARI	Korea Aerospace Research Institute
KASI	Korea Astronomy and Space Science Institute
KATS	Korean Agency for Technology and Standards
KBC	Knowledge-based Capital
Kbiz	Korea Federation of Small and Medium Business
KBSI	Korea Basic Science Institute
KCC	Korea Communications Commission
KDI	Korea Development Institute
KEIT	Korea Evaluation Institute of Industrial Technology
KERI	Korea Electrotechnology Research Institute
KETEP	Korea Institute of Energy Technology Evaluation and Planning
KFF	Korea Fund of Funds
KFRI	Korea Food Research Institute
KIAT	Korea Institute for Advancement of Technology
KICOS	Korea Foundation for International Co-operation of Science and Technology
KICT	Korea Institute of Construction Technology
KIER	Korea Institute of Energy Research
KIET	Korea Institute for Industrial Economics and Trade
KIGAM	Korea Institute of Geoscience And Mineral Resources
KIMM	Korea Institute of Machinery & Materials
KIMS	Korea Institute of Materials Science
KIOM	Korea Institute of Oriental Medicine
KIST	Korea Institute of Science and Technology
KISTEP	Korea Institute of Science and Technology Evaluation and Planning
KISTI	Korean Institute for Science and Technology Indicators
KIT	Korea Institute of Toxicology
KITECH	Korea Institute of Industrial Technology
KONEX	Korea New Exchange
KOPRI	Korea Polar Research Institute
KORDI	Korea Ocean Research & Development Institute
KOSBIR	Korea Small Business Innovation Research programme
KRCF	Korea Research Council of Fundamental Science and Technology
KRIBB	Korea Research Institute of Bioscience and Biotechnology

KRICT	Korea Research Institute of Chemical Technology
KRISS	Korea Research Institute of Standards and Science
KRRI	Korea Railroad Research Institute
KTTC	Korea Technology Transfer Centre
KVCA	Korea Venture Capital Association
KVIC	Korea Venture Investment Corporation
LINC	Leaders in Industry-University Co-operation
M&A	Mergers and acquisitions
MEST	Ministry of Education, Science, and Technology
MKE	Ministry of Knowledge and Economy, former MOTIE
MLTM	Ministry of Land, Transport and Maritime Affairs
MOE	Ministry of Education
MOFAT	Ministry of Foreign Affairs and Trade
MOLIT	Ministry of Land, Infrastructure and Transportation
MOSF	Ministry of Strategy and Finance
MOST	Ministry of Science and Technology
MOTIE	Ministry of Trade, Industry and Energy
MSCs	Middle-sized companies
MSIP	Ministry of Science, ICT, and Future Planning
NEET	Not in Employment, Education or Training
NEP	New Excellent Product
NES	National Evaluation System
NET	New Excellent Technology
NFRI	National Fusion Research Institute
NHS	National Health Service
NIMS	National Institute for Mathematical Sciences
NRF	National Research Foundation
NRF	National Research Foundation
NSRI	National Security Research Institute
NSTC	National Science & Technology Council
OCS	Office of the Chief Scientist
OSEO	French national innovation financing agency
OSTP	Office of Science and Technology Policy
PBS	Project-based management system
PCT	Patent Co-operation Treaty
PEP	Pre-proposal evaluation Panel
PRIs	Public research institutes
RFID	Radio Frequency Identification

ROAMEF	Rationale, Objectives, Appraisal, Monitoring, Evaluation and Feedback
ROS	Research Outcomes System
RTTCs	Regional Technology Transfer Centres
SATT	Technological Transfer Acceleration Companies
SCIF	Seed Co-Investment Fund
SEC	Securities and Exchange Commission
SERI	Samsung Economic Research Institute
SES	Seed and early-stage
SIC	Standard Industrial Classification
SISE	Integral Monitoring and Evaluation System (Spain)
SMBA	Small and Medium Business Administration
SME	Small and Medium-sized Enterprise
SPC	a special purpose company
SSC	Scientific steering committees
STEM	science, technology, engineering and mathematics
STEPI	Science and Technology Policy Institute
TEA	Total entrepreneurial activity
THCs	Technology holding companies
TLOs	Technology Licensing Offices
TNO	Netherlands Organisation for Applied Scientific Research
TRL	Technology Readiness Level
TSB	Technology Strategy Board
TTAs	Technology Transfer Alliances
TTOs	Technology transfer offices
UCSD	University of California San Diego
VC	Venture capital
VIF	Venture Investment Fund
VTT	Technical Research Centre of Finland
WIT	World Institute of Kimchi

Executive summary

In many respects, the Korean innovation system is highly developed. But Korea will need to address a number of economic and institutional challenges to sustain a steady flow of innovations and drive productivity increases in manufacturing and services.

The evaluation system for R&D

- Few OECD countries are as comprehensive in evaluating public support for research and development (R&D) as Korea. However, evaluation of R&D programmes could evolve further in providing intelligence for economic policy making.
- The government intends to accept greater risk in publicly-supported R&D projects. Care is needed to ensure that a greater tolerance for failure produces a higher average rate of return to projects and not just an increased number of unsuccessful projects.
- The awardee evaluation process might be improved to enhance the impact of R&D project funding. Korea could introduce a system whereby assessors examine the potential awardee and his/her proposal over a longer period of time and individually. The link between the different stages of project evaluation could likewise be strengthened.
- Connections between technology and the market could be strengthened. Korea could take lessons from the practice followed by ARPA-E, in the United States, which has in-house ‘technology to market’ advisors, and also enhance co-operation between key institutions (KIAT and KEIT).

Commercialisation of publicly supported research

Korean policy makers wish to translate a greater share of publicly supported R&D into new products and services in the market. Many enterprises, particularly SMEs, appear to shy away from intense collaboration with academic institutions. The same holds, the other way around, for many academic researchers. Approaches to enhance commercialisation could include:

- Establishing a more business friendly education system and addressing cultural and other barriers to start-ups and to joint working between business and the research base.
- Encouraging the development of more highly trained students to support industrial innovation and stimulating the secondment of undergraduate and graduate students to innovation-oriented companies, in particular SMEs.
- Giving systematic support for public-private innovation partnerships. While programmes operate in Korea to support public-private research and innovation collaboration, more systematic efforts might be made.
- The mission and institutional and financial set-up of the GRIs should be re-considered (ideally after a thorough “system-evaluation” in the light of international experiences).
- Further promoting technology holding companies (THCs).

- Adopting longer timeframes in programmes to advance commercialisation and ensure commensurate levels of funding for commercialisation activities.
- Reviewing aspects of the intellectual property protection system that may be causing unnecessary uncertainty. Assess whether more needs to be done to increase awareness of intellectual property among SMEs.
- Examining where opportunities exist to use innovation challenge prizes.
- Increasing expertise in public institutions on commercialisation. Publicly funded research institutes (within and outside universities) whose research activities are relevant for commercial purposes should build their expertise as well as networks to foster commercialisation.

Encouraging more start-ups and SME growth

The Creative Economy Strategy seeks to increase entrepreneurial activity in Korea. Much is being done to achieve this goal. Ensuring good framework conditions must be the priority. Policy makers should also:

- Examine whether features of the R&D tax credit make it hard to access for firms in creative industries.
- Ensure the R&D tax credit strengthens radical innovation in small (often service sector) firms.
- Assess whether the R&D tax credit sufficiently encourages industry-university collaboration.
- Fully test market needs before the introduction of new programmes and carefully choose the evaluation criteria used to assess programmes such as business incubators.
- Ensure that distinctive characteristics of female entrepreneurship are reflected in support programmes.
- In supporting access to equity finance, continue the emphasis on co-investment and fund-of-fund approaches and give more consideration to whether demand-side conditions are now a limiting factor.
- Seek to make general public procurement more likely to induce innovation and examine opportunities for introducing competition processes in tendering for R&D.
- Achieve greater overall coherence in public support, focusing on the rationale and effectiveness of the many programmes underway and the avoiding duplication or overlap.

Manufacturing and services: A new balance

- Key framework conditions that require on-going policy attention include education and training, labour market flexibility and competitive markets for goods and services. Structural reform in the service sector also requires the social safety net to be strengthened to ease adjustment costs that individuals face.
- Any legacy policies that served to underpin manufacturing at the expense of services need to be reconsidered.

The Creative Economy Strategy as Industrial Policy

- Minimise the risks associated with sector-based industrial policy, based on a facilitative, co-ordinating role for government, with the emphasis on systems, networks, institutions and capabilities.

Chapter 1

Assessment and recommendations for Korea's policies on industry and technology

This chapter provides an overview of the key analytic findings and policy recommendations contained in this study of industry and technology policies in Korea. Overall, five main issues are addressed: the innovation system and the Creative Economy Strategy; the evaluation system for R&D programmes and projects; the commercialisation of publicly supported research; entrepreneurship and SME growth; the relative performance of the manufacturing and services sectors; and, the Creative Economy Strategy as a form of industrial policy.

The Korean innovation system is in many respects highly developed. That system has helped to underpin Korea's rapid industrialisation. However, long-standing policy emphases on manufacturing and large firms are today in question. Structural problems such as the relatively weak innovation performance of SMEs, a lagging services sector and limited domestic job creation among the industrial conglomerates have led to a shift in policy priorities. This shift is crystallised in the current government's Creative Economy Strategy. This Strategy entails a far-reaching set of measures aimed at fostering cutting-edge innovation and consolidating a knowledge-based economy increasingly driven by high-value services. In conducting this review of industry and technology policies in Korea five main issues are highlighted. Each is addressed in a separate chapter of the report. These issues are: The Innovation System and the Creative Economy Strategy; Korea's Evaluation System for R&D; Commercialisation of Publicly Supported Research; Encouraging More Start-Ups and SME Growth; A New Balance Between Manufacturing and Services; and, the Creative Economy Strategy as Industrial Policy.

As summarised in Table 1.1, Korea has a range of important strengths, including high levels of investment in R&D, notably from business; a highly educated and skilled workforce; a high take-up of advanced technologies, including ICT; and a significant number of globally competitive firms. It also benefits from a range of good framework conditions for innovation, including a broad array of government support programmes and a strong government commitment to innovation-led growth.

These strengths are accompanied by a variety of existing and emerging opportunities. Being located in East Asia, Korea is well placed to benefit from the economic dynamism of the region. A number of relatively recent free trade agreements, notably with the European Union and the United States, ensure that Korea can access other key markets in the global economy. Another opportunity exists in the form of the growing number of Koreans living abroad – the diaspora – which has provided other Asian countries, such as China and India, with new growth opportunities in the past. With its powerful manufacturing sector and significant investment in innovation, Korea is also well placed to take advantage of developments in science and technology, such as the convergence of ICT, biotechnology and nanotechnology.

In contrast to these strengths and opportunities, Korea is also faced with weaknesses, some of which have been persistent. These affect the degree to which Korea may be able to benefit from its otherwise strong performance. Weaknesses include low productivity in the services sector, imbalanced development between SMEs and large firms, and the underutilisation of women throughout the economy, including in science and technology.

A number of long-term threats will also affect the Korean economy. These include rapid ageing, which is linked to low fertility rates; growing international competition within Asia, notably from China; and slow growth in a number of key markets for Korean exports, at least in the wake of the global crisis.

The challenge for Korean policy makers is to build on the strengths that characterise the Korean economy, seize the emerging opportunities, address the key weaknesses, and develop comprehensive responses to the threats that Korea will face in the future.

Table 1.1. Korea's innovation system: Strengths, weaknesses, opportunities and threats

Strengths	Opportunities
• Strong, mobilising national vision • Relatively high growth of GDP, sound macro-economic policies • Strong government support for innovation • Relatively good framework conditions for innovation • High share of business spending on R&D in overall R&D • Highly educated workforce and good supply of human resources for science and technology • High adoption rate of new technologies • Highly-developed ICT infrastructure • A significant number of internationally competitive firms • Strong focus on policy learning, with a capacity to learn from failures and international good practices	• Geopolitical position in one of the most dynamic regions of the world • Growth of China and other newly industrialising economies, with a growing middle class, in the region and worldwide, offering new markets for Korean exports • Free trade agreements (US in 2007, EU in 2011) • Growing globalisation of economic activity, including of R&D • Growing Korean S&T diaspora • High overall population density in major cities, affording accessible markets for certain services activities • Developments in S&T (technological change), particularly information technology, nanotechnology, biotechnology and environmental technology – and their possible fusion • Increasing global recognition of Korea in creative industries
Weaknesses	Threats
• Relatively weak linkages, in some respects, between science and industry • In education, overemphasis on university entrance and high cost of private education • Underutilisation of female labour, including in science, technology and innovation. • Low productivity in the services sector, with low investment in services R&D • A relatively weak SME sector • Strong government-led strategies, which may hamper the development of a more diffusion-oriented innovation policy • Unbalanced international linkages, with low levels of international collaboration	• Low fertility rates and a rapidly ageing society • Arrival of new competitors in fields in which Korea excels, e.g. ICTs, particularly from China • Potentially disruptive geopolitical developments in the region • Disruption in the supply of imported natural resources and energy upon which the Korean economy is highly dependent

1.1. Improving innovation policy

Korea will need world-class innovation capabilities to sustain a steady flow of innovations and drive continuous increases in productivity in Korean manufacturing and services firms. Achieving this goal implies:

- Providing Korean business with world-class framework conditions as well as world-class infrastructure, including in ICT, one of Korea's major assets.
- Increasing the economic and social benefits derived from R&D performed at Korea's universities and the public research institutes, which will require strengthening excellence in public research and enhancing the links between public research and the business sector.
- Further fostering internationalisation so as to be at the forefront of science, technology and innovation and attract and retain the best students, researchers, enterprises and research centres.
- Adopting and pioneering new approaches to innovation – including in services – and industrial policy.

- Enhancing growth prospects for new and young innovative firms, to complement the strengths of Korea's large firms and create new growth and employment opportunities.
- Continuing to strengthen the quality of human resources, using all segments of the population to their full potential.

The following sections describe in greater detail the key policy observations and recommendations contained in this report. The text is organised by chapter.

1.2. Extending Korea's evaluation system for R&D

The criteria and processes used in undertaking *ex ante* and *ex post* evaluation of public efforts to support R&D are clearly critical in determining the types of R&D that are funded and, over time, the overall efficacy of public support. Korea operates extensive and systematic evaluation procedures as regards R&D projects and programmes.

Areas where changes should be considered include the following:

- *The present programme R&D evaluation system facilitates “transparency” of fund allocation and expenditure – as required by law – but should provide more intelligence for strategic economic policymaking.* Feedback from evaluation into policymaking is certainly built into the overall system. However, the evaluation process seems to generate much descriptive content. Discussion with Korean counterparts suggests that quantified evaluation criteria – with too much of a focus on outputs rather than outcomes – might also be missing some important but less easily quantified research outcomes. More assessment of the economic impact of programmes and projects as well as greater arms-length evaluation of overarching policy issues could be beneficial.
- *The number of persons in Korea with policy evaluation expertise needs to be increased. International experiences could guide how to approach this challenge. Steps could also be taken to involve overseas experts, including Koreans living abroad, in R&D project appraisals and selection.*
- *The programme evaluation system will need modification if services-sector R&D is to receive greater public support.* This is because innovation in services exhibits characteristics which often differ from those in manufacturing. A danger exists that full account might not be taken of these characteristics using current evaluation metrics and approaches.
- *A “system evaluation” of the Government Research Institutes (GRIs) is recommended.* There is a widely-shared concern that the GRIs, which played crucial roles during the phase of Korea's economic catch-up, now need a strategic reorientation. A “system evaluation” of the GRIs could identify different missions and suggest other future institutional setups. System evaluations have proven useful in several European countries (e.g. in Germany, Norway and Finland).

Ex ante evaluation and the selection of industrial R&D projects

Korea has an elaborate system of *ex ante* evaluation for industrial R&D projects. However, this system also has features that may need to be reconsidered in the light of international best practice. In particular:

Unlike practice in many countries, in Korea, the lead for identifying and submitting promising projects lies in large part with the responsible agency – the Korea Evaluation Institute of Industrial Technology (KEIT) - rather than with the research performers, both firms and research institutions;

A separation is made in the appraisal process between identifying a potential R&D project and approving a team to carry out the project. Such an approach may be appropriate for government R&D procurement, where government is the ultimate client, but seems ill aligned with the desire to support promising ideas emerging from research performers; and;

The process of *ex ante* evaluation in Korea includes an extensive process of hearings and committee work. This process can help build consensus on key priorities, but may lead to a focus on safer projects that fit into the mainstream, rather than also making room for risky projects that are more likely to emerge from smaller and less central actors in the innovation system.

The above features may stem from the desire of the government to steer and control the direction of research and innovation. However, they are not well aligned with a highly advanced economy in which good ideas can come from many independent sources.

In terms of *ex ante* appraisal, various changes are under way designed to improve the quality and relevance of the R&D projects that do receive funding. The government intends there to be a greater risk appetite in R&D projects and in particular a willingness to tolerate what is described as “failure deserving a second chance” (i.e. when projects yield research outcomes that do not significantly contribute to knowledge creation, but which do follow scientifically sound practice). The main recommendations here are the following:

- *Care will need to be taken to ensure that the greater tolerance for failure produces in the medium to longer term a higher average rate of return to projects and not just an increased number of unsuccessful projects.* There is no guaranteed procedure for ensuring this outcome. However, project selection processes can be adjusted to reflect higher technical risk and the chances of market success.
- *The awardee evaluation process could be modified so as to enhance the impact of R&D funding.* In Korea, unlike the systems of other countries described in Chapter 3, awardees are selected to implement projects which have themselves been chosen through a previous selection process. It is questionable whether such a procedure is optimal in simultaneously mobilising the best ideas and the best entrepreneurial talent. Furthermore, KEIT spends several months to identify the projects to be supported, but only a couple of hours to select who will implement the project. In other countries, awardees are selected in tandem with the project, and this selection involves considerably more time than in Korea. Indeed, at KEIT, committee members reviewing potential awardees are not provided with the application documents until the day of the committee meeting. Accordingly, much of the review is based on the applicant's presentation and a period of Q&A, in which the outcome may depend in part on the applicant's presentational abilities, rather than on the actual quality of the proposals. Furthermore, in comparator countries, such as the United Kingdom, Israel and France, assessors are allowed to access and review applications individually (and have considerable time for conducting their review). While much can certainly be gained from collective deliberation in the context of a committee, allowing time for individual

assessment may help avoid situations where committee-based discussion is swayed by more vocal or forceful reviewers. Furthermore, in Korea an unsuccessful applicant's complaint is rarely accepted. By contrast, in the United States, ARPA-E even allows the applicants to read reviewers' comments and to provide a rebuttal, which the Agency considers before making its funding decision. In sum, benefits might be had if Korea modified the current practice, introducing a system whereby assessors can examine the applicant – the potential awardee – and his/her proposal for implementing a project, over a longer period of time and individually.

- *The link between the different stages of project evaluation might be strengthened.* KEIT implements a thorough process of mid-term and final project evaluation. However, links between evaluation stages might be strengthened. In particular, the final evaluation committee does not include a Programme Director. The United States (ARPA-E) and the United Kingdom (TSB) may have better practices in this connection. At ARPA-E, Programme Directors take part in mid-term and final evaluations. In the United Kingdom, for instance, a monitoring officer who is contracted by the TSB takes charge of project monitoring and of completing a final report. KEIT could allow Programme Directors to participate in the final evaluation process, or appoint a project monitoring expert who participates in the final evaluation process as well as the monitoring activities.
- *Efforts should be strengthened to connect technology to the market.* Currently, all of the criteria used in project assessment, from awardee selection to final evaluation, include points relevant to commercialisation. However, Korea could take lessons from the practice followed by ARPA-E. ARPA-E has in-house 'technology to market' advisors as well as Programme Directors. The advisors provide awardees with practical training and critical business information to equip projects with a clear understanding of market needs so as to guide technical development and help projects succeed. Awardees are required to provide a technology-to-market plan prior to receiving an award. They must also work closely with ARPA-E's technology-to-market advisors throughout the project, developing custom strategies to move projects toward the marketplace. In addition, ARPA-E facilitates relationships with investors, government agencies, small and large companies, and other organisations in order to move awardees to the next stage of project development. In Korea, the implementation of MOTIE's commercialisation policy is conducted by KIAT, separately from KEIT's R&D support. Korea might benefit by enhancing cooperation between the two institutions or employing the in-house technology-to-market advisors in KEIT so that the technologies developed through publicly supported R&D move efficiently toward the market.

1.3. Generating greater economic benefit from publicly supported research

Korean policy makers wish to translate a greater share of publicly supported R&D into new products and services in the market. This reflects concerns that high levels of public investment in R&D yield relatively low returns in terms of productivity and sustainable growth within and beyond the sectors that are presently strong.

Commercialisation of publicly-supported R&D takes place through many routes. And, in Korea, the complexity and scale of innovation-related institutions and activities that bear on commercialisation is considerable: in 2011 there were a total of 41 619

government-funded R&D projects implemented under 493 programmes. Accordingly, changing overall commercialisation outcomes could require alterations to a number of policy levers. The Government is putting more support into technology start-ups and MOTIE is focusing its research projects to a greater degree on commercialisation. IP barriers are also being addressed through programmes such as Technology Transfer Offices and Technology Holding Companies.

Strengthening business and academic co-operation

Except for the larger, technology-based companies, many enterprises, particularly SMEs, appear to shy away from intense collaboration with academic institutions. The same holds, the other way around, for many academic researchers. By some measures, the quality of basic research in Korea could be further strengthened (although Korea performs well in terms of the total number of scientific publications, ranking for some years around 12th globally). Basic research and teaching are the fundamental missions of the university sector. Policies to enhance commercialisation of university research therefore need to be crafted so as not to impair these fundamental missions. Korean policy makers should:

- *Facilitate universities' ability to effectively pursue commercialisation.* Until the beginning of this millennium universities reportedly had little interest in research commercialisation. However, changing economic circumstances in Korea and jobs shortages for young educated people have increased universities' interest in commercialisation. One issue on which a balance needs to be struck, requiring agreement between Ministries, relates to the incentives faced by universities. Researchers appear more focused on research than its commercialisation. Reports indicate that the system for evaluating universities focuses on patents and academic citations, not on interactions with business, leading to a situation in which commercialisation has lower priority (this is, of course, not surprising and is broadly similar across OECD member countries). Although awards of Government funding are also to some extent dependent on success in commercialisation, the incentives are not always transmitted to the professors/researchers. Other Ministries, more directly concerned with commercialisation, might wish to see a shift in the structure of incentives offered. But the Ministry of Education and the National Research Foundation (NRF), on which universities rely for support, are far removed from the market. And it is debatable whether they should be pushed closer to the market. Achieving the right balance in incentives between institutions that have differing mandates requires orchestration from the centre.
- *Establish a more business friendly education system and address cultural and other barriers to start-ups and to joint work between business and the research base.* Universities outside the top-rated group find it difficult to attract interest from the private sector. The Ministry of Science, ICT and Future Planning (MSIP) is reported to be taking action to facilitate university commercialisation, through improving the incentives for individual researchers and enabling university professors both to publish and to pursue commercially-oriented research. However, senior representatives of the Korean business sector also refer to a lack of trust between the corporate sector and universities. In particular, concerns exist that profit sharing-arrangements do not meet firms' needs. Medium-sized firms also express concern that patents owned by the public sector are occasionally transferred to the private sector, but that such cases are exceptional. This is considered a problem since industry will not risk investing in technologies that it does not control.

- *Re-consider the mission and institutional and financial set-up of the GRIs* (ideally after a thorough “system-evaluation” in the light of international experiences). As a result some of the GRIs – or subsets of them – might be turned into curiosity or problem-oriented public research institutes collaborating closely with universities, while others – and this is relevant for commercialisation – could be organised as industrially oriented contract R&D institutes with limited but reliable public funding and a relevant share of industrial income. The funding mode of the institutes of the Fraunhofer Society (FhG) in Germany may serve as an interesting example (see also VTT in Finland; TNO in the Netherlands and Carnot in France).
- *Encourage the development of more young and highly trained students to support industrial innovation.* Particular emphasis should be placed on mentoring, access to finance and business networks for young entrepreneurs. More might also be done to stimulate the secondment of undergraduate and graduate students to innovation-oriented companies, in particular SMEs. Universities can require (or at least stimulate) that graduation thesis research work (e.g. in engineering sciences, management studies) be conducted in direct project-based collaboration with industry. This requires that professors are ready to define/accept thesis themes relevant for industrial innovators. In North-western European countries this has proven to be a major mechanism to bring graduates closer to companies. Indeed, such collaboration has often led to the subsequent employment of students in the partnering companies. This, in turn, helps to establish long-term personal links between companies and academics.
- *Give systematic support for public-private innovation partnerships.* While programmes do operate in Korea to support public-private research and innovation collaboration, more systematic efforts might be made. A successful model in this connection is the United States’ Manufacturing Extension Program initiative, stimulating public-private research and innovation collaboration. Incentives should be established for university researchers and the government research institutes (GRIs) to participate. The Korea Research Council of Industrial Science and Technology (ISTK) spends around USD 6 million a year on a Korean version of the manufacturing extension programme. This, however, represents a rather small allocation when considered nationally. There are also a number of comparable approaches in Europe.
- *Ensure the presence and effective functioning of proof-of-concept centres.* Commercialisation support at the proof-of-concept stage aims to close funding gaps that can arise when business angels and venture capital companies focus their funding on larger and/or later-stage deals. Many existing policy initiatives in Korea will have an impact on this gap. However, it could be valuable to ensure that such support is available at all institutions undertaking research activities of significant scale.

Improving government support programmes

- *Carefully evaluate the impacts of patent funds.* A number of governments and organisations around the globe are sponsoring the creation of patent funds to promote the economic use of patent rights. For instance, in addition to Korea’s Intellectual Discovery and IP Cube Partners funds, France operates ‘*France Brevets*’ and Japan runs the ‘*Life Sciences IP Platform Fund*’. Recent OECD

work in this area suggests that there is not enough evidence to make well-founded recommendations on the design features of such funds that might be considered best practice. Indeed, the rationale for public patent funds is still subject to debate, and a number of objections have been raised regarding publicly-backed funds. Given the limited international experience to date with public funds, it is essential to improve the evidence base before policy is scaled-up significantly. Complementary measures to improve the functioning of the IP ecosystem – such as database services – could be helpful and entail few if any downsides.

- *Further promote technology holding companies (THCs).* An interesting development in Korea since 2010 has been the creation of THCs, which are for-profit organisations set up by individual universities or groups of universities to commercialise early-stage university technology through start-ups and joint ventures. A critical point to address is their potentially uneasy relationship with the technology transfer offices (TTOs) responsible for university technology licensing. Another critical point is their relationship with external private funding from business angels and venture capital (VC) companies. A third issue is the ability of public universities to accept high failure rates in the THCs. THCs will often be the only supporters of fledgling start-ups before the drafting of detailed business plans that business angels and VCs require. The THCs must be well equipped to advise start-ups in IP matters.
- *Adopt longer timeframes in commercialisation programmes and ensure commensurate levels of funding for commercialisation activities.* Some programmes in Korea seem to have rather short time horizons, and perhaps even a misplaced low tolerance of failure. One instance of this is that significant near-term expectations have been placed on the Technology Holding Companies as regards their commercialisation objectives. Some of the Holding Companies are only two or three years old. Similar bodies in countries like Israel and the United States have taken many years to realise a substantial deal flow (and reach a break-even point).
- *Review aspects of the intellectual property protection system that may be causing unnecessary uncertainty. Assess whether more needs to be done to increase awareness of intellectual property among SMEs.* The IPR situation, especially with regards to intellectual property developed with public funding, may need some attention. In 2011-12, Korea ranked 40th on the World Economic Forum's IP protection indicator, which is based on responses from a survey of executives. More than the need for new IP-related laws, industry representatives refer to the importance of more efficient enforcement processes. Korea may need additional capabilities in the public courts and more specialist IP attorneys.
- *Create a systematic monitoring of commercialisation outcomes.* The extent to which systematic monitoring of overall commercialisation outcomes occurs in Korea is unclear. New metrics could be valuable in assessing the performance of the system. Metrics might monitor such developments as new registered trademarks, staff exchanges, student employment on funded projects, alumni in the workforce and the number of licenses from university or government laboratories that are actively used in commercialised products (i.e. a new metric used by the United States Department of Defense).

- *Examine where opportunities might exist to expand the use of innovation challenge prizes.* Innovation challenge prizes can help to influence public perceptions, mobilise talent and capital, strengthen problem-solving communities and educate. While the literature on commercialisation of the results from challenge prizes is limited, such prizes can clearly yield innovations with commercial application. In Korea, challenge prizes have not been used extensively and only a few small-scale prizes exist at present.
- *Seek to improve commercialisation-related expertise within public institutions.* Publicly funded research institutes (within and outside universities) whose research activities could be relevant for commercial purposes should build up their own expertise and networks to foster commercialisation. Government and regional authorities can support such efforts financially. Measures that could be taken include: creating an institutional platform for all issues around commercialisation in a (major) research organisation (e.g. a research university). This platform should run databases about commercialisation-relevant research units and projects; organising roundtables with researchers and industry; supporting inventors and founders of new tech-businesses; organising fairs and exhibitions etc. A relevant example in this connection is the Technical University of Dresden (see <http://tu-dresden.de/forschung/wissens- und technologietransfer>).

1.4. Encouraging more start-ups and SME growth

The Creative Economy Strategy seeks to invigorate entrepreneurial activity in Korea, increasing rates of business creation and the presence of fast-growing young and small firms. A wide range of policies and support programmes are envisaged or already in place. Achieving conducive framework conditions must be the overarching priority. These conditions provide the essential context without which no number of targeted programmes is likely to bring efficient long-term outcomes. Main recommendations in this connection include the following:

Making better use of the R&D tax credit

- *Policy makers should examine whether design features of the R&D tax credit programme could make it hard to access by firms in creative industries.* For example, in the United Kingdom tax relief may be hard to access for games businesses, because innovation in games companies is usually organised around collaborative projects across multiple teams, rather than being housed in a single R&D department (as happens for instance in the pharmaceuticals sector). Because R&D and production are intertwined, it is difficult to account for staff time when preparing R&D tax relief claims. Furthermore, the success of innovative games technologies, software and designs is frequently a function of tests with users. But such testing does not – in the United Kingdom at least – qualify for the R&D tax relief.
- *Re-examine the design of the R&D tax credit to ensure its focus on strengthening radical innovation in small (often service sector) firms.* Recent OECD research on R&D tax credits suggests they may primarily benefit incumbent firms, possibly slowing the reallocation of resources towards more productive and innovative entrants. R&D tax credit programmes need to possess carry-over provisions or cash refunds, or use payroll withholding tax for R&D-related wages, to facilitate access for young and small firms.

- *Greater use might be made of the R&D tax credit to encourage industry-university collaboration.* The latest information available to the OECD indicates that Korea's R&D tax credit system includes R&D subcontracted to academic institutions. However, it appears that no additional benefit is had when the R&D is undertaken collaboratively. By contrast, R&D tax credit arrangements in a number of other countries offer significant additional incentives for collaborative research, above and beyond the tax credit received when R&D is undertaken in-house. In Hungary, for instance, a company's taxable income is reduced by up to 300% of the amount spent on collaborative R&D with academic institutions. Various strands of evidence point to the economic benefits of collaborative R&D.

Fine-tuning advice to start-ups

- *Korea has a large number of support programmes in place for start-ups. Market needs must be tested before the introduction of new programmes. Attending to market signals is likely to increase the relevance and quality of programmes.* Access to information and advice is a key aspect of effective management in any company. But whether the market works well in providing advisory and information services to new and small firms is a contested subject, and market failure may be less frequent than is claimed (after all, the Internet is augmenting information supply to small firms, and many providers of technical and managerial information have a strong interest in demonstrating products, equipment and services to potential clients). This highlights the need for some sort of demand assessment prior to the introduction of new programmes.
- *Information should be made available to entrepreneurs on where they can find high-quality privately provided advice and mentoring.* While international evidence on the impact of advisory services is rather limited, growth in recipient firms may be most closely associated with private sources of advice such as lawyers, accountants and customers.
- *Advice for SMEs/start-ups on developing overseas markets could also be valuable, because high-tech start-ups in particular need to cater to an international market and, more generally, survival rates are positively correlated with the distance over which one trades.*

Focusing incubation on enterprise development not just employment

- *Policy makers must carefully choose the evaluation criteria used to assess business incubators, as this could affect programme performance in important ways.* Across countries, job creation is a frequently used metric of the performance of incubation schemes. However, it is relevant to the Creative Economy Strategy to note that if business development and growth are principal objectives, job creation might not be the most suitable short- or medium-term indicator of incubator performance. By evaluating and monitoring schemes against inappropriate criteria, the chances of eventual success could in fact be reduced. The focus of incubation should be on enterprise development rather than employment growth. Most job creation often occurs after tenant firms graduate from incubators. Employment growth will generally follow successful commercial outcomes.

Supporting youth entrepreneurship

- *Especially in the digital economy, and across a number of OECD countries, some young business founders have helped to create entirely new industries, and this group needs to be facilitated.* For instance, programmes can be tailored to help offset the lack of human capital and networks that typifies young entrepreneurs. Programmes can also provide technical advice in sectors that are often targeted by young entrepreneurs (such as the digital economy).

Further encouraging entrepreneurship among women

- *Research suggests there are a number of distinctive characteristics to female entrepreneurship – such as the tendency to initiate smaller projects - which should be reflected in the design of support programmes.* One goal of policy in Korea is to increase women's involvement in start-ups. As derived from studies in countries other than Korea, there are some stylised features of women's entrepreneurship which may need to be taken into account in the design of policy and support programmes. For example, women frequently elect business opportunities that can be combined with family responsibilities. And for a number of reasons women tend to initiate smaller projects than men and sometimes commence with lower growth expectations. Also relevant to Korea is that entrepreneurship among women is often concentrated in service sector businesses (reflecting broader sectoral patterns of women's labour market participation). Among other considerations, government is critical in enabling the provision of high-standard, reliable and affordable childcare services, without which entrepreneurship will be an excessively demanding challenge for many women. Policy makers in Korea will also need to guard against circumstances in which women face a bigger reduction in wages than men should they try self-employment and then switch back to waged employment.

Increasing access to Finance

- *Given the objectives of the Creative Economy Strategy, the current focus on facilitating access to early-stage equity is appropriate.* With respect to the market for venture finance, it seems that the venture capital sector is not too small. Rather, the problem is that too few firms receive seed and early-stage (SES) finance. This is also the stage in the financing process where market failures and/or gaps are most likely to be binding. The focus on SES finance is also welcomed by the private sector. The forms of public support for venture finance, the emphasis on co-investment and fund-of-fund approaches clearly accord with identified good practice internationally.
- *While this initiative is not among the largest in the current set of programmes, Korean policy makers should note that there is scepticism internationally that equity crowdfunding could become a significant vehicle for increased entrepreneurship and research commercialisation.*
- *Much emphasis appears to be placed on supporting the supply side of the early-stage equity market, and more consideration should be given to whether demand-side conditions are now a limiting factor.* Attention should be given to whether the number and quality of the investment proposals and business plans put to potential financiers is adequate. Historically, in many countries, development of

the venture capital industry – and of informal equity investment - has followed rather than preceded the availability of deal flow. In this connection, the Korean Venture Capital Association (KVCA) indicates that it is becoming increasingly hard to find good investment opportunities. One symptom of this is that some of the Association's members are starting to establish themselves overseas, in countries such as China and Vietnam. This would again suggest that a greater demand-side focus may be needed.

Making public procurement friendlier to innovation

- *Consideration should also be given to making general public procurement more likely to induce innovation.* Since 1996 the Korean government has implemented the New Technology Purchasing Assurance Programme for innovation-oriented SMEs and has increased procurement of innovative goods based on new technology. Under this scheme the Small and Medium Business Agency (SMBA) can recommend that all public institutions, including central and local government and state-owned or funded companies and institutions, procure certain innovative products with higher priority. To make sure that all public institutions procure those innovative goods, the institutions are required by law to submit their purchasing plans for the coming year – and the purchasing results of the previous year – to SMBA. This OECD report does not aim to examine the procurement system in detail. However, it is noted that the comprehensive certification process for products-to-be-procured is rather different from the approaches adopted in other countries. Korea's certification system may provide an incentive for innovation. However, consideration might also be given to making general public procurement more likely to induce innovation. This might be done through introducing a greater focus in tender documents on functional characteristics of products (rather than on specific features of the procured items defined *a priori* [through a classification scheme]). Perhaps of greatest relevance to the Creative Economy Strategy is that benefits of different sorts could possibly be had from introducing competition processes in tendering for R&D. Such pre-commercial procurement is aimed at purchasing R&D, design, prototyping and testing services for products or services that do not yet exist on the market.

Monitoring growth thresholds

- *Korean policy makers are well aware that problems exist in connection with SME growth thresholds and they have shaped policy responses to try to address these problems. The task now is to monitor the efficacy of those policy responses.* There is a limited presence of medium-sized companies in Korea. The abrupt discontinuation of government support once companies graduate from the SME category may depress the ambition to grow. The system of inheritance tax may also inhibit SME growth. It will be important to closely monitor the effectiveness of policy responses to the growth threshold challenge.

Achieving overall coherence in public support

- *The Korean government is implementing a vast array of entrepreneurship and SME support measures. Some streamlining could be beneficial, focusing on the rationale and effectiveness of the various programmes and the avoidance of duplication or overlap.* Over time, in many countries, with the introduction of

new policy initiatives the number of support schemes available to businesses easily proliferates, creating a complex and potentially confusing landscape for start-ups and SMES. It is not possible to determine, without further assessment, whether the number of schemes is excessive in Korea. However, given that the supply of programmes is already diverse and numerous, consideration should be given to whether some degree of streamlining could be beneficial. Simplification measures of this sort have been undertaken in a number of countries, from which lessons could be learned. One way of bringing about a streamlining might be to create an inventory system that allows policy makers to see the benefits that individual SMEs receive from the different programmes, thereby indicating if there is significant overlap between programmes.

1.5. A new balance between manufacturing and services

Improving the size, productivity and knowledge-content of the Korean services sector is a key challenge facing Korean policy makers. Korean economic development to date has placed great emphasis on manufacturing, initially in heavy industry and more recently in technology-based lighter industry such as electronics. There is widespread recognition that, in the face of low-cost competition from China and others, the next phase of economic development needs to put more emphasis on manufacturing-related services and other knowledge-intensive services that will help strengthen competitiveness, improve quality of life, help address societal challenges and aid the creation of (high-wage) jobs.

- *No number of services-specific programmes will offset the drag on service-sector development coming from unsupportive framework policies. Key framework conditions that require ongoing attention include education and training, labour market flexibility and competitive markets for goods and services.* For instance, important concerns exist regarding the high degree of internal trade in services that occurs within the large conglomerates.
- *Policies that are plainly discriminatory towards services, in their design or application, need to be identified and removed.* Any legacy policies that served to underpin manufacturing at the expense of services need to be reconsidered.
- *Shifting resources from manufacturing into services and undertaking structural reform in the service sector both require the social safety net to be strengthened. This will ease the adjustment costs that individuals face.* Much public financial (credit) support for SMEs is aimed at maintaining employment, in a country where social welfare expenditures are low as a share of GDP. This helps to keep resources locked into low productivity firms and entails a bundling of social and economic policy. Better design of social and SME support policy is likely to occur when the two forms of policy are unbundled.
- *Many service industries would gain from learning from best practice in other firms and even in other sectors, yet many are relatively closed to information sharing and co-operation, partly for competitive reasons. Public support for the dissemination of best practice – for example through technical extension programmes – could complement traditional R&D subsidies in fostering more innovation in the services sector.*

1.6. The Creative Economy Strategy as Industrial Policy

Korea has long been regarded as one of the relatively few examples of successful industrial policy. However, the present government has so far put less emphasis on sectoral priorities. The emphasis seems to be to promote the creative economy through strategic technologies. While it is not yet clear what role sectoral targeting will play in the Government's industrial and technology policy, Korea will be able to learn lessons from other countries' experiences:

- Industrial policy around the world can be focused on technologies, activities or tasks, or cross-cutting issues. However the different approaches are not mutually exclusive. It is possible to target technologies, sectors and wider goals at the same time, on the proviso that there are sufficient instruments available to policy makers and policy must be joined up and integrated to ensure consistency and clarity of purpose.
- There are various ways that the Creative Economy priority could be combined with a sectoral dimension. One way would be to designate the creative industries as one of the priority sectors for industrial policy. An alternative (and possibly complementary) approach would be to add an additional requirement to the criteria for identifying priority sectors, namely a sector's potential contribution to the wider goals of the Creative Economy Plan.
- The choice of sectors should depend on an assessment of future needs, sector strengths, and the opportunity and capacity to intervene successfully. It is the combination of factors that is important – there is no point in selecting a sector based purely on future needs if there is also no evidence of potential comparative advantage or of market or systems failure.
- Overall, recent experience suggests that there continues to be a place in innovation and technology policies for a sectoral dimension, and therefore for sectoral strategies, but this needs to occur in a different way than in the past and be less government-led. The risks associated with selective industrial policy can be minimised through an approach based on a more facilitative, co-ordinating role for government, with the emphasis on systems, networks, institutions and capabilities. Successful implementation of such an approach will require - even more than usual – well designed plans for monitoring and evaluation. Ideally such plans should be put in place before the policy begins, so that data gathering and real-time tracking of progress can take place from the outset.

1.7. Concluding policy observations

Korea is characterised by considerable policy activism. The number of policies and programmes is extremely large and their redesign and sometimes dissolution are frequent. Policies and programmes implemented abroad and considered benchmarks are regularly adopted in Korea. Indeed, few other countries create so many programmes and policies at such a pace. Furthermore, successive recent governments have ushered in significant changes in the institutions responsible for designing and implementing policy. These changes have inevitably brought a degree of disruption. In conducting this review, the impression received is that Korea requires a period of programme consolidation. Any new initiatives need to be subject to thorough consideration of need, along with careful assessment of how they can be adapted to (rather than adopted in) Korea's specific circumstances.

Chapter 2

The Korean innovation system and the Creative Economy Strategy

This chapter provides an overview of the recent evolution of innovation and technology policies in Korea. The main features of the Creative Economy Strategy are described. Relevant legislative developments, the functions of key institutions, and governance arrangements are also examined.

The Korean innovation system is extensive and in many respects highly developed. That system has been one of the underpinnings of Korea's rapid industrialisation. However, long-standing policy emphases on manufacturing and large firms are today in question. Structural problems such as the relatively weak innovation performance of SMEs, a lagging services sector and limited domestic job creation among the industrial conglomerates have led to a shift in policy priorities. This shift is crystallised in the new government's Creative Economy Plan. The shift is not entirely new however. The fostering of creativity in an economic sense involves objectives and measures not greatly different from those espoused by recent previous governments (see, for example, World Bank/OECD, 2000). However, the current administration is instituting a particularly far-reaching and comprehensive set of measures aimed at fostering cutting-edge innovation and consolidating a knowledge-based economy driven to a growing extent by high-value services. This Chapter describes the recent evolution of policies towards innovation, the main features of the Creative Economy Strategy and the functions of the key institutions involved.

2.1. Technology and innovation policy, past and present

Policy from the 1960s to the mid-1990s

Korea is a well-known case of successful economic catch-up achieved through a government-led, manufacturing and export-oriented strategy. Korea is one of the few recent examples of a country that has managed to rapidly transform its agricultural economy, to the extent of becoming a leading industrial power. A major policy instrument in Korea's successful catch-up has been the multi-annual plans. From 1962 to 1992, the Korean government established seven consecutive Five Year Economic Development Plans which supported the creation of domestic capabilities. The Plans set clear targets and orchestrated actions across several fields, including industry and technology, trade, education and infrastructure. Each of the Plans identified key objectives, introduced selective policies and directed resources to achieve them. A major characteristic has been the gradual upgrading of targets in the different planning periods.

During the period 1962 to 1996 the *chaebols* – family-controlled conglomerates such as Samsung, Hyundai and LG – emerged and played a leading role in economic development. The government nationalised the banks so as to channel scarce capital to *chaebols* and encourage them to invest in industries it saw as strategic to achieving national objectives (the banks were privatised in the early 1980s). The government-favoured *chaebols* had special privileges and grew larger, with many SMEs acting as subcontractors to them.

As the main focus of Korean industrial development shifted from light to heavy and high-tech industry, the government supported the modernisation and technological upgrading of domestic industries by fostering learning and by progressively promoting the creation of domestic scientific and technological capabilities. From the mid-1960s, several government research institutes were established, such as the Korea Institute of Science and Technology (KIST). These institutes aimed to carry out R&D in key technological fields, with a view to supporting the industrial upgrading strategy. The Ministry of Science and Technology (MOST) was established shortly after, followed by the drawing up of the Science and Technology Promotion Law. In the 1970s R&D tax credits were introduced. This entire era has been described as one of imitation, with Korea putting in place a science and technology system that would allow it to absorb and adapt foreign technologies in support of industrialisation.

Table 2.1. Five year economic development plans, Korea, 1962-96

Five-year economic development plan	Principal objectives
1st (1962-66)	Building domestic light industry: textiles, etc. Infrastructure development: power plants
2nd (1967-72)	Building key domestic heavy and chemical industries (HCI): steel, machinery, chemicals, shipbuilding, etc. Infrastructure development: Gyeongbu expressway (Seoul-Busan)
3rd (1972-76)	Industrial restructuring: Building heavy and chemical industries (industrial complexes)
4th (1977-81)	Industrial restructuring: Strengthening heavy and chemical industries (building the bases for technological capabilities)
5th (1982-86)	Economic stabilisation: Industrial competitiveness by opening and rationalising the economy
6th (1987-91)	Regulatory reforms Supporting high-tech industries Building high-tech and innovative capabilities
7th (1992-96)	Revitalising the economy Establishing a basis for balanced development of industrial sectors and companies

Source: OECD (2012), “Industrial Policy and Territorial Development: Lessons from Korea”, Development Centre Studies, OECD Publishing, Paris. doi: [10.1787/9789264173897-en](https://doi.org/10.1787/9789264173897-en).

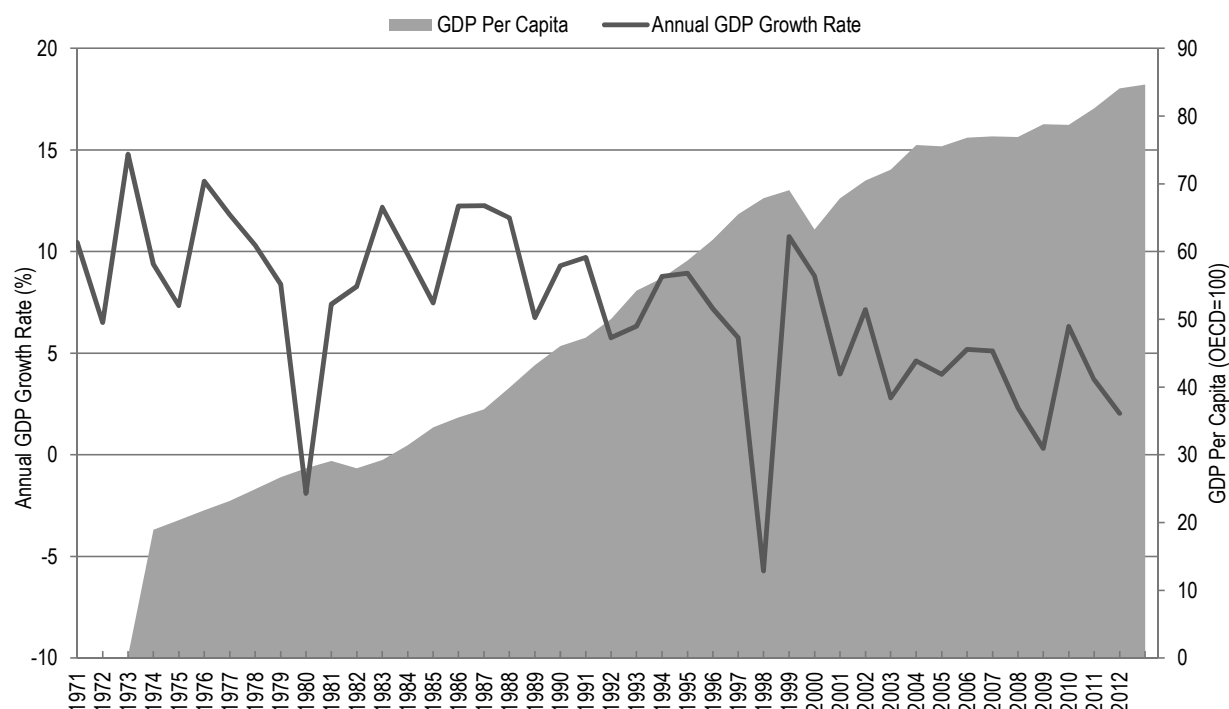
In the 1980s, the government looked to target core technologies that would actively lead Korean national economic growth rather than passively supporting industry’s technological demands. The first national R&D programme initiated by MOST was introduced in 1982. Shortly afterwards, similar R&D programmes were set up in various ministries. In particular, a separate directorate to support industrial R&D was set up in the Industry Ministry.

In addition to public funding of R&D, the private sector was encouraged to engage actively in absorbing and improving technologies from countries operating at the technological frontier, such as the United States and Japan. Learning has been supported in several ways, from selective human resource mobility programmes to controlled capital imports and targeted support for technology transfer. During this phase, however, productivity increased mainly as a result of the extensive use of low-waged labour and processes of reverse engineering, rather than technological innovation.

Policy from the mid-1990s to 2012

Since the second half of the 1990s the Korean government has been pressured to change its catch-up oriented industrial development policy, based on extensive labour and capital input, and to seek new growth engines. Economic growth, which averaged more than 8% a year from 1960 to 1997, slowed from the mid-1990s to a yearly average of 5%. The Asian financial crisis in 1998 caused negative GDP growth (-5.7%) and mass unemployment. There has been growing concern that the legacies of past successes are obstructing further advances for Korea in the broader context of the information and knowledge economy. These legacies include the nature of the catch-up strategy, the dominant role and sometimes alleged unfair business practices of the *chaebol* (which are believed to weaken the innovation capacity of SMEs), and a lagging services sector compared to manufacturing.

Figure 2.1. GDP growth and income per capita, Korea, 1971-2011



Source: OECD (2013), “National Accounts at a Glance 2013”, *OECD National Accounts Statistics* (database). doi: [10.1787/data-00652-en](https://doi.org/10.1787/data-00652-en).

In 1998, when President Kim took office, the country launched drastic reforms in the areas of government, labour, business and finance. In addition, Korea searched for new sources of growth appropriate to the knowledge economy. The government extensively supported ICT and creative venture companies.¹

In 2003, the Roh government initiated an extensive innovation-oriented drive in all sectors of the economy, and looked to the subnational regions – which are under-developed relative to the capital area – as a new source of growth. As part of this effort, the Five Year Balanced National Development plan (2004-2008) was introduced and implemented, and included the transfer of most ministries and public agencies to provinces outside of Seoul from 2012. Ten industries – such as digital TV and displays – were designated to develop as Korea’s Next Generation Growth Engines. The government also launched a so-called ‘win-win’ strategy between SMEs and large companies.

Since 2008, the Lee government sought to strengthen potential output growth and create employment by developing a more favourable business environment, and making the economy more knowledge-based. The Ministry of Commerce, Industry and Energy became the Ministry of Knowledge Economy. The government searched for new sources of growth, such as “green growth” and a selection of 17 technologies and sectors.² President Lee continued the ‘win-win’ strategy (the name of the policy was changed to ‘shared growth’) through key reforms such as designating SME-suitable business areas, and introducing a profit sharing system.

These efforts to transform Korea into an innovation-driven economy produced a variety of technology and innovation measures, co-ordinated by the promulgation of national laws and national plans. At the highest level is Vision 2025, formulated in 1999. This proposed the following fundamental shifts in technology policy: i) moving from a government-led and development-oriented innovation system to a private industry-led and diffusion-oriented innovation system; ii) moving from a closed R&D system to a globally networked R&D system; iii) moving from a supply-dominated investment enhancement strategy to an efficient utilisation and investment-distribution strategy; iv) moving from a short-term technology-development strategy to a long-term market-creating innovation strategy; and v) moving towards a science and technology-led national innovation system. Based on Vision 2025, the Science and Technology Framework Law was created to promote science and technology more systematically. The Framework Law is the legal basis for five-year Basic Plans of Science and Technology (2003-07 and 2008-12). The Basic Plans are Korea's overarching guide for the conduct of science and technology policy. In addition to the Basic Plans, in 2008 the Lee government announced the "577 Initiative". This included several ambitious targets: to reach an R&D intensity of 5% by 2012; to focus upon seven key areas of R&D and seven support systems (world-class human resources, basic and fundamental research, SME innovation, science and technology globalisation, regional innovation, science and technology infrastructure, and science and technology culture); and to become one of the seven major science and technology powers in the world.

Technology and innovation policy today

The current Park government took office in 2013 and is continuing the efforts of the previous governments to turn Korea into an innovation front-runner rather than an effective innovation follower and to seek new means of ensuring continued economic growth. In this context, President Park, elected in 2012, has launched plans to develop a 'creative economy' and accomplish 'economic democratisation'.

President Park has set up a new ministry – the Ministry of Science, ICT and Future Planning (MSIP) – which is in charge of driving the creative economy strategy. In June 2013 the MSIP drew up the guiding plan for the creative economy, the "Creative Economy Plan". With respect to the possibly ambiguous concept of 'creative economy' the Plan stated that "Korean creativity and imagination will be combined with science, technology and ICT to create new industries and markets, and to make existing industries stronger and thus create decent jobs". The Plan also affirmed that 'the Korean economy has reached the limits of the catch-up strategy which had driven economic growth for the last 40 years, and the government is now working to switch the Korean economic paradigm to that of the leading type of growth founded on creativity.'

The Creative Economy Plan establishes a vision for "realising a new era of happiness for the Korean people through a creative economy", setting three goals, six strategies, and 24 tasks. The three goals are:

- Create new jobs and markets through creativity and innovation;
- Strengthen Korea's global leadership through a creative economy;
- Creating a society where creativity is respected and manifested.

The six strategies are to:³

- Properly compensate for creativity and create an eco-system that promotes the creation of start-ups;

- Strengthen the role of venture firms and small and medium-sized enterprises (SMEs) in the creative economy and improve their ability to enter global markets;
- Create growth engines to pioneer new markets and new industries;
- Foster global creative talent that has the spirit to rise to challenges and pursue dreams;
- Strengthen innovation capacities in science, technology and ICT, which form the foundation of the creative economy;
- Promote a creative economic culture together with the Korean people.

Within each of these six strategies there are typically 3-5 tasks to be accomplished (see Box 2.1). Relevant ministries and agencies will develop and implement appropriate tasks from among this list, which will be co-ordinated by the newly formed MSIP. The government also plans to set up a public-private partnership which is expected to help effective implementation of the Creative Economy Plan through constantly receiving the views of private sector actors and reflecting these in policies.

Even though ‘creativity’ is clearly emphasised in the Creative Economy Plan, the objectives and measures of the Plan are not greatly different from those announced by recent previous governments. However, the current government gives new emphasis to the role of venture firms and start-ups and has drawn up a wide range of measures to reinvigorate them. The government regards venture firms and start-ups as key to the creation of new markets and jobs (a view which accords with international evidence that new and small firms act as sources of radical innovation and carriers of structural change).

However, some SMEs and innovative start-ups may find it hard to thrive if in some sectors the *chaebol* rely primarily on their in-house networks of suppliers, and as long as getting a job at LG, Samsung or Hyundai remains a principal goal for college graduates. Therefore, President Park promised ‘economic democratisation’ during her presidential campaign and has committed to addressing Korea’s chronic challenge of a widening productivity gap between SMEs and large companies, as well as any anti-competitive practices of the *chaebol* with respect to SMEs.

In 2013, Korea’s National Assembly approved several revisions to laws aimed at curbing conglomerates’ unfair business practices and creating a level playing field for companies of all sizes. Among these changes are provisions that: subsidiaries of a *chaebol* will face constraints in awarding supply orders and contracts to sister companies without competitive bidding; unreasonable determination and reduction of subcontracting prices will be liable for punitive damages of up to three times the damage caused; the maximum share of a bank that a *chaebol* can own will be reduced to 4% – from 9% – to prevent manufacturers from owning too large a part of financial firms (which addresses concerns that conglomerates might seek to bend banking rules to secure loans for their units); and the rights of franchise owners under franchise deals with big companies will be protected through several measures, such as not allowing another store of the same type to open in the area.

Based on the creative economy strategy, the new five-year Basic Plan for Science and Technology (2013-17) has been launched. The Basic Plan’s vision is one of “pioneering a hopeful new generation guided by creative science and technology” which is an acknowledgement of the broader creative economy initiative. Compared to the previous Basic Plans, this Plan is characterised by a strengthening of R&D’s ties to economic growth, technology commercialisation and job creation (NSTC, 2013).

Box 2.1. The six strategies of Korea's creative economy plan

1. Properly compensate creativity and develop an ecosystem that promotes start-ups

For start-ups:

- Support for start-up funding is to change from the previous loan-based structure to an investment-based one.
- Tax benefits to boost angel investment: Capital gains taxes can be deferred. If cash from the stock sales of existing ventures are reinvested in another venture, the capital gain tax on the sales (10%) will be deferred until the new shares are cashed out. To foster angel investment, the deduction rate of income tax will increase from 30% to 50% for up to 50 million Korean Won (KRW) of investment, while the rate for the amount for over KRW 50 million will remain at 30%. The deduction limit on total annual income will be raised from 40% to 50%.
- A crowd-funding system will be introduced to provide an on-line funding platform for small-scale investments in start-ups. And a KRW 500 billion 'Future Creation Fund' will be created (KRW 200 billion for start-ups and KRW 300 billion for mergers and acquisitions [M&A]). This fund will give private investors priority in profit distribution.
- A door will be opened for venture capital firms of overseas Koreans to receive investments from the Fund of Funds (FOF) under equal conditions to domestic venture capital firms. For top-tier venture capital firms from foreign countries the FOF will also provide active collaboration if they want to invest in Korean start-ups. Overseas Koreans will also be eligible for support from the Angel Investment Matching Fund. The government will form the 'Start-up Supporters for Young People' with successful venture businessmen at home and abroad. It will also actively invite overseas Koreans to mentor and invest in Korean start-ups.
- The government will also introduce the 'Start-up-Friendliness Index' to the evaluation of government-funded research institutions.

For growth and exit stages:

- M&A is not a common exit route for venture companies in Korea. To promote M&A for the purpose of new technology acquisition the government will provide new tax benefits. 10% of the value of technology in an M&A deal will be deductible from the buyer's corporate tax. To allow large firms to actively acquire venture companies, when it acquires a venture company or an SME with a minimum of a 5% R&D investment ratio the large company will be able to postpone the affiliation of the acquired company for three years.
- A Growth Ladder Fund (public KRW 0.6 trillion, private funds KRW 0.4 trillion) will consist of stocks, mezzanines, asset-backed securities and loans for growth and exit stages, including the protection of intellectual property rights, support for M&A, IPO and restart-up.
- The government will expand participation from accounting firms and overseas consulting firms in the operation of the 'M&A Information Network'. To promote M&A it will introduce a certification system for brokerage institutions and will increase their incentives by giving them priority in the M&A Matching Fund.
- The Korea New Exchange (KONEX) will be established to boost the growth of innovative start-ups. KONEX's listing requirements and items subject to public notice will be minimised. In the case of M&A activity between a company listed on the KONEX and a company that is not, some regulations for listed companies will be excluded. Restrictions on venture investment partnerships will not be applied to KONEX-listed companies.

.../...

Box 2.1. The six strategies of Korea's creative economy plan (*continued*)

- The KOSDAQ market will undergo significant reform. The government will separate the KOSDAQ Market Committee from the Board of Directors at the Korea Exchange and will strengthen the organisation and function of the Committee to the level of an independent organisation. The government will also seek to improve the operation of the Listing Committee by staffing it mainly with experts in technology and by relaxing listing requirements.
- The government will operate a KRW 100 billion 'Restart Support Fund'. Restarting companies will also receive preference in the Angel Investment Matching Fund.

2. Strengthen the role of venture companies and SMEs in the creative economy and support entry in global markets

- Attracting a technical workforce to venture and start-up companies. The government will expand the current availability of stock options in a venture company. A Start-up Visa will be introduced to remove obstacles for foreigners with good technologies wishing to start a business in Korea.
- Corporations with promising future products will be given opportunities to enter public procurement markets through the Excellent Product System and can also be publicised in the government-sponsored online shopping malls.
- The protection of technology and prevention of piracy will be strengthened. KRW 100 billion will be added to the Intellectual Property Right Fund, which can buy patents from SMEs and lease the right back to the SMEs so as to protect the patents and technology of companies. Stronger sanctions will also be introduced against unauthorised use of technology. The government will expand its 'Technology Deposition Safe' system, which proves the ownership of technology by keeping technologically valuable items such as design drawings in public institutions. Support will also be increased for companies to apply for patents in the United States and other foreign countries after acquiring domestic patents. Abuse of trade secrets will be monitored closely.

3. Growth engines to pioneer new markets and new industries

- Efforts will be made to combine science, technology and ICT in existing industries. Under the 'Vitamin Project', industries which were traditionally strong but are now lagging will improve their productivity by expanding management systems based on IT. Steps will also be taken to rationalise regulations that affect market creation and industry convergence.
- Unlike the previous one-time (even if sometimes long-term) loan guarantees, the government will provide SMEs pursuing technological and industrial convergence with loan guarantees tailored to each stage of the process (such as technology transfer or commercialisation).
- Creating new industries based on software and the Internet. More than 5 000 people will be trained as software security professionals by 2017. The Korea Digital Contents Fund (KRW 400 billion) will aim to promote content production and business creation in industries such as music, film, games, animation and music. To foster new Internet industries, the Cloud Computing Development Act will be enacted and a Big Data Analysis and Utilisation Centre will be established.
- Investment in new future-oriented industries will be promoted. Promising future sectors such as biomedical, nano and environment technology and large-scale national strategic industries such as satellites and nuclear power will be given more support.

.../...

Box 2.1. The six strategies of Korea’s creative economy plan (*continued*)

4. Fostering global creative human resources

- The development of creative talent will be strengthened. Support will be given, for instance, to develop new didactic material for elementary and middle school students, convergence classes and departments for university students. A technology start-up camp will be operated and a new mentoring programme developed. Overseas jobs will also be announced to the public through K-Move Portal and the Global Internship Programme.

5. Strengthening the innovation capacity of science, technology and ICT

- Government investment in basic research will be increased by up to 40% by 2017. To provide opportunities for creative young researchers, Future Challenge Adventure Research Projects will be conducted. The evaluation process for basic research will be simplified.
- Promising future technologies such as 5G mobile communication and realistic media will be developed and next-generation networking industries fostered.

6. Building a creative economy culture

- A Creative Economy Expo will be held for the public, giving publicity to success stories. Infinite Imagination Rooms which provide mentoring programmes to the public will be established. An on-line portal for the creative economy – Creative Korea – is available. Government-owned data useful to create new business models will be opened to the public, with enactment of the Public Information Supply and Use Stimulation Act. Channels for communication between the public and private sectors will be strengthened.

Source: MSIP (2013), “Korea’s Creative Economy Plan”, Press release, June 2013, Korea, and MOSF (2013), “Plan for Venture and Start-up Ecosystem”, May 2013, Korea.

The Basic Plan for Science and Technology has three policy goals with five strategies and 18 tasks. The three goals are: to contribute 40% of economic growth through R&D; to create 640 000 jobs; to raise Korea’s innovation capability to the level of the top seven globally.

The five strategies are:

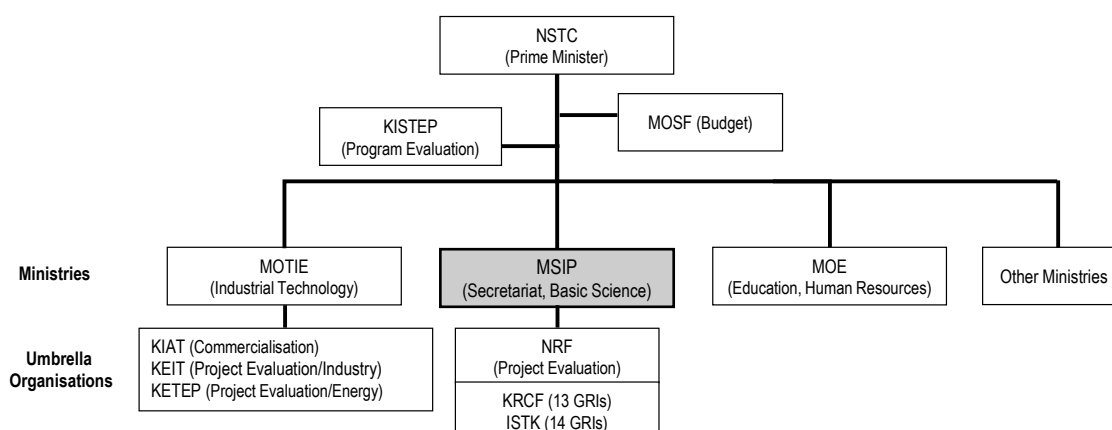
- Enhancement of R&D investment and maximising efficiency, including raising R&D support from KRW 68.0 trillion to KRW 92.4 trillion between 2013 and 2017, up 35% from the previous government;
- The strategic development of technologies: 30 priority and 120 strategic technologies have been identified, covering energy, environment, ICT and healthcare fields; more specifically, priorities include smart grids, carbon capture and storage, big-data applications and personalised pharmaceuticals;
- Building mid to long-term creative capability through greater funding for basic sciences and international exchange;
- Greater support for SMEs and venture companies in new industries, and the stimulation of intellectual property generation and commercialisation; and,
- Creating new science related jobs, in part through new measures to boost start-ups.

The MSIP is responsible for the Basic Plan and emphasises that the Plan will be implemented effectively through linking to the process of R&D budgeting, co-ordination and evaluation. MSIP also plans to draw up a strategic roadmap for the 30 priority technologies, together with other ministries.

2.2. Technology and innovation policy system

In most OECD countries, the governance of technology and innovation is organised around a multi-layered matrix of ministerial bodies, advisory structures and a range of other actors, all concerned with the making and steering of policy and its implementation. This situation is similar in Korea, which has a rich organisational landscape of ministries, public agencies and co-ordination bodies engaged in formulating, implementing and evaluating technology and innovation policy (Figure 2.2). This section briefly describes the main ministries, public agencies and co-ordination arrangements in the area.

Figure 2.2. The technology and innovation system in Korea, 2013

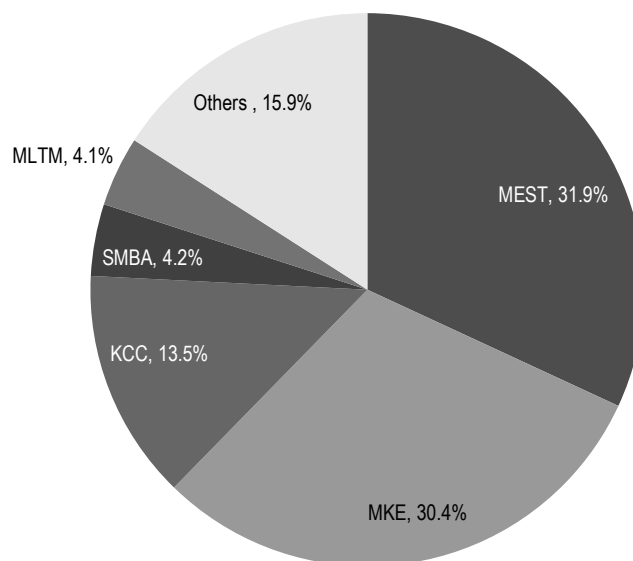


NSTC: National Science & Technology Council; MOSF: Ministry of Strategy and Finance; MOTIE: Ministry of Trade, Industry and Energy; MSIP: Ministry of Science, ICT, and Future Planning; MOE: Ministry of Education; KISTEP: Korea Institute of S&T Evaluation and Planning; KIAT: Korea Institute for Advancement of Technology; KEIT: Korea Evaluation Institute of Industrial Technology; KETEP: Korea Institute of Energy Technology Evaluation and Planning; NRF: National Research Foundation; KRCF: Korea Research Council of Fundamental Science and Technology; ISTK: Korea Research Council of Industrial Science and Technology.

Ministries and public agencies

Technology and innovation policy in Korea is organised around many ministries engaged in policy formulation, implementation and evaluation. The key ministries, however, are MSIP and MOTIE (Ministry of Trade, Industry and Energy), both of which account for more than 60% of total public R&D expenditures in 2013 (MSIP accounted for 31.9% of total public R&D, and MOTIE 30.4%). Other ministries with significant research responsibilities include: the Defence Acquisition Programme Administration (DAPA); the Small and Medium Business Agency (SMBA); and the Ministry of Land, Infrastructure and Transportation (MOLIT).

The Ministry of Strategy and Finance (MOSF) is also involved in technology and innovation policy in terms of budget allocation. MOSF allocates the total R&D budget to ministries on the basis of their technology and innovation programmes, including the R&D they perform, and to government research institutes in the form of block funds, after approval by the National Assembly each December.

Figure 2.3. Share of public R&D investments by ministry, 2012

MEST: Ministry of Education, Science, and Technology; MKE: Ministry of Knowledge and Economy, former MOTIE; KCC: Korea Communications Commission; SMBA: Small and Medium Business Administration; MLTM: Ministry of Land, Transport and Maritime Affairs.

Source: KISTEP (2012), “Government Research and Development Budget Analysis in the FY 2012”, Korea Institute of Science and Technology Evaluation and Planning, Korea.

As noted earlier, created by President Park, the MSIP (Ministry of Science, ICT and Future Planning) is a super-ministry responsible for driving the creative economy forward through science and ICT. Launched in February 2013, MSIP has incorporated the science and technology functions of the former MEST (Ministry of Education, Science and Technology)⁴, as well as ICT functions which had been dispersed in several ministries, such as the former MKE (Ministry of Knowledge Economy).⁵ The organisational structure of MSIP gives the ministry two “wings”, one dedicated to science and technology and the other to ICT, each headed by a different vice minister. However, there is a concern that the integration of the two will occur, and that science and technology policy, which needs a long-term approach, could be relatively neglected in favour of ICT, which may have more challenges of a short-term nature. MSIP’s major functions are to:

- Formulate and co-ordinate the creative economy strategy;
- Co-ordinate national science and technology policy;
- Formulate, implement and evaluate basic science R&D policy;
- Plan, promote and support the development of core, future-oriented and large-scale technology;
- Support basic and applied research conducted by GRIs, universities and private research institutes;
- Attain technological self-reliance and the safe use of nuclear technology;
- Promote public awareness of S&T; and,
- Promote ICT infrastructure and industry.

MOTIE, formerly MKE, is responsible for the development, transfer and commercialisation of industrial technology and facilitating business innovation. IT-industry promotion activities that formerly were the responsibility of MKE have been transferred to MSIP. Trade negotiation activities of the former MOFAT (Ministry of Foreign Affairs and Trade) were incorporated in MOTIE. The key mandate of MOTIE in terms of technology and innovation includes:

- Formulating, implementing and evaluating industrial R&D policy;
- Fostering the transfer and commercialisation of industrial technologies, and industrial standards;
- Promoting the regional innovation system;
- Enhancing companies' intrinsic ability to innovative;
- Facilitating private investment in R&D;
- Strengthening global co-operation in joint technology development; and
- Formulating demand-side technology policy.

Both MSIP and MOTIE consult with public organisations, funded by the ministries, to formulate, implement and evaluate technology policies. MSIP relies on the Korean Institute of Science and Technology Evaluation and Planning (KISTEP) for planning, co-ordinating and evaluating national R&D programmes. The National Research Foundation (NRF) supports MSIP in funding and performance management of the basic science R&D projects for which MSIP is responsible.

MOTIE relies on the Korean Institute for Advancement of Technology (KIAT) for designing industrial technology policy. KIAT conducts research and analysis on issues relating to industrial technology and innovation, and draws up industrial technology road maps. MOTIE conducts the evaluation of industrial technology R&D projects through support from the Korea Evaluation Institute of Industrial Technology (KEIT), KIAT and the Korea Institute of Energy Technology Evaluation and Planning (KETEP). KEIT is in charge of the manufacturing sector, while KETEP is responsible for energy sectors. KIAT also supports MOTIE in the evaluation of regional R&D projects.

With the exception of KISTEP, these evaluation and management organisations (NRF, KEIT, KETEP and KIAT) publicly propose various R&D projects in the sectors for which they are responsible, garner proposals from researchers, select appropriate researchers for projects, monitor and review the performance of projects, evaluate the final performance of annual and multiannual projects and report the end results to their respective ministries. KISTEP is not involved in the evaluation of individual R&D projects, but is involved in the evaluation of overall national R&D programmes, establishing standards for ministries' evaluation of their own R&D programmes, and monitoring the quality of the evaluations conducted by ministries (which will be discussed in detail later).

The Science and Technology Policy Institute (STEPI) is a think tank for science and technology policy. STEPI conducts research and analysis on issues relating to science and technology, and provides ministries and public organisations with policy ideas and suggestions for the promotion of technology and innovation.

Box 2.2. The main public organisations for technology and innovation

The Korean Institute of Science and Technology Evaluation and Planning (KISTEP) is the main STI planning agency in Korea, and supports MSIP in co-ordinating and evaluating national R&D programmes. Its specific functions are: to formulate, co-ordinate and support major S&T policies, including forecasting S&T development trends; to analyse and evaluate S&T-related programmes implemented by all government ministries while providing support for co-ordinating and distributing R&D budgets; to conduct research into domestic and overseas research planning, evaluation and management systems; and, to disseminate R&D policy information and data.

The National Research Foundation (NRF) manages and evaluates basic science R&D projects, provides subsidies for operating academic research organisations, supports domestic/international academic exchanges, supplies facilities and accommodation for academic activities, provides scholarships or loans for education, conducts surveys, analyses and evaluations, and collects statistics on support and management of research conducted in universities.

The Korean Institute for Advanced Technology (KIAT) supports MOTIE's industrial technology policy (e.g. through research and statistical analysis, trend and competitor analysis, technology road mapping). Main functions also include evaluation and management of regional industry support projects; upgrading innovation capability through international joint R&D and co-operation; and, promoting the transfer and commercialisation of developed technology.

The Korea Evaluation Institute of Industrial Technology (KEIT) is dedicated to supporting MOTIE's industrial R&D project planning, and evaluation and management, and to undertaking technology demand surveys and technology forecasting in manufacturing.

The Korea Institute of Energy Technology Evaluation and Planning (KETEP) supports MOTIE in designing industrial technology policy (e.g. through research and statistical analysis, trend and technology road mapping). KETEP also evaluates and manages national R&D projects in the area of energy.

The Science and Technology Policy Institute (STEPI) conducts research and analysis on issues relating to science, technology and innovation. STEPI also provides government agencies with policy ideas and suggestions for the promotion of innovation, suggests strategic options for technological development by the public and private sectors, and creates and disseminates S&T policy information and data.

Source: Various brochures and websites of the agencies concerned.

Government Research Institutes (GRIs)

Since the 1960s, Korea's Government Research Institutes have played a key role in conducting fundamental research and supporting technology development and adaptation by Korean firms. A description of the GRIs, their functioning and proposals for their reform are contained in Chapter 4.

Governance of technology and innovation policy

A key challenge for Korea has been to co-ordinate its fast-growing list of policy measures (and the activities of institutions devoted to delivering such measures). Perhaps more than most countries, Korea has taken the issue of policy co-ordination seriously. Recent years have seen the introduction of several reforms aimed at avoiding any duplication of policies and programmes between ministries and addressing insufficient inter-ministerial co-operation. Korea's major policy co-ordination effort comprises three mechanisms: the promulgation of laws and national plans; institutionalising horizontal co-ordination; and the evaluation of public R&D programmes. These are briefly described below.

The promulgation of laws and national plans

The Science and Technology Framework Law of 2001 was created to promote science and technology more systematically. It includes provisions for the formulation of mid and long-term policies and implementation plans, and is the legal basis for inter-ministerial co-ordination of science and technology policies and R&D programmes. It also provides the overall framework of support for R&D activities and science and technology agencies, and the legal basis for fostering an innovation-driven culture. Based on the Framework Law, five-year Basic Plans for Science and Technology (2003-07, 2008-12 and 2013-17) have been formulated. Each Basic Plan proposes 5-year goals and a strategy for the nation's science and technology policy, as well as inter-ministerial tasks to achieve the goals. Based on the Basic Plan, each ministry draws up its own technology promotion plan (e.g. MOTIE's 5-year Basic Industrial Technology Plan)

Institutionalising horizontal co-ordination

An important challenge for the Korean government has been to improve co-ordination among the many ministries and agencies with a stake in R&D and, more broadly, innovation. The scale of the co-ordination task has been complicated by Korea's densely populated organisational landscape of ministries and public executive agencies involved in technology and innovation policy and programming. In this regard, it is important to understand the division of labour among the various ministries that support research. Currently, MSIP is focused on funding universities and public research institutes associated with basic and applied research, and supporting R&D activities of the ICT industry. MOTIE, however, emphasises support for SMEs associated with developmental research at the pre-commercial stage. Other ministries support universities, research institutes and industries associated with their own functions. In practice, there had been some overlap between the targets and types of funding available, so that ministries' traditional foci had become somewhat blurred.

To eliminate unnecessary duplication and enhance the coherence of a distributed set of policies and programmes, Korea created the National Science and Technology Commission (NSTC) in 1999. It was composed of 13 ministers with an STI policy remit, plus nine experts from the S&T community. The NSTC, a cross-ministerial body, was expected to play a pivotal role in policy co-ordination among ministries since the president took the chairmanship. Since its creation, and to make it more effective and efficient, the NSTC has experienced a succession of changes in its governance system. In 2011, the previous Lee administration made NSTC a permanent organisation with its own secretariat so as to enhance its independence and accountability (previously, the Ministry of Education, Science and Technology fulfilled the secretariat function). The ministers were excluded from membership. Instead, the president appointed a civilian commissioner, two standing commissioners, and seven non-standing commissioners.

The current Park government also reformed the NSTC's governance. The independent secretariat was abolished and its function taken over by MSIP. The change was aimed at giving MSIP, the Park government's flagship ministry, the authority to co-ordinate national R&D and technology policy. The composition of members also substantially returned to that which existed before 2011 (ministers now participate in the NSTC and the only difference is that the Prime Minister, and not the President, acts as the Commissioner of the NSTC). The mission of the NSTC, however, remains the same as with the previous governments. The Council has the following responsibilities:

- Co-ordination of major policies and a plan for science and technology promotion;
- Establishment of a Basic Science and Technology Plan;
- Distribution and co-ordination of the national R&D budget;
- Investigation, analysis and evaluation of national R&D programmes; and,
- Co-ordination of policy for science and technology human resources development.

The NSTC has authority to make decisions over 70% of all public R&D-related funding. Major R&D programmes must be reviewed by the NSTC, and the MOSF should respect the NSTC's review in making budget allocations. On behalf of the NSTC, KISTEP evaluates the performance and effectiveness of every programme and its assessments are reflected in the following year's R&D budget.

The recent changes in the NSTC structure, however, have raised some concerns. These concerns centre on the independence and accountability of the NSTC. As MSIP, one of the ministries responsible for its own R&D programmes, takes over the secretariat function of the NSTC, MSIP acts as both “player” and “referee”. This is a main reason why the previous government set up an independent secretariat under the NSTC.⁶

Table 2.2. Organisational history of the NSTC

	1999-2003	2004-07	2008-10	2011-12	2013-
Organisational composition	Chair: President Governmental members (14) private sector members (3)	Chair: President Governmental members (13), private sector members (8)	Chair: President Governmental members (10), private sector members (13)	Chair: appointed by the President Standing Commissioners (2), private sector members (7)	Chair: Prime Minister Governmental members (10), private sector members (9)
Secretariat	Ministry of Science and Technology	Office of Science and Technology Innovation (under MOST)	Ministry of Education, Science and Technology	Internal Secretariat	Ministry of Science, ICT and future Planning

Evaluation of public R&D programmes and budget allocation

The evaluation of R&D programmes, as part of the R&D budget allocation process, also plays a role in co-ordinating Korea's technology and innovation policies. The Korean system of evaluation for public R&D support is considered in Chapter 3.

R&D investment and support

Despite budget constraints caused by the global financial crisis, the Korean government has invested significantly in R&D. The Previous Lee government targeted total R&D investment of up to 5% of GDP by 2012. As a result, government R&D investment in 2012 was 1.5 times as high as in 2008. According to the new five-year Basic Plan of Science and Technology (2013-17), the increase in R&D investment is expected to continue. The current government plans to achieve annual average R&D investment of KRW 18.5 trillion between 2013 and 2017 (an increase of 35% from the previous government). Moreover, the Basic Plan for Science and Technology specifies that the government will raise the proportion of fundamental research to 40% of total R&D expenditure (in 2011 this was 30.7%). The R&D investment will focus on developing a total of 120 technologies,

especially 30 priority technologies in five sectors (social safety; health care; the environment; future growth engines; and ICT combined with other industries).

Table 2.3. Public R&D investment, Korea, 2009-12

	KRW trillion				
	2009	2010	2011	2012	Average growth rate
Total government expenditure	284.5	292.8	309.1	325.4	4.6%
Total government R&D	12.3	13.7	14.9	16.0	9.2%
(Number of projects)	(39 471)	(39 179)	(41 619)	(-)	

Source: Office of Prime Minister (2012), “Review and Future Direction of the New Growth Engines”, Korea.

The Korean government has been providing diverse tax incentives to promote the private sector’s R&D investment and innovation activities. Korea’s R&D tax credit is provided on either the volume of R&D expenditure or incremental R&D expenditure (see Chapter 5).

Technology transfer and commercialisation

Like other OECD countries, Korea has actively engaged in promoting technology transfer and commercialisation. The institutions and policy measures adopted to meet this challenge are examined in Chapter 4.

International technology co-operation

Weak international research collaboration and the relatively small number of foreign researchers working in Korea all suggest that the Korean innovation system is only loosely linked to international knowledge networks. Against this background, the Korean government has been enacting policy initiatives to increase the internationalisation of its research base. In the new Basic Plan for Science and Technology, devised in 2013, Korea has announced a push for the globalisation of its science and technology. In this connection the government has identified several targeted tasks. Among them are: expanding international joint research on global challenges such as climate change and energy; establishing Korea as a hub of global science and technology; increasing overseas development assistance in science and technology; and building infrastructure for international co-operation.

In Korea, several ministries have started their own international programmes. The two biggest are MSIP’s Internationalisation Programme of science and technology in the area of fundamental science and technology and MOTIE’s International Joint Research and Development Programme, which focuses on industrial technology. Both programmes are conducted by their umbrella agencies. The Korea Foundation for International Co-operation of Science and Technology (KICOS) used to support MSIP for international co-operation, but with the abolishment of KICOS NRF now performs that task. On the other hand, KIAT, on behalf of MOTIE, has operated several programmes to facilitate international technology co-operation.

Notes

1. A legal definition of ‘venture company’ exists in Korea. The Korean government enacted the ‘Special Measures on the Promotion of Venture Companies’ in 1997 to promote venture start-ups. According to that law, a venture company is defined as a small and medium business in which: 1) a venture capital company has invested; 2) research and development expenses are large in relation to its revenue; or 3) the main business activity is technology related.
2. The 17 sectors representing new growth engines are: Green Technology (new and renewable energy, low-carbon energy, advanced water processing, LEDs, green transportation systems, and high-tech green cities); High-tech Convergence (broadcasting and communications, IT convergence, intelligent robots, nanotechnology, biopharmaceuticals and medical devices, food industry); Value-added services (health care, education, green financing, content and software, and conventions and tourism).
3. In May 2013 the details of the first and second strategies were released in advance in ‘Measures to Develop a Virtuous Cycle in the Venture Start-up Capital Ecosystem’.
4. Responsibility for the education function has been given to MOE (Ministry of Education).
5. The former MKE has now become MOTIE.
6. MSIP and KISTEP have emphasised that since the ministers participate and discuss in the NSTC, presided by the Prime Minister, co-ordination works properly. However, considering that the NSTC’s Commissioner used to be the President, before the NSTC became permanent during 2011 - 2012, its co-ordination authority must be weakened to some extent.

References

- KISTEP (2012), “Government Research and Development Budget Analysis in the FY 2012”, Korea Institute of Science and Technology Evaluation and Planning, Korea
- MOSF (2013), “Plan for Venture and Start-up Ecosystem”, May 2013, Korea
- MSIP (2013), “Korea’s Creative Economy Plan”, Press release, June 2013, Korea
- NSTC (2013), “Five-year Basic Plan for Science and Technology”, National Science and Technology Committee, July 2013, Korea
- OECD (2013), “National Accounts at a Glance: National Accounts at a Glance 2013”, OECD National Accounts Statistics (database). doi: [10.1787/data-00652-en](https://doi.org/10.1787/data-00652-en) (accessed September 2013)
- OECD (2012), “Industrial Policy and Territorial Development: Lessons from Korea”, Development Center Studies, OECD Publishing, Paris.
doi: [10.1787/9789264173897-en](https://doi.org/10.1787/9789264173897-en)
- OECD (2009), “OECD Reviews of Innovation Policy: Korea 2009”, OECD Publishing, Paris. doi: [10.1787/9789264067233-en](https://doi.org/10.1787/9789264067233-en)
- Office of Prime Minister (2012), “Review and Future Direction of the New Growth Engines”, Korea
- World Bank/OECD (2000), “Republic of Korea: Transition to a Knowledge-Based Economy”. Available at <http://documents.worldbank.org/curated/en/2000/06/437066/korea-transition-knowledge-based-economy>

Chapter 3

Korea's evaluation system for research and development

This chapter analyses the salient features of Korea's system of ex ante and ex post R&D programme and project evaluation. R&D project evaluation processes in a set of other OECD countries are described, and comparisons are drawn with practices in Korea. Conceptual and practical challenges in evaluating project and programme impacts are considered. Principles and practices in managing evaluation findings are discussed. Future directions for policy are assessed.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

The criteria and processes used in undertaking *ex ante* and *ex post* evaluation of public efforts to support R&D are clearly critical in determining the types of R&D that are funded and, over time, the overall efficacy of public support. Korea operates extensive and systematic evaluation procedures as regards R&D projects and programmes, more extensive than in many other OECD economies. However, given that policy makers are currently questioning whether publicly-supported R&D is overly focused on manufacturing, and whether it is of the highest quality, it is important to consider if the evaluation processes used are suitable. Accordingly, this section describes the salient features of the R&D evaluation system and considers ways in which it might require modification. Attention is also given to how evaluation findings might best be used to inform policy development, along with some of the methodological challenges to undertaking *ex post* evaluation.

3.1. Evaluation of public R&D programmes in Korea

The Korean system of programme evaluation is represented in Figure 3.1. In 2005 the government enacted the ‘Law on the Evaluation and Management of Performance of National R&D Programmes’. This aimed to enhance the efficiency of R&D investment and maximise the contribution of R&D to socio-economic development. Based on this law, the Korean government introduced a new evaluation system for R&D programmes known as the National Evaluation System (NES) for R&D, which comprises multi-level evaluation and informs the budget allocation process.

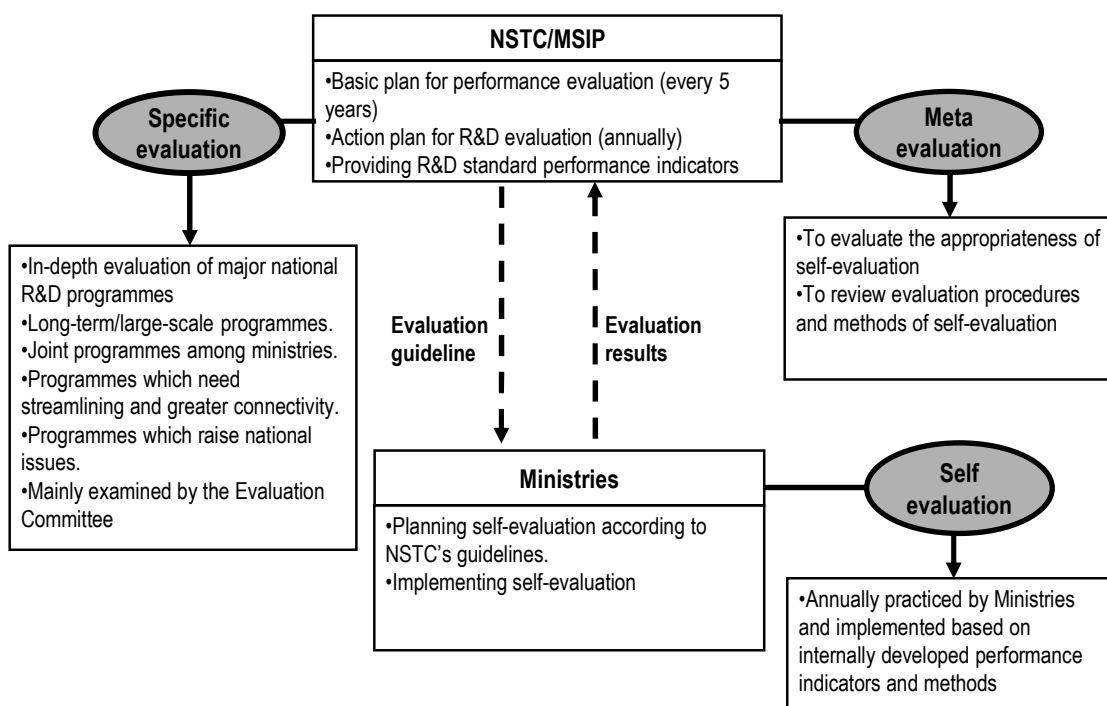
However, R&D programmes and R&D projects should be distinguished. In 2011, Korea had 493 R&D programmes. To implement these programmes, 41 619 R&D projects were undertaken. The distinction is important because the ‘Law on the Evaluation and Management of Performance of National R&D Programmes’ pertains to R&D programmes, not R&D projects. Each Ministry is in charge of evaluating the R&D projects associated with its own mission.

There are three types of *ex post* evaluation of R&D programmes:

- *Self-evaluation* – undertaken by Departments or related agencies (for example, MOTIE, in the case of industrial technology programmes. And GRIs, under the supervision of MSIP, conduct a managerial evaluation once a year). The purpose of self-evaluation is mainly to improve programme implementation or institutional management. Each ministry is required to set up a “Self-evaluation Committee” composed of external experts. MSIP (with the assistance of KISTEP) helps each ministry conduct the self-evaluation by establishing standards for evaluation. MSIP (KISTEP) has also created a “Self-evaluation Support Team” which handles difficulties faced by ministries in their self-evaluation.¹ To realise a tailored evaluation of each programme, each of which will have its own characteristics, different weights and indicators are developed. Key evaluation criteria include: Appropriateness of programme goals; Relevance of performance targets; Quality of the programme management system; and Accomplishment of planned performance and use of the evaluation results.
- *Meta evaluation* – undertaken by MSIP, with the assistance of KISTEP, meta-evaluation is used for budget allocation decisions and assesses evaluation outcomes and processes for each ministry. Meta-evaluations review the reliability of the self-evaluation in terms of quality, data, methodology and actors. The following sorts of questions can be raised in MSIP's meta-evaluations: Is the

evaluation report well-written? Are the evaluation's scope and methodology appropriate? Are the evaluation indicators appropriate to assess the programmes? Are the conclusions and recommendations of the evaluation report reliable? And how helpful are the self-evaluation results in the analysis of the portfolio of overall R&D expenditure?

Figure 3.1. The R&D programme evaluation system, Korea



- *Specific (focused, in-depth) evaluations* are undertaken by MSIP for: those programmes that require a large budget injection over a long period of time; programmes that require inter-ministerial or inter-programme co-ordination; programmes which need streamlining and require greater connectivity to achieve synergies, or programmes related to important national socio-economic issues. Patents and citation data are examined, as well as qualitative data. Focused evaluations, about 10-20 of which are undertaken a year, are used for programme improvement and budget allocations, or to inform major decisions, for example to cancel or re-orient a programme. The in-depth evaluation is conducted along the following six major criteria:
- *Validity of programme planning and contents* (e.g. Are the aim and scope of the programme appropriate? Does the programme fully consider the contemporary economic and social environment? Are sub-projects in the programme overlapping with one another?).
- *Efficiency of programme management* (e.g. Is the implementation of the programme efficient? Does the programme procedure concur with the practice plan? Is the budget for the programme spent and distributed in an efficient way? Are the suggestions and recommendations presented in the previous year considered effectively?).

- *Effectiveness of programme results (output and outcome)* (e.g. Has the programme achieved the main purpose (goal) for the appointed fiscal year? Will the programme be able to attain the final goal of the programme in the future? What are the scientific and technological achievements? How effective is the programme in nurturing human resources in R&D? How effective is the programme in building R&D infrastructure? Does the programme contribute to the strengthening of industrial competitiveness of the country? Is the programme conducive to the promotion of public welfare? Are the research activities of the R&D institute suitable for its given mission?).
- *Necessity of the programme* (e.g. Is the programme better carried out by a private sector actor or does the programme need the government's support? Does the programme concur with the government's strategic S&T policy?).
- *Utility of the programme* (e.g. What is the direct benefit from supporting the programme? What are the consequences that the technological development of the programme brings about?).
- *Appropriateness of budget size* (e.g. Is the budget for the programme reasonable? Is it necessary to reduce or raise the budget for the programme?).

The R&D programme evaluation processes also operate to an established timetable, as described here:

- *December (of the previous year)*: NSTC determines the evaluation action plan which includes the objectives, methodology and evaluation procedure.
- *January*: Each ministry presents materials for Focused Evaluations and an action plan for Self-evaluations.
- *February*: Ministries and MSIP separately undertake Self-evaluation and Focused Evaluations.
- *March-April*: Self-evaluation is finished at the end of April and each ministry reports the results to MSIP.
- *May-June*: MSIP implements Meta-evaluation.
- *June or July*: Focused Evaluation finishes.
- *July*: NSTC confirms the results of programme evaluations and sends them to related ministries, especially to the MOSF. Ministries use the findings and recommendations from the evaluations to improve their programmes.
- *September-December*: MSIP and KISTEP prepare an action plan and undertake preliminary programme and policy analysis for the next year's evaluation cycle.

Evaluating the Government Research Institutes

In addition to evaluations of national R&D programmes, evaluation is also conducted on the government research institutes (GRIs). Evaluation of the GRIs is a two-step process. The first step is undertaken by the respective supervising bodies, KRCF and ISTK. KRCF and ISTK conduct an evaluation of managerial performance annually, as well as an evaluation of research performance every three years (often, it is reported, with only short onsite visits by national and international peers). An external evaluation Committee comprising some 80 people was used to evaluate the GRIs in 2012. MSIP also conducts meta evaluation based on evaluations from KRCF and ISTK.

Some GRIs have held that the evaluation exercise itself limits their performance. The claim is made that research evaluation focuses too much on quantitative measures, such as patents and publications, that it needs more flexibility so as to reflect the characteristics of the individual GRI, and that the frequency of managerial evaluation is excessive.

Quantification is an essential part of evaluation. Some evaluation criteria, such as cost-benefit ratios, must be expressed in quantitative terms. But over quantification can result if there is a restrictive focus on only the quantifiable elements of programme/project outcomes. Over-quantification might also occur if, as is reported to happen in Korea, a quantitative grading is superimposed on all evaluation results, including qualitative evaluations. Useful information can be lost through such a practice. In sum, over-quantification may result in wrong decision-making.

Individual mission characteristics of GRIs (e.g. disciplinary versus interdisciplinary; industry or society-relevance versus basic science) should be reflected in the evaluation criteria used. This should not lead to arbitrary evaluation criteria however, and a proven way to cope with the issue of specificity versus comparability is to compare an institute with peer institutes abroad. If this is done effectively, including international panels and on-site evaluation visits, the frequency of managerial evaluations can also be reduced.

The results of all the forms of evaluation described in this section are reported to the NSTC for review. The NSTC confirms the results and sends them to related ministries, especially to the MOSF for input into its decisions on R&D budget allocation for the following year.

3.2. Evaluation of public R&D projects in Korea and other countries

Once R&D programmes have been developed through consultation with the NSTC and MOSF, each ministry is responsible for planning, evaluating and managing the R&D projects under the programme. The planning, evaluation and management of R&D projects is conducted by public institutions under the ministries (see Chapter 2). By contrast, this section considers Korea's R&D *project* evaluation system, and includes a comparative analysis with the United States, the United Kingdom, Israel and France. The focus is on *ex ante* project evaluation. These four countries were selected for comparison because of their high gross domestic expenditure on R&D. In each country, the detailed R&D project evaluation process is examined in one organisation responsible for implementing R&D. The analysis was done based both on those organisations' written guidelines and rules for R&D project evaluation and on answers to an OECD questionnaire.

The objective in presenting these cases is to highlight lessons learned from the range of experiences in R&D project evaluation systems which may also be applicable – possibly in adapted form – in Korea. The key questions addressed with respect to each organisation's R&D project evaluation system were:

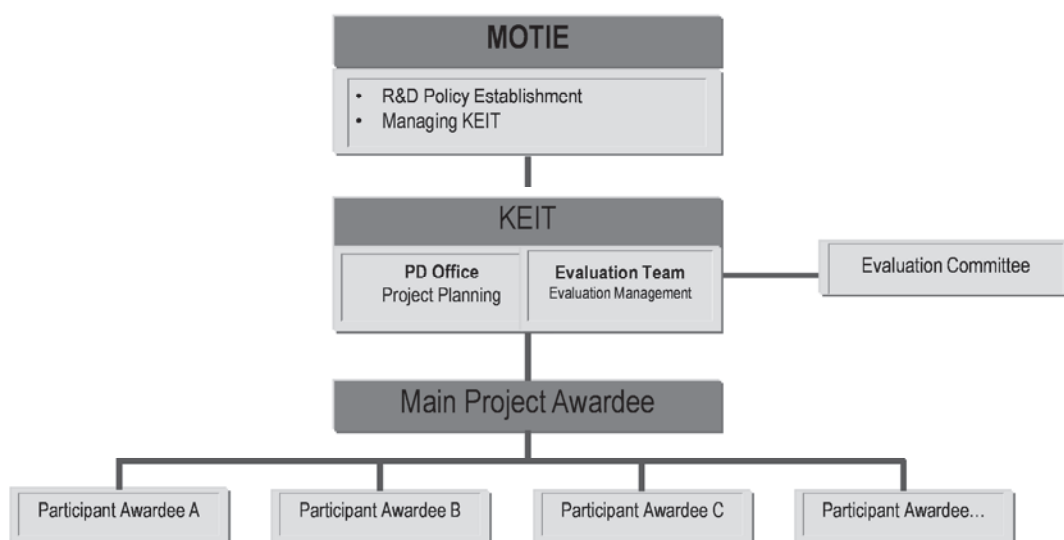
- How are R&D projects under a programme selected?
- How are project awardees selected and what evaluation criteria are used?
- Who conducts the assessment of each process?
- How are the R&D projects monitored?
- How are the projects evaluated after project completion and what are the evaluation criteria?

Overview of the R&D project evaluation system in Korea (focusing on industrial R&D)

Since R&D project evaluation arrangements vary from ministry to ministry, the focus here is on the support that MOTIE gives for industrial technology R&D.² There are three types of R&D in Korea: basic research, applied research and industrial technology. MOTIE is mainly responsible for industrial technology R&D, which is defined as the systematic utilisation of the knowledge or understanding gained from research to the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes. Industrial technology R&D is implemented by KEIT under MOTIE. As of September 2013, MOTIE had funded 1 599 projects under 33 programmes with KRW 1.18 trillion in funding. Approximately 37.2% of funding for projects has gone to small business, 7.9% to universities, 15.0% to large business, 30.8 % to GRIs and 9.1% to other institutions. The projects are divided into mid- and long-term projects (more than three years) and short term projects (less than three years). Most of MOTIE's projects are mid- and long-term projects.

MOTIE develops industrial technology R&D policies such as the 5-year Industrial Technology Innovation Plan and R&D programmes, and is responsible for managing KEIT. KEIT is responsible for implementing, planning and evaluating R&D projects. KEIT comprises a programme director and an evaluation team. KEIT recruits programme directors in 28 technical areas from diverse backgrounds, including academia, industry and GRIs. All are leaders in their fields and go to KEIT for two-year terms (which can be extended once). The programme directors are responsible for planning R&D projects. Once R&D projects are selected, the evaluation team is responsible for setting up and supporting an evaluation committee to select awardees. In most cases, the awardees comprise one main project awardee and a number of other participating organisations. The evaluation team manages the R&D projects and evaluates project results.

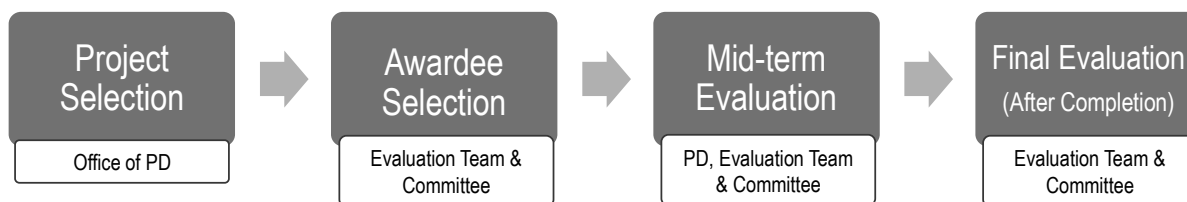
Figure 3.2. Structure of the R&D project evaluation system



The R&D project process in Korea

KEIT's R&D project selection and evaluation system can be divided into four stages (Figure 3.3): R&D project selection; awardee selection; mid-term evaluation; and final evaluation (after project completion).

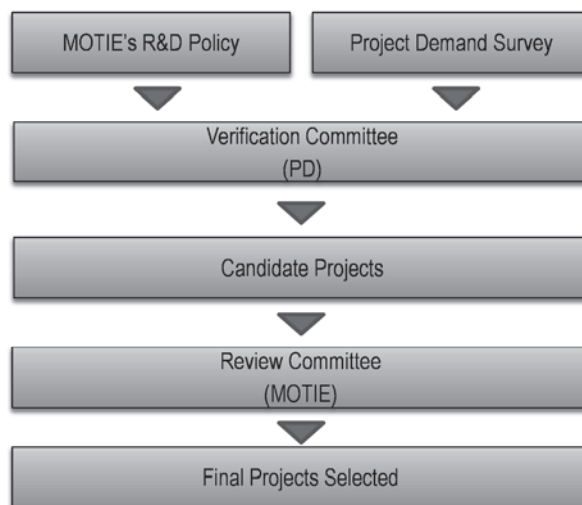
Figure 3.3. R&D project selection and evaluation



R&D project selection

KEIT has two different R&D project selection models, namely: a 'Top-down' model, which is mostly applied to mid- and long-term projects, and developed by programme directors; and a 'Bottom-up' model, which is mostly applied to short-term projects, and receives any applications that meet programme objectives. Most R&D projects are selected through the 'Top-down' model, which is described in the following text.

Figure 3.4. The R&D project selection procedure



Each programme director is responsible for one or several R&D programmes. Programme directors develop candidate projects to meet the needs of the programme under their responsibility. They do this through engagement with diverse science and technology communities, industry and government. Programme directors select candidate projects based on a variety of criteria. These criteria include MOTIE's R&D policy and technology directions, the results of a demand survey from businesses, analysis of technologies, markets, patents and standards, a redundancy check with other projects, and a review from a verification committee which is composed of science, technology and business experts. The total value of the selected candidate projects is twice that of the budget to be allocated. After the selection of candidate projects, MOTIE convenes a review committee. This consists of external experts and makes a final decision on

whether to select particular projects. After that, a Request for Proposals for each project is prepared. In total, the R&D project planning process lasts about 6 months (Figure 3.4).

R&D project awardee selection

KEIT's project awardee selection is conducted through the following procedure:

1. Programme and project announcement

All of KEIT's R&D programmes are announced for competition on the same day in January. In the "bottom-up" model, awardee selection begins with the announcement of the competition. In the "top-down" model, awardee selection usually starts after project selection has been finalised.

2. Submission of application

Unlike the process used by the Technology Strategy Board (TSB) in the United Kingdom, and the process employed by ARPA-E in the United States, in which applications are submitted in two stages, KEIT's R&D competition is a one-stage process. All applicants are required to submit a complete application containing all information to be used during the entire review process.

3. Assessment and selection decision

Once an application is submitted, an awardee selection committee is set up by KEIT for each project. The committee consists of seven experts from relevant fields. The experts are randomly selected from KEIT's pool of experts. Any experts who are related to the project applicants are excluded from the committee for reasons of fairness and transparency.

According to KEIT's rules, the committee members can assess the proposals of the applicants through a document evaluation, presentation evaluation, on-site evaluation, or make an evaluation based on discussion with the applicants themselves. In most cases, however, the committee assesses the proposal through 'presentation and Q&A'. All committee members convene at KEIT's offices and assess the applications based on 20 minutes of participant presentation and another 20 minutes of Q&A. Committee members do not receive the application documents until the assessment day. The assessment criteria include two parts: the technology level and the possibility of success; and economic feasibility and the possibility of commercialisation (see Table 3.1). Within 10 days after notification of the committee's decision, an unsuccessful applicant can ask for a reassessment from KEIT if they consider there have been serious flaws in the assessment process. KEIT is required to hold a special committee to review the assessment. After the assessment committee's scoring and ranking of the applicants, a coordinating committee can be convened, also chosen from KEIT's pool of experts, to finalise a decision on the amount of the support. The results of both committees are reported to MOTIE to obtain final approval for funding.

Table 3.1. Project awardee selection criteria

Evaluation criteria (Weight)	Specific criteria
Technological level and the possibility of success in development (70)	• Readiness of the potential awardee to implement the project • Concreteness and validity of the plan • Appropriateness, clarity, challenge and creativeness of the development objective • Appropriateness of the project structure and strategy • Difficulties and innovativeness associated with the technology • •Capability and ethics of the project manager and team
Economic feasibility and the possibility of commercialisation (30)	• Possibility of commercialisation • Possibility of market entry • •Economic feasibility

Mid-term evaluation

After the project awardee selection and a project contract are concluded, KEIT conducts a mid-term evaluation of the project every year. The project awardees can be asked to submit a mid-term report, and based on this, the mid-term evaluation is conducted. The mid-term evaluation takes the form of a presentation, an on-site evaluation by KEIT's programme director and external experts (including one from the project awardee selection committee) or a document evaluation. The criteria for mid-term evaluations also vary by project, but criteria that are common across projects relate to the achievements of the year under review and the quality of the plan for the year to come.

Table 3.2. Mid-term evaluation criteria

Evaluation criteria	Specific criteria	Description
Goal achievement of the year under review	Achievement of development target	What is the quantitative achievement of the target?
	Technology (performance) level	What is the quantitative (performance) level of the core technology? (in terms of features specific to each type of technology such as, for instance, processing speed in the case of semi-conductors).
	Adequacy of development method	Are the development methods to achieve the target appropriate?
	Spill-over effect of outcome	How many patent applications or registrations were made since the project begun?
Plan of next year	Clarity of development target	Are the technology characteristics and targets defined? Are the evaluation criteria for the developed technology appropriate?
	Changes in business value	Are there any changes in economic and institutional challenges – such as the market size or entry conditions - compared to the beginning of the project?
	Possibility of target achievement	Is it possible to achieve the technology development goal during the project period?

The results of the mid-term evaluation are classified into three categories – “continue”, “stop (honourable/dishonourable)”, and “early completion.” There are two cases for stopping projects – when projects cannot go on because of external factors, such as immature markets or changes in government policy (and as such are assessed as an “honourable stop”), and when project goals have not been met or an awardee firm has entered bankruptcy (“dishonourable stop”). As of 2012, 91.2% of a total of 1 725 projects which KEIT managed had been continued. 6.3% were honourable stops, 0.8% were dishonourable stops, and 1.7% were classified as early completions.

Final evaluation

If the project is completed, a final evaluation is conducted by a Final Evaluation Committee which again consists of selected experts in the pool system. The project awardee must present the project's performance and a commercialisation plan. In addition an on-site evaluation can be followed if it is needed. The achievement of project objectives and the likelihood of commercialisation are evaluated based on three criteria: goal achievement (30%); technology level (30%); and economic and commercialisation feasibility (40%). The specific evaluation criteria are indicated below.

Table 3.3. Final evaluation criteria

Evaluation criteria (Weight)	specific criteria	Description
Goal Achievement (30)	Degree of final goal achievement	To what extent was the planned target achieved? Did the achieved goal lead to technological improvement in the industry?
	Innovativeness of the technological development	Are the performance evaluation results (test reports, certificates) of the developed technology innovative?
	Creativeness in the method of technological development	Is the method to achieve technological development creative?
Technology Level (30)	Practicality of the result of technology development	Can the developed technologies be used in or for the production of goods?
	Technological performance level	How does the technology differ from existing domestic or foreign technologies?
	Technology spillover effect	The number of domestic or foreign applications for a patent and the number of patents within the project, and their quality.
Economic and Commercial Feasibility (40)	Appropriateness of the commercialisation strategy	Possibility of market opening and appropriateness of the investment plan
	Possibility of market entry and of gaining market share	Will the developed technology be easily taken up in the market? Can market share be won following the project?
	Profitability	Retrun on the investment?
	Economic spillover effect	Expertise development, import substitution and job creation effects

The evaluated final projects can be divided into four categories: innovative outcome, average outcome, unsuccessful with honourable performance and unsuccessful with dishonourable performance. As of 2012, 82.3% of a total of 476 projects that had undergone a final evaluation were classed as either 'innovative outcome' or 'average outcome' (392 projects) and the remaining 17.7% (84 projects) were deemed unsuccessful (with either honourable or dishonourable performance). 8.3% of the unsuccessful projects were classified as having 'dishonourable' performance. For the projects with 'dishonourable' outcomes, there may be restrictions on future project participation, a recovery of government grants and other measures. However, unsuccessful projects where performance was deemed 'honourable' can be exempt from those sanctions. The grading scale for the final evaluation is set out in Table 3.4.

Table 3.4. Grading scale for the final evaluation

Grade scale (Score entailed in the classification)		Description
Successful	Innovative outcome (90-100)	The development goals have been reached and there is a high possibility of commercialisation.
	Average achievement (70-90)	The development goals have been achieved and there is a relatively high possibility of commercialisation.
Unsuccessful	Honourable performance (60-70)	The project goal was not fully achieved even through the project awardee has worked on the project in a good-faith manner, or there is a low possibility for project outcomes to be commercialised.
	Dishonourable performance (below 60)	The project goal was not achieved at all, there is very low possibility for the project outcomes to be commercialised, the project expenses were not used or managed in a proper way or there has been non-compliance with stipulated rules.

R&D project systems in other countries: United States, United Kingdom, Israel and France

United States: ARPA-E

The Advanced Research Projects Agency-Energy (ARPA-E) is an agency funding innovative energy research under the US Department of Energy (DOE). ARPA-E was established by the America COMPETES Act of 2007, with the first appropriation coming in 2009 from the American Recovery and Reinvestment Act. ARPA-E concentrates on technology-focused applied research and development aimed at creating real-world solutions to important problems in energy generation, distribution and use. Other Department of Energy programmes provide financial assistance for basic research or funding to improve existing technology platforms. On the Technology Readiness Level (TRL) scale (1~9), the majority of ARPA-E funded projects fall between levels two and four, a space called the “valley of death” for technology development, which many public and private investors consider excessively risky (Wurzelman, 2012).

ARPA-E is composed of programme directors and technology-to-market advisors. Programme directors create R&D programmes, choose projects, and work with project award recipients to help solve technical problems and keep projects on track. Once selected, projects are required to prepare a “Technology-to-Market” plan to ensure technologies are ready for the market. This step is required in order to increase the likelihood that any developed technology has a widespread impact. ARPA-E brings together advisors and stakeholders to provide feedback and support for these plans. This includes working with ARPA-E Technology-to-Market advisors and outside engagement with corporations, investors, service providers and government and regulatory bodies (Wurzelmann, 2012). ARPA-E aims to promote the rapid development of technologies to a point where private or public investors commit funds and bring them to market. With ARPA-E funding and support, projects typically advance to the stage of component validation in a relevant environment (TRL 5) through system prototype demonstration (TRL 7). Programme directors and technology-to-market advisors come to ARPA-E for limited, three- to four-year terms. The directors and advisors come from diverse backgrounds including academia, industry, and national labs. All are leaders in their respective fields.

Project/awardee selection

Unlike Korea where after project selection is made, project awardee selection begins, ARPA-E selects projects at the same time as it selects awardees. ARPA-E's projects and awardees are selected through two models: an "open" model and a "focused" model. The "open" model seeks applications for any idea that has the potential to produce game-changing breakthroughs in energy technology. In the "focused" model, a new programme is created through engagement with diverse science and technology communities. A funding opportunity announcement (FOA), which includes specific technical categories related to the programme, is then made public in order to solicit project proposals (ARPA-E, 2013a). ARPA-E's project and awardee selection is conducted through the following procedure and lasts about five months:

1. Funding Opportunity Announcement (FOA)

Both the "open" and "focused" model selection processes start with an ARPA-E FOA. The FOA contains comprehensive information on the programme, on funding, eligibility, application processes and review procedures.

2. Submission of concept paper and full application

Once an FOA is released, applicants must submit four pages of text – a so-called concept paper – which describes the proposed technology and the applicant's qualifications. Applicants who pass the review of ARPA-E's Concept Paper are required to submit a full application. The full application includes a detailed description of the technology, a budget justification and technical milestones.

3. Reply to reviewer comments

Once ARPA-E has completed its review of full applications, its comments are sent to the applicants. Applicants may submit a reply to these comments, which is a notable facet of ARPA-E's review process. Applicants are allowed to read the reviewers' comments and to provide a rebuttal, which the Agency considers before making funding decisions. The applicant response period allows ARPA-E to avoid misunderstandings and ask clarifying questions that enable ARPA-E to make the most informed selection decisions.

4. Assessment and funding decision

ARPA-E carefully considers all of the information obtained through the application process and makes an independent assessment of each Full Application. During the review the Programme Directors solicit external inputs to help ensure that ARPA-E is funding the best technologies. ARPA-E taps the expertise of dozens of leading experts. The involvement of world-class scientists, engineers and leaders from the technical community brings additional expertise and knowledge to the process. ARPA-E reviewers evaluate applications over several weeks, and then come together for a review panel (ARPA-E, 2011). ARPA-E evaluates proposed projects using the criteria set out in Box 3.1.

Although the Programme Director is responsible for the whole process, a selection official (ARPA-E Director) makes a final decision based on recommendations from the Programme Director. Applicants are promptly notified of ARPA-E's selection decision. They then enter award negotiations directly with the Programme Director.

Box 3.1. ARPA-E's project selection criteria

The Example of the 'Full Spectrum Optimised Conversion and Utilisation of Sunlight' Programme

1. Impact of the proposed technology relative to state-of-the-art (30%)

- The extent to which the proposed quantitative material and/or technology metrics demonstrate the potential for a transformational and disruptive (not incremental) advancement in one or more energy-related fields;
- The extent to which the Applicant demonstrates a profound understanding of the current state-of-the-art and presents an innovative technical approach to significantly improve performance over the current state-of-the-art;
- The extent to which the Applicant demonstrates awareness of competing commercial and emerging technologies and identifies how its proposed concept/technology provides significant improvement over these other solutions.

2. Overall scientific and technical merit (30%)

- The extent to which the proposed work is unique and innovative;
- The extent to which the proposed project is likely to meet or exceed the technical performance targets identified in this FOA;
- The feasibility of the proposed work;
- The extent to which the applicant proposes a sound technical approach to accomplish the proposed R&D objectives;
- The extent to which the applicant manages risk, by identifying major technical R&D risks and clearly proposes feasible, effective mitigation strategies; and
- The extent to which project outcomes and deliverables are clearly defined; and
- The extent to which the applicant proposes a strong and convincing technology development strategy, including a feasible pathway to transition the programme results to the next logical stage of R&D and/or directly into commercial development and deployment.

3. Qualifications, experience, and capabilities of the proposed project team (30%)

- The extent to which the Principal Investigator and Project Team have the skill and expertise needed to successfully execute the project plan, evidenced by prior experience that demonstrates an ability to perform R&D of similar risk and complexity;
- The extent to which the applicant has access to the equipment and facilities necessary to accomplish the proposed R&D effort and/or a clear plan to obtain access to necessary equipment and facilities.

4. Soundness of management plan (10%)

- The extent to which the applicant presents a plausible plan to manage people and resources;
- The extent to which the applicant proposes allocation of appropriate levels of effort and resources to proposed tasks;
- Whether the proposed schedule is reasonable. Submissions will not be evaluated against each other since they are not submitted in accordance with a common work statement.

Source: ARPA-E (2013b), "Funding Opportunity Announcement, Full-Spectrum Optimized Conversion and Utilization of Sunlight", Advanced Research Projects Agency-Energy, July 2013, United States.

In addition to the criteria in Box 3.1, ARPA-E may also consider the programme policy factors in Box 3.2 in determining which applicants to select.

Box 3.2. ARPA-E's policy factors

1. ARPA-E portfolio balance. The project helps to balance ARPA-E's portfolio in one or more of the following areas:

- a. Technological diversity;
- b. Organisational diversity;
- c. Geographic diversity;
- d. Technical or commercialisation risk; or
- e. Stage of technology development.

2. Relevance to ARPA-E mission advancement. The project contributes to one or more of ARPA-E's statutory goals:

- a. Reduction of US dependence on foreign energy sources;
- b. Stimulation of domestic manufacturing;
- c. Reduction of energy-related emissions;
- d. Increase in US energy efficiency;
- e. Enhancement of US economic and energy security; or
- f. Promotion of US advanced energy technologies competitiveness.

3. Synergy of public and private efforts

- a. Avoids duplication and overlap with other publicly- or privately-funded projects;
- b. Promotes increased co-ordination with nongovernmental entities for demonstration of technologies and research applications to facilitate technology transfer; or
- c. Increases unique research collaborations.

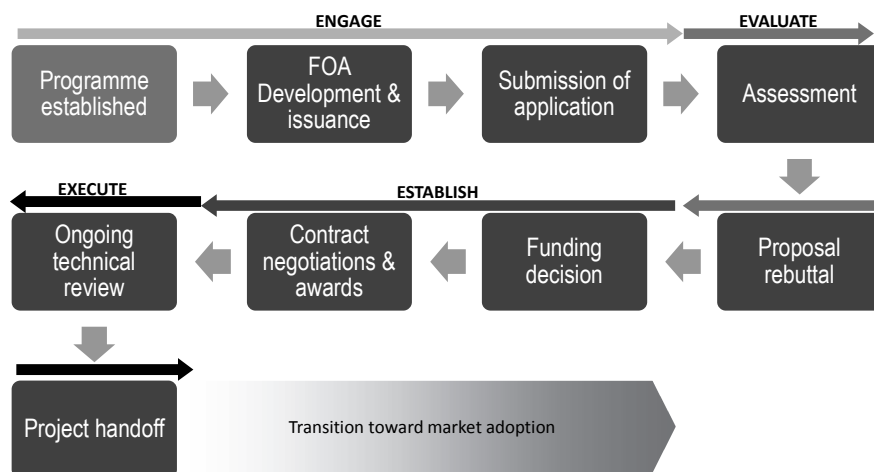
4. Low likelihood of other sources of funding. There is a high technical and/or financial uncertainty that results in the non-availability of other public, private or internal funding or resources to support the project.

5. High-leveraging of federal funds. Project leverages Federal funds to optimise advancement of programmatic goals by proposing cost share above the required minimum or otherwise accessing scarce or unique resources.

6. High project impact relative to project cost

Source: ARPA-E(2013b), "Funding Opportunity Announcement, Full-Spectrum Optimized Conversion and Utilization of Sunlight", Advanced Research Projects Agency-Energy, July 2013, United States.

Figure 3.5. ARPA-E. Programme and project selection cycle



Monitoring and evaluation

After a project starts, ARPA-E monitors the project on the basis of quarterly technical milestones, visiting project sites frequently and making go/no-go decisions about project continuation.

If a project is completed, the programme director determines whether the project is successful or not. The criteria are based on the degree of achievement of programme goals and technical performance targets identified in the FOA. Programme directors also review the achievement of the technology-to-market plan which the project team submitted when it started the project. Programme directors also gauge success by the creation of technical communities and project hand-offs, including the formation of new companies and the fostering of public and private partnerships to ensure projects continue to move towards the market.

United Kingdom: Technology Strategy Board

The Technology Strategy Board (TSB) is the United Kingdom's innovation agency. The TSB operates at arm's length from the government as a business-led executive non-departmental public body. It is sponsored and funded by the Department for Business, Innovation and Skills (BIS).

The TSB's support for R&D is industry-oriented and focuses on areas where there is a clear potential business benefit and where technologies can be applied in the market. The TSB supports all categories of R&D, including basic research, applied and industrial research, and experimental development. The TSB's R&D support is offered on a competitive basis with several different tools, such as (TSB, 2013a):

- Collaborative R&D;
- R&D grants for individual companies, primarily SMEs;
- Knowledge transfer partnership (where associates from public sector research organisations are funded to work on innovation projects in business);
- Feasibility studies (to assess the potential of ideas in specific thematic areas).

The TSB has identified priority areas, and focused its support on those areas, which currently include: advanced materials, bioscience, the built environment, digital economy, electronics, sensors and photonics, energy, food, healthcare, high-value manufacturing, ICT, space, resource efficiency, transport, and other areas such as design, financial services and emerging technologies and industries.

Project/awardee selection

TSB's project selection is similar to that of ARPA-E, in that projects are chosen as part of the same process of allocating funding. The TSB's projects and awardees are chosen in two different ways. Applicants can apply for R&D funding in specific priority areas which TSB has designated, as well as through non-themed 'always open' competitions. TSB's project and awardee selection processes differ depending on the size of the award and the programme under which the award is given. However, TSB's selection generally follows the steps outlined immediately below and lasts about five months.

1. Competition opens

For each competition, the TSB releases two key documents to guide applicants through the application process.

- Competition brief – this document provides key competition information such as the technical summary, background, challenge, scope, research area, funding available, entry requirements, key events and dates.
- Competition details – this document provides more details about the competition, including the process for applying. The document is available once the competition opens on the competitions page of the TSB website.

2. Submission of application

There are two types of TSB competition: one-stage and two-stage competitions. In a one-stage competition, applicants directly submit a full application, while the two-stage competitions require Expressions of Interest or video submissions prior to a full application. There is no set rule determining when one- or two-stage processes should be used. Rather, competitions are designed on a case-by-case basis. Expressions of interest or video submissions are assessed by an independent panel of experts. Selected applicants are then invited to submit a full application (TSB, 2013b). The main parts of the full application are composed of three sections: the business proposition (four questions); project details (four questions); and funding and added value (two questions). Sections 1 to 3 address specific questions (see Box 3.3). Each question has an equal weighting.

3. Assessment and decision

Independent assessors with relevant sector expertise, knowledge and experience in the particular technology areas are appointed by the TSB Board for each competition. Each application is assessed by up to five assessors from both business and academia, working in isolation from each other. The assessors are briefed on the competition's scope and will score proposals against the answers to the questions provided in the application form (see Box 3.3). It takes about two and a half weeks for assessors to appraise the applications. After the assessors' scoring, a review panel is convened to receive the collective scoring and recommend a ranked list of applications to be funded by the TSB. The recommended list is presented to the TSB's Funders' Panel to obtain final approval for funding.

Box 3.3. The TSB's application form and assessment criteria: The example of the 'Infrastructure for Offshore Renewables' programme

Section 1: Questions on the business proposition (10 points per question = 40 points in total)

1. What is the business opportunity that this project addresses?
2. What is the size of the market opportunity that this project might open up?
3. How will the results of the project be exploited and disseminated?
4. What economic, social and environmental benefits are the project expected to deliver to those inside and outside of the (R&D) consortium, and over what timescale?

Section 2: Questions on the details of the project (10 points per question = 40 points in total)

5. What technical approach will be adopted and how will the project be managed?
6. What is innovative about this project?
7. What are the risks (technical, commercial and environmental) to project success? What is the project's risk management strategy?
8. Does the project team have the right skills and experience and access to facilities to deliver the identified benefits?

Section 3: Questions on funding and added value (10 points per question = 20 points in total)

9. What is the financial commitment required for the project?
10. How does financial support from the TSB and its funding collaborators add value?

Source: TSB (2013c), "Competition Guidance for Applicants, Infrastructure for Offshore Renewables-Collaborative R&D", Technology Strategy Board, December 2013, the United Kingdom.

Monitoring and evaluation

For larger projects, each project is assigned a Monitoring Officer who is contracted by the TSB in a similar manner as the assessors. Monitoring Officers hold quarterly visits to the awardee, and they assess and report on how the project is progressing against its stated objectives and milestones. The same Monitoring Officers also complete a final report with the awardee at the end of the project. This report assesses progress against the project objectives, and describes outcomes (such as new intellectual property or jobs created) from the project. This report is collected from awardees in free-text format and awardee responses are not reported in full (as they may contain commercially sensitive information). For smaller projects, under GBP 100 000, site visits are not held, and the awardee submits an end-of-project report setting out the progress made.

Israel: Office of the Chief Scientist

The Office of the Chief Scientist (OCS) of the Ministry of Industry, Trade and Labour in Israel is responsible for implementing government policy regarding support to and encouragement of industrial research and development. The role of the OCS is to assist in the development of new technologies in Israel, fostering the development of the Israeli economy, encouraging technological entrepreneurship, leveraging Israel's science-based resources, supporting high added-value R&D, enhancing the knowledge base of Israel's

high-tech industries and promoting cooperation in R&D both nationally and internationally (OCS, 2013a).

The fact that the R&D programmes and projects are managed by an Office in a Ministry is one of the differences from other countries, where R&D projects are usually managed by agencies supporting a Ministry.

The Industrial Competitiveness R&D Programme is one of the main instruments used to support R&D. It provides partial financing of 20% to 50% to approved R&D projects lasting one or more years that will result in the development of a new product or a significant improvement to an existing product. The annual budget of approximately USD 400 million is spent on approximately 1 000 projects undertaken by around 600 applicants (OCS, 2013b).

Project/awardee selection

In a way that is similar to the project selection processes described above in the United States and the United Kingdom, the projects of the OCS's Industrial Competitiveness R&D Programme are identified through a project awardee selection process, rather than top-down project selection by government. It usually takes three to four months from the beginning of the awardee selection process to the end of selection. The two steps involved are briefly described here:

1. Announcement and submission of application

The application process for projects under the Industrial Competitiveness R&D Programme is straightforward. Information about the Programme is announced on the OCS website. However, only one application per company per budget year is accepted. But there is no restriction on the number of programmes to which an applicant may apply. The application submission period varies based on the size of the project (OCS, 2004). The application should include a chapter which refers to the technology, business and marketing plans, and the applicant also needs to specify funding sources (OCS, 2005).

2. Assessment and selection decision

After the submission of applications, a professional examiner³ reviews the applications and can conduct on-site evaluation if necessary. The examiners evaluate the applicants using three criteria: technical; business and company competence, with a score of 1 to 5 for each criterion (Table 3.5). The examiners also review the funding history of applicants if needed, contact previous professional examiners for better understanding of the application, and meet the applicant company representative at least once during the review process. The evaluation results are submitted to the Head of the Professional Area (OCS, 2003).

The Head of Professional Area⁴ also grades all the applications within his/her field of operations based on the same criteria and scores (Table 3.5) and reviews the quality and completeness of the professional examiner's opinion, giving guidance to and inspecting the work of the professional examiners. The evaluation results, including a recommendation regarding approval or rejection of the application, are submitted to the Committee. A financial check by the OCS can follow to examine the company's ability to fund the R&D project as a pre-requisite for granting an approval.

Table 3.5. Industrial competitive R&D project awardee selection criteria

Evaluation criteria (score of 1-5 for each criterion)	Specific criteria
Technological aspect	• Product's level of technological inventiveness and uniqueness • Technological obstructions • Development prospects versus risks • Creation of intellectual property in the project • Technological contribution to Israel's economy, etc.
Business aspect	• Market needs • Contribution to the economy (employment, exports, added value, etc.) • World-market size • Prospective market share • Features distinguishing the firm from competitors.
Company's competence	• Company's positioning in its field and the corporate strategy • Production abilities • Management and marketing competencies • Competence of the R&D team • Financial standing • Past performance.
Others	• The application's clarity and data completeness

Source: OCS (2004), "Function regulations, as of the submission of the support application until termination of the R&D period", Office of the Chief Scientist, December 2004, Israel.

Lastly, the designated Committee, which consists of experts from the private sector and programme directors, examines and approves or rejects the submitted projects, taking into account the evaluation opinion of the Head of Professional Area. For each application, the research committee issues one of the following decisions: 'full' or 'partial approval'; 'rejection'; 'conditional approval' of R&D support; or 'postponement of the hearing'. A decision can also be made regarding the budgetary contribution of applicants (OCS, 2003). If the opinions of committee members contradict each other, a decision is made by a majority vote (KIAT, 2012). It takes 10 days for the decision to be made by the Committee.

Within 14 days of the research committee's decision being made, the OCS sends a letter specifying the decision. The applicant can request a hearing in the research committee following a rejection of its application, so long as this request is made within 30 days of the receipt of the research committee's decision.

Monitoring and evaluation

The professional examiner is responsible for visiting the awardee and monitoring the R&D project process and its compliance with the project objectives. After project completion, the project awardee needs to submit both a final technological report and a fiscal report. The final evaluation is conducted by the professional examiner through document evaluation and on-site evaluation (OCS, 2010). The final evaluation criteria focus primarily on the level of innovation achieved compared to the plans and to the capability of the company in terms of financial, human and other resources.

There are no penalties for project 'failure'. It is understood that R&D is an experiment, which means that the project outcome cannot be guaranteed because it is innovative and has never been done before. Even if the project does not succeed in achieving its goal following the required regulations, there are no penalties.

France – National Research Agency

The French National Research Agency (Agence Nationale de la Recherche, ANR) is a public funding organisation within the Ministry of Higher Education and Research. ANR was created in 2005 to organise the funding of projects whose end-purpose is to give impetus to the research sector and to strengthen the competitiveness of France and the international visibility of its research work. It offers funding for the various challenges and needs of the scientific community, both for fundamental and applied research and for public research organisations, universities and private companies.

As of 2012, ANR had funded 1 301 projects, to the value of EUR 555.5 million, from 6 829 project submissions. 54.4% of the projects involved funding for research-performing organisations, 21.5% went to universities, 8.4% to firms, and 15.7% to others. 33% of the budget was allocated to public-private partnership projects (ANR, 2013a).

Project selection

The ANR runs projects for all research subjects ("Blanc" Programme) and for specific themes. The Blanc programmes are specifically aimed at young researchers, returning post-doctoral researchers or top-level researchers. The projects which have specific themes usually target key societal issues.⁵ Those themes are developed through the work of the eight Strategy and Planning Boards which include 200 scientists and representatives from industry, public authorities and research alliances. This work is reflected in the ANR Work Programme of the year.

Project/awardee selection

The project applicants are reviewed based on their submitted proposals and different ANR review panels play different roles in the selection process. The project awardee selection process is conducted during a period of about six months through the following steps:

1. Announcement

ANR announces generic calls for proposals, based each year on the ANR Work Programme aimed at addressing major societal challenges.

2. Submission of applications

The application process occurs in two stages. First, the applicants need to submit the pre-proposal document describing the project as well as information on the nature of the project (such as the type of challenge being addressed, scientific research themes, disciplines concerned, administrative information on the partners, etc.). At the end of the first stage, the applicants will be informed of the result of the pre-proposal evaluation. If successful, the applicants will be invited to submit a full proposal including scientific documentation and administrative and financial information posted on-line on the ANR submission site. The main reason for a two-stage selection process is to avoid having a large number of researchers spend a lot of time working on the detailed proposals for highly

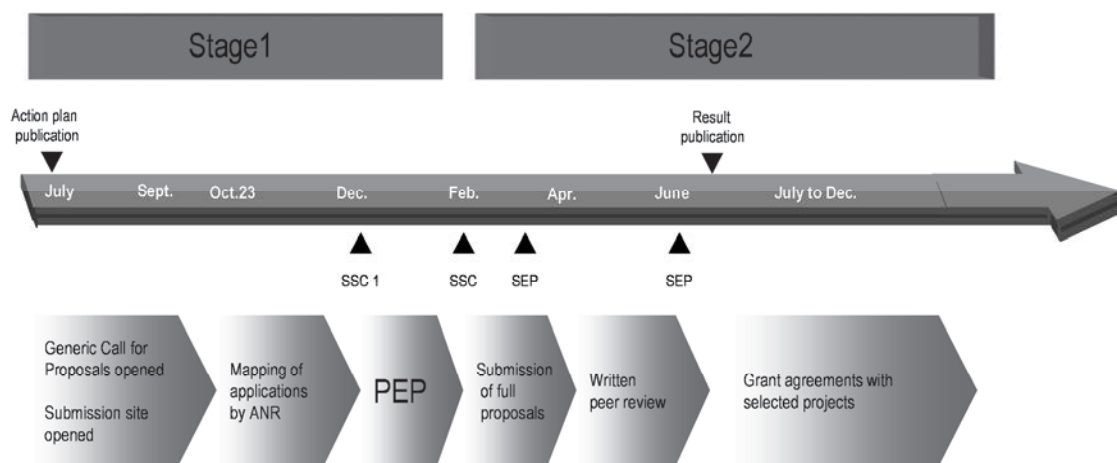
competitive projects (ANR, 2013b). The main elements for each proposal are as follows:

- Pre-proposal: Scientific and technological objectives, relevance and strategic nature of the project with regard to the orientations of the call for proposals, and presentation of the consortium.
- Full proposal: Context, positioning and objective of the full proposal, how the project is organised scientifically and technically, strategy for technology transfer, protection and use of the results, overall impact of the proposal.

3. Assessment and decision

The Pre-proposal evaluation Panel (PEP) at ANR checks the eligibility of pre-proposals according to the criteria specified in Box 3.4, and grades the projects using a rating scale of 0 to 5. The pre-proposals are ranked in descending order and these results are reviewed by the scientific steering committees (SSC) to finalise the priority order. Applicants are informed of the result of pre-proposal evaluations and the selected applicants are then required to submit a full proposal.

Figure 3.6. ANR project awardee selection process



The evaluation of the full proposal is done by *ad hoc* peer reviewers from various external panels and at least two members of scientific evaluation panels (SEP) who did not participate in the pre-proposal selection process. They evaluate the full proposals on the basis of the criteria in Box 3.4, using the same rating scales as were used in the pre-proposal selection. In the final meeting of SEP, the quality of submitted full-proposals is examined and the project awardee selection is finalised (ANR, 2013c).

Box 3.4. Criteria for awardee selection for ANR's generic calls

1) Pre-proposal selection criteria

- Significance of scientific and technological objectives (importance of the subject, ability to generate results, potential for progress in the field, ambition)
- Relevance and strategic nature of the project with regard to the call's orientations (correspondence to societal challenges in the case of projects with specific themes, benefits to society, how appropriate the chosen instrument is for the objectives, no crossover with the European Union's Horizon 2020 programme or national calls for proposals),
- Consistency of the pre-proposal with the project's objectives (the applicant's scientific references or the scientific references of the "research organisation" partners and the consortium's complementarity, consistency of the amount of funding requested in relation to the project's objectives).

2) Full proposal selection criteria

- Relevance of any changes to the proposal in relation to the pre-proposal (criterion for elimination if the differences are considered significant)
- Scientific excellence and/or innovative nature of the technological research
- Quality of the project's design and its feasibility
- Overall impact of the project

Source: ANR (2013b), "Guide for Applicants", Agence Nationale de la Recherche, July 2013, France.

Monitoring and evaluation

Through intermediate and final reporting the ANR monitors the progress of the funded projects and verifies that they meet their initial commitment. The ANR plays a role in disseminating the project results by publishing project summaries and by organising symposia on specific research topics, enabling projects that have reached or are nearing completion to disseminate their findings to the community concerned.

The key features in the project evaluation systems operated in the case-study countries are summarised in Table 3.6.

Table 3.6. Comparison of R&D project evaluation systems

Organisation	Korea KEIT	US ARPA-E	UK TSB	Israel OCS	France ANR
Type	Public institution	Government Agency	Public institution	Office in the Ministry	Public institution
R&D Type	Industrial R&D	Applied R&D	Basic, applied and industrial R&D	Industrial R&D	Basic and applied R&D
Project Selection	Project selection by PD	No separate project selection*	No separate project selection*	No separate project selection*	No separate project selection*
Awardee Selection					
Application Submission	One stage	Two stages	Two stages	One stage	Two stages
Evaluation body	Committee (Expert pool)	Programme Director	Individual assessors (Expert pool)	Individual assessors (Expert pool) In-house experts	Individual assessors (Expert pool)
Evaluation Criteria	Technical criteria and economic impacts (the detailed criteria differ in each country).				
Project Monitoring	• Yearly • Report & site visit • Committee	• Quarterly • Site visit • Programme Director	• Quarterly • Site visit • Monitoring officer	• Site visit • Independent assessors	• Report
Final Evaluation					
Evaluation Body	Committee (expert pool)	Programme Director	Monitoring officer	Independent assessors (expert pool)	Independent assessors (expert pool)
Evaluation Criteria	• Goal achievement (detailed criteria differ in each country).				
Evaluation Result	No determination	Success, Failure	Success, Failure	No determination	No determination

* Projects are selected in the process of awardee selection.

3.3. Standard challenges in evaluating the impact of programmes

This section briefly reviews selected issues relevant to assessing the impact of public support for R&D and other facets of innovation. Evaluation must address fundamental questions regarding the types of programmes that do or do not work, the design features that affect performance, and how well such public interventions perform on a number of efficiency criteria (such as the cost to the public purse of each unit of private R&D spending generated). The distinction needs to be drawn with monitoring and audit processes. These are forms of process control that examine issues essential for programme management, such as whether intended expenditures have been made, whether activities have been performed on time, etc. Studies of this sort are important, because poor operational practice can negatively affect programme performance. However, process control and other forms of audit should not substitute for economic impact assessment.

Evaluations of the impact pro-innovation programmes – from R&D subsidies to programmes aimed at fostering commercialisation – face a standard set of challenges. The ultimate aim is to attribute changes in a target group (usually firms, but also institutions and sometimes individuals) to the effect of a given programme or policy. Being able to attribute impact to a given programme is a first step in being able to assess the cost-effectiveness of the programme or project.

The challenge in trying to assess impact comes from the fact that simply comparing the situation of target groups before and after a programme is insufficient. This is because the programme or project may be only one among a number of causes of any observed change in the target group. The observed change in state in the target group is in fact a result of three sets of influences:

1. The impact of the programme or policy.
2. Unrelated factors – among many possibilities, influences unrelated to the programme might include changes in the policy context, trend changes in the target population (for instance, firms in a given sector might be operating on a learning curve, leading to improvements in performance over time), and fluctuations in the business cycle.
3. How the programme is observed - observations of a programme might focus on output or outcome variables that are inappropriate, for instance concentrating on employment outcomes rather than more suitable measures of innovation performance. Observations might be made too early or too late. Furthermore, biases in the way respondents reply to surveys can be problematic. For instance, survey respondents might exaggerate the benefits of a moderately beneficial scheme if they believe that this will increase the likelihood of future assistance. And large firms are more likely to respond to surveys than small firms. Observations might also fail to capture the full scope of programme benefits. This might easily be done, for instance, with programmes to stimulate R&D partnerships, where hard-to-quantify changes can occur in the behaviour of participants.

Estimating the counterfactual: What would have happened without the programme?

Identifying changes in target groups and attributing these to the effects of programmes requires knowledge of what would have happened without the programme. Without information on what might have happened to target groups in the absence of a programme, evaluators cannot know that it is the programme that was responsible for any observed changes in state (such as increased outlays on R&D). In other words, they cannot know what was truly 'additional' in the observed changes in the target group. Evaluations therefore need to identify genuine programme impacts by discounting changes coming from unrelated factors – such as credit constraints in the wake of the global financial crisis – as well as other changes in the target groups that would have occurred without the programme.

The beneficiaries of pro-innovation programmes usually undergo some form of selection procedure. Accounting for selection bias is a key part of understanding what would have happened to the target group without the programme. Selection bias refers to the possibility that there are some unobserved characteristics of target group members that cause them to be selected and which, at the same time, affect how they will perform in the programme. For instance, researchers with the best ideas might also be those who are most likely to receive government support for R&D spending (i.e. to be selected into a support programme). But they might also be more likely to perform well as regards various dimensions of R&D output: because of their good ideas they could have a better chance of attracting other sources of funding; they could have higher incentives to invest their own funds in their good ideas; and they might be more likely to generate good ideas in future.

Evaluations of impact essentially take three generic forms. Each has strengths and weaknesses in being able to identify unrelated effects, minimise selection bias, and accurately attribute impact. The appropriateness of each method should be fully appreciated before proceeding with an evaluation, and in some cases will require in-depth understanding of programme data and econometric method. The different approaches are as follows:⁶

1. *Experiments:*

Experiments generally represent the highest evaluation standard. Comparisons are made between firms or persons assigned randomly to two categories: those that receive the programme (the target group) and those that do not (the control group). Random assignment can sift out the influence of extraneous factors because these affect the target and control groups equally. Random assignment also minimises selection bias because selection occurs randomly: observed and unobserved characteristics linked to participation are equally present in the target and control groups. In the example of self-selection cited above, the pro-active forward-looking, risk-friendly entrepreneur is just as likely to end up in the target group as in the control group.

One of the strengths of random assignment is its intuitive appeal: policy makers and the public more broadly are generally familiar with the concept of randomisation, in part from knowledge of medical trials. However, a drawback to random assignment is that some potential programme participants must be overtly excluded from assistance. The method of random assignment might therefore be most acceptable in situations where there is excess demand for support.

2. *Quasi-experiments:*

Quasi-experiments compare the assisted firms or persons and a similar non-assisted group. However, unlike experiments, the process does not entail random assignment. The identification of a control group occurs after the programme has commenced. As described below, quasi-experimental evaluations have been performed on a number of pro-innovation programmes, including R&D tax credits and manufacturing extension services. The critical issues are how to control for selection bias and how to statistically identify a control group that is similar to the target group in terms of the mean, range and distribution of characteristics that affect programme outcomes.⁷

3. *Participant opinion and expert review:*

This approach involves members of the target group being asked for their assessment of how the programme has affected performance. Participant opinion can often be an unreliable source of information with which to evaluate programme impacts. To yield valid impact estimates, respondents would have to be able to correctly estimate what would have happened in the absence of the policy or programme.⁸ But unravelling the impact of a government programme from the many other determinants of innovative performance may be beyond the respondent's cognitive capacities. The estimation of benefits over time can be particularly problematic. For instance, evaluations of technical extension programmes in the United States show a tendency for firms to overestimate benefits immediately after assistance by comparison with views expressed later (Shapira, 2003). Another drawback to reliance on participant opinion is that participants may have reasons for responding strategically. For instance,

entrepreneurs might reply positively to surveys that will determine whether a soft-loan scheme is continued, regardless of the intended use of the funds. Respondents might also feel uncomfortable telling an assessor that a programme was ineffectual. And if innovation is part of a corporate marketing image, respondents might be reluctant to declare that public support is a driver of the company's innovation effort.

Despite their limitations in attributing impact, interviews with and surveys of participants are essential evaluation tools. Qualitative techniques can help shed light on less tangible programme benefits, such as changes in company research strategy. The qualitative information they yield can be useful in explaining why a programme has or has not worked, beyond quantitative measures of impact. In Norway for instance, Godoe and Nygaard (2006) point to system-wide factors that have impeded development of fuel cell technologies, beyond the impacts of a number of individual support programmes.

When preparing surveys, methods should be employed to maximise the response rate and minimise response bias. For instance, response bias might be reduced if there is anonymity among respondents. Oldsman (2000) also recommends that: the population to be surveyed should be clearly defined and an appropriate sampling strategy adopted. Survey questions should be worded clearly and address the entire range of programme effects, including immediate, intermediate and final outcomes. Explicit reference should be made to the counterfactual, with multiple questions asked for the same concept using different scales. Responses should be grounded in empirical data, while respondents should not be asked to make calculations. It is also important that the correct respondent is approached during a survey: the business unit that pays the fee to participate in a programme might not be the same unit that receives programme services.

The three generic evaluation approaches described above were presented in descending order of strength of causal inference, generalisability of results and cost. These are important considerations that have to be balanced. Public authorities should use the most rigorous evaluation technique that is practical. But budget constraints may preclude experimental approaches. The high cost of experimental methods means that they are most appropriate when the programme to be evaluated is large, or is new with the possibility of being significantly expanded. In practice, more than one evaluation method might be used to evaluate a given programme. Indeed, multi-method approaches can afford otherwise unattainable insight and credibility.

The choice of outcome measure

Evaluations of public support for innovation have generally sought to identify incremental or additional changes in three types of outcome:

- **Changes in inputs:** for instance, participating firms could increase the volume of their own resources dedicated to R&D or other innovation-related activities.
- **Changes in outputs:** innovation outputs might include patents or prototypes, an increase in skills, increased capacity for scientific or technological problem-solving, and changes in firm performance such as productivity, profitability, market share, exports, etc.

- **Changes in behaviour:** firms in receipt of support might undertake changes in collaborative practices, in other research strategies, in the management of R&D, in information search procedures, etc.

The measures chosen must be relevant to the initiative being assessed. That is, they must accurately reflect the concept being measured. They must also be reliable. That is, they must be subject to as little measurement error as possible. The practicality of data requirements must also be considered. For instance, many pro-innovation programmes aim to enhance productivity. There are a number of ways to measure productivity. These include output per employee, value-added per worker hour and total factor productivity. While total factor productivity is the most complete measure of productivity, its calculation requires data that are usually difficult to obtain. However, data on output per employee are easier to find (even if this measure of productivity could mislead, as a firm's productivity could appear to rise when it increases outsourcing). The choice of outcome measure will often entail trade-offs between relevance, reliability and practicality.

When to evaluate?

Deciding when to perform an evaluation is also important. Different programmes have different gestation periods. The impact of some programmes might be significant initially, but decline over time. Some initiatives offer the possibility of almost immediate benefits, such as schemes offering near-to-market funding solutions. Others require months or even years before change is evident, as can occur with collaborative R&D programmes. Programmes can also have long-term effects that go beyond the immediate objectives of the schemes. For example, in the United Kingdom in 1982 the Department of Trade and Industry provided a grant to a company named Acorn Computers to develop a computer for use in schools. Decades later, descendants of the technology created by Acorn still continued to be developed (Barber, 2009). Research teams in companies assisted by government may also need to move several times before they end up in a business fully able to exploit the results of their work. Indeed, a high-cost programme with long-term positive effects could easily fail a cost-benefit test if evaluated soon after programme implementation. Accordingly, the time period over which an evaluation is performed might need to exceed the duration of participation in the scheme by months or even years, depending on the type of programme being examined.

Early evaluation has the advantages that programme participants are easily reached, data and information can be more readily available and details of the programme more easily recalled. Firms that applied but were not accepted to a programme might be more easily traced. By contrast, late evaluation can encounter difficulties in data collection and in tracing key individuals. Late evaluations may also suffer from 'survivor' bias. Part of the solution to such problems is to ensure that good systems of data collection are built into programmes from their inception. If well designed, such systems need not impose significant reporting burdens on programme beneficiaries. Another response is to conduct an interim evaluation based on monitoring returns and/or a preliminary survey, with a more considered evaluation implemented later. It may be appropriate for instance to show that a programme has achieved certain well-chosen intermediate objectives or results which are known from academic research or case studies to be likely to lead to certain economic and social benefits. Whether an interim evaluation is appropriate could depend on a variety of considerations, including the policy cycle - noting too that time horizons can differ across stakeholders, including levels of government -, the resources available for evaluation, the size and significance of the programme and the burden which evaluation places on programme participants.

When the timeframe of expected impacts is greater than the period covered by the evaluation the evaluator may need to project the estimated benefits outside the period of the data. Smith (2004) notes that while theory or evidence from other evaluations of similar programmes can help to guide this decision; the best course will probably be to make cost-benefit estimates that assume multiple plausible durations for programme benefits.

Drawbacks to using performance standards as a measure of programme impact

Administrative performance standards typically consist of quantitative measures of programme outcomes (such as the number of firms that begin doing R&D). Their use has become more prevalent since the 1990s (being particularly important in the United States government as a consequence of the Government Performance and Results Act (GPRA) of 1993).

Performance standards have many uses. They can for instance provide managers with essential information on the extent to which a programme is meeting its institutional remit (for instance, to respond to information requests from firms within a given time period). However, reliance on performance standards as a proxy for impact estimates requires evidence of a systematic relationship between the two. But there is no reason why such a relationship should exist (see Smith [2004]). This can be illustrated by considering a hypothetical programme that aims to help small firms undertake R&D. Assume that the programme uses as its performance standard the percentage of firms that increase R&D spending within 24 weeks of participation in the programme. For this performance standard to serve as a valid proxy for the programme's impact it must be positively correlated with programme impact. But the reverse may be true. To see why, consider the extreme cases of firms which would increase R&D in the absence of the programme, and other firms that would never usually spend on R&D, but do so half the time when they participate in the programme. Assume too that in a given year the programme's beneficiaries include half of each type of firm: the easy-to-serve firms and the hard-to-serve firms. The programme's rate of "increased R&D spending within 24 weeks" is 0.75, because the easy-to-serve firms all do more R&D, as do half of the hard-to-serve firms. The programme's impact is 0.25 (reflecting the fact that the programme only creates benefits for the hard-to-serve clients). But in a second year the programme might only cater to hard-to-serve firms. Then, its rate of "increased R&D spending within 24 weeks" is 0.50 but its impact is also 0.50, because none of the hard-to-serve firms would have invested in R&D without the programme. In other words, achievement against the performance standard has fallen, but the impact has risen. For this programme, the performance standard provides a poor substitute for programme impact. Furthermore, the use of this performance standard provides a strong incentive for programme managers to choose to work only with easy-to-serve firms.⁹

Other challenges to impact evaluation relevant to public support for R&D

The assessment of impact of some types of support for R&D poses particular evaluation challenges. Outcomes may be hard to measure and may require that more than one evaluation strategy is used. Two cases are noted here: support for collaborative R&D, and public financing of R&D performed at public research institutes and universities.

A characteristic of many schemes to support collaborative R&D is that they entail multiple objectives. These can also be wide-ranging and difficult to measure (such as the disposition to collaborate). The evaluative evidence of benefits to collaborate R&D has

relied primarily on case studies. If it is correct to assume that policy failures are less likely to be published than policy successes, selection bias among these case studies may be a problem.

An example of an evaluation of a collaborative research initiative is provided in Georgiou and Roessner (2000). The authors describe an assessment of the National Science Foundation's Engineering Research Centre (ERC) programme in the United States. That programme seeks to encourage industry-university research collaboration. The evaluation employed case studies, a focus group of beneficiary companies, a survey of around 500 companies based on case study and focus-group findings, and follow-up phone interviews. Some notable results relevant to survey-based evaluations of support for collaborative R&D were that:

- Often, only a small number of persons in each firm were in a position to assess the benefits of participation. Consequently, the nature of each respondent's involvement with the programme needs to be established at the outset;
- The business unit that pays for programme participation was not necessarily in a position to judge programme impacts;
- Most companies had not tried to place a financial value on the benefits of participation (a finding common to evaluations of other innovation support programmes). Rather, companies evaluated participation as a dynamic process giving rise to an array of possible benefits that changed over time.

With respect to evaluations of support for R&D at public research institutes and universities, Cozzens et al. (1994) examined the methods that have been used and grouped these into three categories:

- *Research outputs measured in patent counts, citations, bibliometrics, etc.:* a large literature examines the usefulness of such output measures and shows that each measure has strengths and weaknesses. For instance, biases in patent counts arise from: differences across technologies and sectors in the importance of patents as a source of protection against imitation; and differences across firms in the propensity to patent, particularly in the patenting of unimportant innovations (Pavitt, 1988).¹⁰ Despite drawbacks to the use of patent counts, citations and bibliometrics, a set of such indicators taken together can provide valuable information on programme effectiveness and efficiency. Difficulties exist, however, in relating this set of output measures to economic and market outcomes.¹¹ It is these outcomes that are of greatest interest to policy makers concerned with the allocation of public resources.
- *Retrospective tracing of the knowledge inputs to a particular innovation:* such approaches can shed light on the relative contribution to an innovation of different sources of knowledge as well as the role of different sources of institutional support. However, this approach also has drawbacks: subjective judgement is called upon to assess the importance of different inputs to the innovation process; the method is costly; and the scope of the impacts from R&D is underestimated. This restriction of scope occurs because the method takes single products of R&D – a particular technology – and traces backwards to their multiple inputs. A more complete picture would trace R&D inputs forward to their multiple outcomes. Furthermore, such outcomes can even include research dead ends, because these also provide valuable information for innovators (Georgiou and Roessner, 2000).

- *Changes in productivity, national income or social welfare.* A number of studies indicate that public R&D spending is positively related to growth in output and productivity. Typically, a production function approach is used, where public R&D is one of a number of inputs in equations explaining productivity or growth. Guellec and van Pottelsberghe (2004) offers an example of this approach, and distinguishes the effects of private sector, public and foreign R&D on productivity and growth in 16 countries between 1980 and 1998. However, not all support for R&D aims to foster economic growth (support for medical research, for instance, does not usually have this goal). Furthermore, the relative contributions of basic and applied research – which is important for policy analysis – can be difficult to disentangle.

Various studies attempt to estimate a social rate of return to investments in R&D. These measure social benefits as the sum of consumer and producer surpluses.¹² However, calculating these surpluses requires information on supply and demand curves, which is conceptually problematic when entirely new or radical innovations are generated (Georgiou and Roessner, 2000). Furthermore, being based on individual case studies, such studies are costly and also hard to generalise from. Externalities from the R&D are likewise difficult to capture. And uncertainties exist over the correct discount rate to use, given that benefits to R&D might accrue over long periods (the duration of which might be unknowable *a priori*).

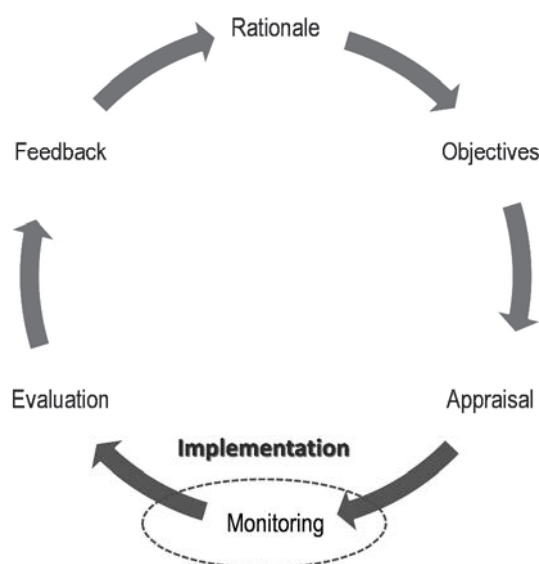
The methodological constraints noted above suggest that multi-method approaches – combining case studies and the various forms of econometric research – are required to best estimate the returns to public support for R&D.

3.4. Principles and practices in managing evaluation findings: Insights from international experience

This section discusses the role of evaluation in the programme and project management cycle, with particular reference to the system and practice in the United Kingdom, but also drawing on experience elsewhere. Starting from the role of evaluation in the policy cycle, it discusses the various uses of evaluation evidence and suggests some principles for the effective use of evaluation findings and ways of organising the evaluation framework. It concludes with a discussion of how an evaluation culture can be fostered and the scope for creating institutions for enhancing the use of evaluation.

The role of evaluation in the policy cycle

Figure 3.6 sets evaluation in the context of the policy-making cycle and is drawn from the Magenta Book guide to evaluation used by the United Kingdom Government (HM Treasury, 2011). As the figure illustrates, appraisal, monitoring and evaluation are integral parts of the broad policy making and delivery cycle, sometimes known as the ROAMEF (Rationale, Objectives, Appraisal, Monitoring, Evaluation and Feedback) cycle.

Figure 3.7. The role of monitoring and evaluation in the policy cycle

Source: Drawn from HM Treasury (2011), “The Magenta Book: Guidance for Evaluation”, HM Treasury, London, April 2011.

Key to the effective operation of this cycle is that evidence generated from monitoring and evaluation can be used to build on analysis undertaken at the appraisal stage by testing and refining the assumptions made. This applies not just at the conclusion of the programme. It can also occur throughout the whole policy and delivery cycle to help track progress and offer real-time identification of barriers that could inhibit successful delivery. Effective management systems for evaluation need to ensure that the processes for feedback from monitoring and evaluation are robust.

Uses of evaluation evidence

The Magenta Book, employed in the United Kingdom, identifies four ways in which evaluation evidence can be used:

- To inform immediate decisions about policy options (for example whether to roll-out a pilot as a national or local programme);
- To inform longer-term decisions about the policy/programme (for example providing input to government spending reviews and the future scale of investment);
- To inform how the programme/policy could or should be improved, for example if the evaluation identifies major flaws; and
- To inform how future policies should be designed and implemented.

Examples can be found around the world of good practice in each of these applications. For instance, in the Netherlands, the design of the innovation voucher scheme evolved through various pilot programmes whose results were evaluated. In the United Kingdom, recent capital spending allocations to government departments were in part based on evaluation evidence for past programmes presented to the Treasury. As an example of how policies have been improved, the early monitoring and evaluation of one of the United Kingdom’s interventions in response to the economic and financial crisis (an export insurance guarantee product) led to the correction of a design flaw in order to ensure that the market failure was properly addressed.

Sometimes the link to future policy development may not be immediately obvious. In the case of R&D, formal and informal evaluation contributes to the body of corporate knowledge. Policy makers draw on this knowledge in making decisions about the amount of resources to devote to R&D, how much to devote to each programme, the choice of research themes meriting support and the selection of individual projects. In these processes, and notwithstanding the simple representation shown in Figure 3.3, the use of evaluation evidence is not a linear or closed-loop process.

Principles for effective use of evaluation¹³

Securing stakeholder involvement

If evaluations are to have influence, stakeholders, including senior officials and analysts responsible for policy and programme development, should be involved from the outset. Various approaches can help to secure staff ownership and buy-in. Staff involved in policy decisions on R&D and resource allocation can be appointed to evaluation commissions or be involved through steering or advisory groups. Staff involved in project selection and project design can be brought into the planning, selection, design and guidance of evaluations. The determination of evaluation outcomes can be designed as a learning process through the use of participatory evaluation methods and dialogue with users and staff. Such mechanisms can improve evaluation quality and also create consensus and ownership in a change process. However, care should be taken to avoid the risk of capture or participant biases.

Maintaining links with decision-making processes

Evaluation should not be a box-ticking exercise or an objective in itself. It should be relevant and address issues that are significant for political, budgetary, management and other strategic reasons. The proposed use of evaluation should be clearly defined at the outset. Building requirements for evaluation into policies from the start, and defining the objectives, will improve the usefulness of evaluation and facilitate planning and data collection.

It can also help to institutionalise an impact evaluation system with strong buy-in from key stakeholders if there is a powerful central government champion who can help make the case for undertaking evaluation and make sure that the results are used. Finance Ministries and Planning Departments have an important role to play in this, for example by insisting that evaluation evidence is brought forward before decisions are made on future resource allocation.

Where relevant, an evaluation plan should be agreed with key policy makers to maximise the likelihood that evaluation results will be applied to policy development. The evaluation plan will include an agreement on how and when interim and final results will be disseminated and feed into the policy cycle. Particular attention should be placed on project and policy cycles to identify entry points for use of evaluation results. An evaluation plan should include the explicit identification of the processes for feeding results back into policy and programme design.

Communications planning

Clear and well communicated messages increase the likelihood that evaluation studies will have impact. It helps when the evaluation results point to clear policy implications. A good evaluation will have a limited number of well-focused conclusions and recom-

recommendations that flow logically from the analysis. The recommendations should be realistic, relevant and preferably prioritised, distinguishing the most important and best-evidenced recommendations from those that are more difficult and/or controversial.

Evaluation reporting may need to be targeted to the intended users and to specific audiences. In more complex cases, this may require both a technical annex to establish credibility with an expert audience and a non-technical annex to bring out the main conclusions for policy makers and the wider public.

Effective dissemination of evaluation findings is also essential. One reason that many potentially useful evaluations are never used is that few people have ever seen them. This can be avoided if there is continuous and targeted communication with the intended users to build interest and confidence and ensure there are no surprises at the time of the final report. There is also value in regular communication and dialogue through, for example, one-to-one briefings, workshops and short briefing papers.

Publication of evaluation reports increases credibility, stimulates wider dialogue and debate and creates pressure to act upon findings. It also helps build trust and confidence in the process if evaluation findings are presented in language that focuses on overcoming problems rather than on assigning blame.

Placing evaluation data in the public realm, possibly in anonymised form, could facilitate (cost-free) academic analysis and serve as a form of evaluation quality control. Furthermore, in the pluralistic policy systems that characterise OECD countries, evaluation should be expected to serve the knowledge needs of a wider set of actors beyond programme managers and public policy officials.

Requiring a management response

The requirement for senior managers to publish a formal response to evaluation findings is one way to ensure that evaluation studies are not ignored. In the United Kingdom, at least one government Department requires a formal management response for all its evaluations. Managers are required to set out their agreements or disagreements with each key finding, conclusion and recommendation, giving reasons and setting out what action will be taken. Management's responses are published as part of an annual Directors' Statement of Assurance. Beyond this, senior management should also be given the opportunity to reflect more generally on the lessons from evaluation evidence – this can be encouraged through regular opportunities for board-level discussion, whether as part of a formal evaluation strategy or in the context of wider strategic planning.

Building knowledge management systems

Knowledge management systems are no substitute for good communication but can be an important adjunct to it. Access to a structured database of evaluation findings in a computer-searchable format makes it easier for analysts and policy makers to make more use of evaluation findings in policy and programme development. In the United Kingdom, the Department for Business Innovation and Skills (BIS) is creating a depository of evaluation evidence. In the case of R&D funded by the Research Councils, Research Councils in the United Kingdom ask researchers and/or institutions to submit information about their research through an online system. Most of the Research Councils use the Research Outcomes System (ROS), a web-based system which collects data on the outputs, outcomes and impacts of research, such as: publications; other research outputs such as new materials, exhibitions and websites; staff development; collaborations and partnerships; communication and dissemination activities; and summaries of impact.

However, the findings of single evaluations may not always be applicable more widely. Meta-evaluation studies or other forms of systematic review are also required in order to identify broader lessons. This is particularly important for longer-term decisions about spending allocation, research themes and the strategic direction of R&D policy.

Organising the evaluation framework

This section discusses good practice in improving the organisation of evaluations and frameworks for their use across the public sector.

Managing evaluation activities strategically

It is essential to take a strategic approach to evaluation, focusing on the major areas of spending and tracking the indicators and impacts that will guide strategic decision-making. It is good practice to set out an evaluation strategy that will make clear what the evaluation priorities are, describe the evaluation framework and promote greater openness, awareness of and credibility of the evaluation activities. Box 3.5 gives an example of an R&D evaluation system in Spain. Several government Departments in the United Kingdom now publish their evaluation strategy.

Box 3.5. An evaluation tool for R&D in Spain

The Integral Monitoring and Evaluation System (SISE) was introduced in Spain in 2008 as a tool for controlling the management of publicly funded RD&I programmes, making them more transparent and giving the general public and Spanish society a better understanding of the activities being financed with public resources. The SISE was integrated into the Spanish National Plan for RD&I 2008-2011 as a mechanism for following up and evaluating research and innovation policies, incorporating *ex-post* evaluation of R&D programmes into reviews of current activities and identifying the need for new initiatives.

The main goals identified for the system were:

- To establish a logical framework capable of linking, on a rational, global and hierarchical basis, the goals set out in the National Plan with the instruments identified for achieving them.
- To put in place a monitoring and evaluation system that covers administrative issues as well as technical and strategic aspects.
- To identify a battery of indicators for each instrument that enables a simple analysis to be made of the degree of achievement of the goals established and assessment of the outcomes and their impact on the Spanish science and technology system.

For *ex-post* evaluation, the National Plan called for the final outcomes of projects to be incorporated into the SISE tool in computerised form, enabling immediate online use, with the aim of applying criteria of productivity, additionality, efficiency and effectiveness to science and technology policy, and elaborating a Results Evaluation Programme, known as PROEVAR.

Analysing general indicators of the National Plan, INGENIO 2010 and the National Strategy for Science and Technology, as well as indicators from the evaluations of the activities started up under them, the system was designed to help define proposals for new activities and funding and to provide mechanisms for the *ad hoc* supply of information needed by decision-makers.

Source: Fernandez de Labastida J.M. (2008), "Presentation to OECD Symposium on international comparison of the budget cycle in R&D and innovation policies", Madrid, July 2008.

www.oecd.org/gov/budgeting/symposiumoninternationalcomparisonofthebudgetcycleinrdandinnovationpoliciesjuly2008.htm

Special attention should be given to evaluation of activities that cut across many organisations. Central government agencies play an important role in managing the evaluation process. However, the actual evaluations can be decentralised to actors at all levels of government. Ideally, major programmes should have funding earmarked for *ex post* evaluation as part of the programme budget. However, special funds for financing evaluations can serve as an important incentive for policy evaluation.

Choosing the right evaluator

One choice that has to be made in setting up an evaluation framework is between internal and external evaluators and their degree of independence. Evaluation can be carried out by those responsible for managing the programme, by central teams within the funding department (for example, central analysis, audit or strategic planning teams), by other Ministries with an oversight function (for example, Finance or Planning Ministries) or by external bodies (for example research institutes, management consultants or academics). Comparing these evaluation arrangements, OECD (1998) concluded that:

“**Self-evaluation** by an organisation is appropriate when the main objectives are organisational learning and improved implementation. However, the time and skills of staff may be insufficient, the range of issues covered may be limited and the credibility of findings may also be questioned. Evaluation by **central management agencies** is appropriate when the objective is improving budget priorities and when it is important that the evaluator has close links with decision-making processes. Evaluation by **external evaluators** is appropriate when the objective is to provide new perspectives on public policies or when there is a need for specialised evaluation skills. However, these evaluators may have limited understanding of the substance and the culture of the evaluated policy or organisation and offer theoretical evaluations.”

Fostering an evaluation culture

The government has the most important role to play in fostering an evaluation culture that encourages adaptation to a changing environment. The basic message should be that, to stay relevant, organisations need to continue learning from feedback about results. Support for evaluations is demonstrated through leadership from the top and in particular the willingness of politicians, policy managers and central management agencies (for example central research Ministries and/or the Ministry of Finance), to make effective use of policy advice generated in evaluations.

It is obviously important to counter institutional barriers to evaluation, such as possible internal resistance from programme managers wary of the possible ramifications of negative findings. In this connection, evaluations that reveal problematic outcomes should not provide automatic grounds for termination of a programme. Rather, evaluation should be viewed as a tool to provide a basis for improved policy.

Creating institutions for embedding better use of evaluation

The creation of independent institutions with the formal role of synthesising evidence for policymaking is one way to help embed evaluation into the policy making cycle. There are a number of models for this around the world, with varying degrees of independence. Examples include: the National Bureau of Economic Analysis (CPB) in the Netherlands; the Productivity Commission in Australia; the Agency for Growth Policy Analysis in Sweden; the Washington State Institute for Public Policy in the United States

and the new What Works Centres initiative in the United Kingdom, established in 2013. A network of 'What Works Centres' covers diverse social and economic policy fields. Together these Centres address over GBP 200 billion of public spending and are intended to provide high-quality syntheses of research evidence on the effectiveness of interventions in each field (Box 3.6).

Box 3.6 'What Works Centres' in the United Kingdom

Each "What Works Centre" will be independent of government, with a clear and relevant policy focus. Each will:

Generate evidence syntheses

Undertake systematic assessment of relevant evidence and produce a sound, accurate, clear and actionable synthesis of the global evidence base which: i) Assesses and ranks interventions on the basis of effectiveness and cost-effectiveness; ii) Shows where the interventions are applicable; iii) Shows the relative cost-effectiveness of interventions; and iv) Shows the strength of evidence on an agreed scale.

Translate the evidence

Produce and apply a common currency for comparing the effectiveness of interventions.

Evidence absorption

Publish and disseminate findings in a format that can be understood, interpreted and acted upon.

Promote good evidence

Identify research and capability gaps and work with partners to fill them. Advise those commissioning and undertaking innovative interventions and research projects to ensure that their work can be evaluated effectively.

Source: The United Kingdom Government website, www.gov.uk/what-works-network (accessed on September 2013)

In the Netherlands, the National Bureau of Economic Analysis (CPB), established in the late 1940s, is tasked both with macroeconomic forecasting and the evaluation of government and opposition policies. Although formally part of the Ministry of Economic Affairs, the CPB has earned a worldwide reputation for independence and objectivity. The existing Korean Institutes, or a new institution, could have a more formal role in the synthesis of evaluation and other evidence for R&D policy, along the lines of the institutions described here.

3.5. Assessment and discussion of possible ways forward

The Korean system for R&D (and policy) evaluation is in many ways well developed, systematic and comprehensive. In this field of government policy, the existence of such an encompassing evaluation system is in some ways unique among OECD countries. However, there are a number of observations on the operation of the Korean evaluation system that policy makers should consider:

- *The R&D evaluation system should evolve further in the direction of providing intelligence for strategic economic policymaking and the development of the national R&D and innovation system.* In general, the present R&D evaluation system appears to facilitate "transparency" of fund allocation and expenditure – as required by law – rather than to provide intelligence for strategic economic policymaking and development of the national R&D and innovation system. Feedback from evaluation into policymaking is certainly built into the overall

system. However, the evaluation process mainly seems to generate much descriptive content. Discussion with Korean counterparts suggests that quantified evaluation criteria – with too much of a focus on outputs rather than outcomes – might also be missing some important but less easily quantified research outcomes. Although there is clearly evidence of good practice in *ex post* evaluation of R&D programmes, and while this goal is inherently challenging, relatively little is done in the way of true economic impact evaluation (for instance using experimental methods).¹⁴

- KISTEP plays a central role in R&D evaluation, conducting regular exercises for MSIP (with NSTC and MOSF as major supervisors and stakeholders) and other Departments. STEPI – an independent policy think-tank under the NRCS (National Research Council for Economics, Humanities and Social Sciences) of the Prime Minister's Office – operates at arm's length, conducting independent evaluation research concerning strategic issues affecting the national R&D and innovation system, though not part of the regular decision-making hierarchy and procedures.¹⁵ For example, STEPI conducts an annual 'Innovation Survey' as well as *ad hoc* programme and policy-level evaluations. The overall evaluation effort in Korea could benefit from more strategic policy analyses of the sort produced by STEPI.
- With the recent institutional reorganisation, the NSTC has lost its 200-person strong support structure. It depends on MSIP and KISTEP for appraisals. KISTEP, however, currently works under strict and short time deadlines that do not allow the longer term impact assessments (both *ex ante* and *ex post*) which would enable it to give effective programme intelligence to NSTC.¹⁶ MSIP is reportedly trying to increase the budget for in-depth evaluation.
- *Evaluation metrics must be developed to accommodate long-term time horizons.* There is a concern that the evaluation system may be encouraging too short-term a focus in research. There is an over-emphasis on short-term results (one year or even six months), creating a bias against basic research in favour of industrial R&D. KISTEP is seeking to develop methods for long-term impact and is trying to do more on measuring direct outcomes, as a proxy for long-term impact. However, it appears that relatively little progress has been made.
- *Care needs to be taken that the desire to measure and control does not stifle autonomy.* There is also concern about the impact the evaluation system may be having on the autonomy of scientists/researchers. Researchers are reported to feel there are too many rules governing issues of process, and want more autonomy in research. Clearly, there is a balance to be struck between the autonomy of researchers and setting strategic direction to meet economic challenges and other societal goals. Government priorities may differ from those of the scientific community. However, if creativity is to be encouraged, concerns about autonomy will have to be addressed. One way to address such tensions is to stimulate competition between government funding areas and between funded (and evaluated) institutional actors. An example of the latter is the German 'Excellence Initiative'. This Initiative is organised as a competition between universities for increased funding, on the basis of submitted proposals about self-chosen research priorities, and is evaluated by international academic peers.¹⁷ Another example is provided by the 'Programme-oriented funding' of the German (GRI-like) institutes of the Helmholtz Association: since the early 2000s Helmholtz no longer invests government resources in individual institutions, but rather funds Research Programmes that compete with each other for funding.¹⁸

- *R&D evaluation should help to assess effectiveness and usefulness beyond just short-term results of R&D funding.* KISTEP's (and other Korean actors') R&D evaluation work is largely based on various quantitative indicators and statistical evidence of investments and achievements. While this is very useful and can be state-of-the-art, there is nevertheless a need to critically reflect the (often reductionist) content and the sometimes problematic social effect of certain indicators, e.g. when rigorously applied for decisions about career development of researchers and allocation of funds for (risky) creative research (Rip, 2011). Creative research and innovation-friendly environments need leeway (e.g. discretion in resource allocation and work planning in research teams, along with the fostering and appreciation of intra-group and interdisciplinary collaboration) (Heinze *et al.*, 2007). R&D evaluation evidence and procedures should reflect this. So short-term output pressure should be avoided, depending on the institute/groups' mission, and longer lead times allowed. Qualitative as well as quantitative indicators should be used, referring for instance to the relevance and outreach of research in the wider societal and economic context.
- R&D evaluation exercises should help to understand strategic policy options concerning the R&D and innovation system's strengths, weaknesses, opportunities and threats. It is evident that R&D evaluation should operate as objectively as possible. However, generating and using evaluative information for decision-making is inevitably also subject to the involved actors' strategic interests and perspectives. The relative role and value of R&D policies and projects differs across the various groups in society and the economy, such that what might be evaluated as 'excellent' in the view of some actors may be assessed as negligible by others. For example, proven strong performance in basic science may be of high long-term value for society at large, while manufacturing SMEs would give greater value to short-term research-based contributions to product innovation. As a consequence, evaluation should be understood as one of several tools helping the sometimes competing and negotiating actors in the policy-making system to achieve insights that facilitate decision-making. Hence, there is a need for distributed "strategic intelligence", i.e. a diversified community of public (governmental and academic) and private experts in R&D and innovation policy analysis (Kuhlmann *et al.* 1999).
- Following from the preceding point, *there is a need to increase the number of persons in Korea with policy evaluation expertise.* In Korea, KISTEP plays a proven and indispensable role as provider of high-level evaluative information, yet KISTEP is a governmental organisation, tasked by law, with limited independence and leeway. As noted above, KISTEP's highly valuable work is complemented by STEPI and other institutions and academics which can act as more independent analysts and think-tanks. Yet, the community of skilled and independent evaluators in Korea is still too small. In other OECD countries national associations of R&D evaluation professionals have been established, *inter alia* helping in talking with Ministries as regards codes of conduct, guidelines, and quality standards. In Korea there is no such association yet (although there are many evaluation study groups focusing on specific issues). A Policy Analysis Evaluation Association exists, but this is not focused specifically on R&D. A national association of R&D evaluation professionals should meet once or twice a year and exchange ideas and skills and help to further develop the labour market for R&D evaluation experts. This happened earlier as a bottom-up development in the United States and in Europe (for instance: the R&D-related Topical Interest Group in American Evaluation

Association; the Washington Research Evaluation Network; a working group on R&D Evaluation at the German Evaluation Association¹⁹; and, the Austrian Platform on Research and Technology Policy Evaluation²⁰). The NSTC in Korea could take a role in catalysing such an effort. A good example of a positive role for policy in this regard is provided by the Austrian Platform which was set up in 1996 and is co-sponsored by the relevant Austrian ministries and research funding organisations.

- *The evaluation system will need modification if services-sector R&D receives greater public support.* Chapter 5, and other sections in this report, describe the attempts being made to increase the scale and productivity of the Korean services sector. If, in this connection, there is an increase in government support to services-related R&D then adjustment to aspects of the evaluation system will likely be needed. The current evaluation system, focusing on manufacturing sectors and technologies, is, as described here, comprehensive but requiring further flexibility. If KISTEP were to use the same quantitative metrics with patents and publications, but for services-oriented programmes, the results would likely be disappointing. The basic reason for this is that innovation in services exhibits characteristics which often differ from those in manufacturing. These include: an often closer relationship with clients; greater recourse to social sciences; more collaboration across organisations (open innovation); less use of traditional IPR protection; a focus on changes in business methods (see for instance Miles, 2005 and OECD, 2007). It is even unclear whether the classic organisation of public R&D programmes (i.e. thematic orientation, call for proposals, co-funding) can accommodate the direct needs of the services sector.²¹

Evaluation of the GRIs

A “system evaluation” of the GRIs is recommended. There is a widely shared concern that the GRIs, which had played crucial roles during Korea's catching-up in recent decades, need a strategic reorientation. The overall functioning and appropriateness of the GRIs in the national innovation system (embedded in global competition and collaboration) should be critically assessed. A “system evaluation” of the GRIs is recommended, with a view to future innovation system needs – from basic research, through problem-driven and demand-led research, to technological innovation and commercialisation – that should be met with the help of public sector organisations. As a result of such a “system evaluation” of the GRIs, different missions could be identified, potentially suggesting different future institutional setups: a possible major public organisation for basic research, lining up with research universities; a public organisation for problem-driven and demand-led research, linking up with research universities, industry and societal organisations; and a vehicle for commercialisation, linking up with industry (including SMEs), KIAT, and Technology Holding Companies. In several European countries such “system evaluations” of larger national settings have proven extremely useful (e.g. in Germany in the late 1990s; Norway, Finland in 2000s and more recently) (see for instance Arnold, 2004). A “system evaluation” should be launched by NSTC or MSIP. Furthermore, by focusing on output rather than outcomes/impacts the existing evaluations do not help in the strategic objective of GRI reorganisation.

Ex ante and project evaluation

The terms of the *ex-ante* evaluation process directly relate to funding decisions for R&D projects and programmes and thus to the likelihood of achieving key aims of the Creative Economy Strategy. In terms of *ex ante* appraisal, various changes are under way designed to improve the quality and relevance of R&D projects funded. While the Government does not typically select projects, it plays a major role in determining the programmes for agencies to run and issues guidelines to the agencies on the selection of projects. Changes reported to be under way with respect to R&D projects include:

- Project selection will be more informed by surveys of market demand, drawing on private sector views, rather than simply being chosen by scientific expert panels. The criteria used in appraising project proposals will include technological potential (including spillover effects), with the weights varying according to the programme. The greater role of market demand in appraisal runs the risk of a greater focus on short-term outcomes rather than longer-term impacts, and this will need to be carefully balanced in the process.
- A greater share of the research budget will go to SMEs, particularly those with higher job creation potential. It is unclear, however, how job-creation potential will be assessed. A priori identification of job-creating firms is a highly problematic undertaking in any context. Moreover, in most OECD countries the share of the SME population undertaking R&D is low – perhaps in the order of 3% of all SMEs. So policy would be right to correct any prior biases that have led to SMEs being underserved with respect to support for R&D. But, unless care is taken, policy may be misplaced, and project selection could be complicated to no good purpose in linking overall job creation with SME R&D.
- There will be a greater risk appetite in R&D projects and in particular a willingness to tolerate what is described as “failure deserving a second chance” (i.e. failure that results in research outcomes that do not significantly contribute to knowledge creation, but which is the result of diligent and scientifically sound practice). “Failure” in research can of course be a productive outcome, if learning occurs in the process (see for example Denrell, 2003). It is reported that the past success rate of publicly supported R&D projects was around 80%, sometimes higher, which was felt to indicate that project choice in the past had been too conservative.²² Guidelines to agencies will change to encourage them to select riskier projects and not stigmatise failure.
- *Care will need to be taken to ensure that the greater tolerance for failure produces in the medium to longer term a higher average rate of return to projects and not just an increased number of unsuccessful projects.* A number of points should be noted in this connection:
 - There is no certain way of ensuring this. However, project selection processes can certainly be adjusted to reflect higher technical risk and the chances of market success. For instance, evaluation panels can be constituted by technical experts (ideally of younger age) and business experts (ideally with long market experience such as retired company managers) and such panels can work independently of each other without sharing information on specific proposals. At the end a mixed panel would examine the combined grades on the basis of some predetermined formula that weights technical and market risk. In the United States, The Advanced Technology Programme of the National Institute for Science and Technology has experimented with such panels.

- ‘Failure’ may mean several things. It may mean technical failure (the research did not produce new knowledge) or failure in terms of realising a marketable innovation. Failure might be the result of too early an introduction of a technology in an unprepared market. Failure could also mean that the original technical idea is correct but the proof of concept when trying to turn this idea into a specific product failed. Accordingly, project evaluation criteria need to clearly specify the meaning of the term “failure” for proposal reviewers. The definition of failure could differ across projects depending on project objectives. If the meaning of the term “failure” is not clearly specified, then the reviewers will decide on their own what it entails and the result could be inconsistent and/or misleading evaluation findings.
- *The Korean system of ex ante evaluation is systematic and elaborate, but also has some features that may need to be reconsidered in the light of international best practice.* First, unlike practice in many other countries, in Korea, the lead for identifying potential projects lies in large part with the responsible agency, KEIT, rather than with the research performers – both firms and research institutions – that submit promising proposals for appraisal. This contrasts with experience in most OECD countries. Second, a separation is made in the appraisal process between identifying a promising R&D project and approving a team that would carry out the project. Such an approach may be appropriate for government R&D procurement, where government is the ultimate client, but seems ill aligned with the desire to support promising ideas emerging from research performers. Third, the process of *ex-ante* evaluation in Korea includes an extensive process of hearings and committee work. This process can help build consensus on key priorities, but may lead to a focus on safer projects that fit into the mainstream, rather than also making room for risky projects that are more likely to emerge from smaller and less central actors in the innovation system. Such features may stem from the desire of the government to steer and control the direction of research and innovation, but are not well aligned with a highly advanced economy where good ideas can come from anywhere and where the government will need to leave more autonomy to independent actors that are better able to identify promising areas for research, including possible new markets.
- *The awardee evaluation process might be improved so as to enhance the impact of R&D funding.* The information presented in this chapter pertaining to KEIT and the process of project assessment shows that Korea spends several months to identify the projects to be performed, but only a couple of hours to select who will implement the project. None of the case-study countries - except Korea - have separate project selection procedures. In Korea, however, awardees are selected to implement projects which have themselves been chosen through a previous selection process. The selection of awardees takes a relatively short time to determine. In other countries, awardees are selected in tandem with the project (under broad programme headings), and this selection involves considerably more time than in Korea: several weeks in the United States (for ARPA-E); 2.5 weeks in the United Kingdom (for the TSB); 10 days in Israel (Office of the Chief Scientist); 8 weeks in France (ANR).
- In Korea, more time could be given to members of the assessment committee to review selection of the awardee. Committee members are not provided with the application documents until the day of the committee meeting. Accordingly, much of the review is based on the applicant’s presentation and a period of Q&A, in which the outcome may depend in part on the applicant’s presentational abilities,

rather than on the actual quality of the proposals. In addition, since the reviewers are only allowed to assess the applicants in the committee meeting, a forceful reviewer might disproportionately influence the other reviewers' decisions. In the United Kingdom, Israel and France the assessors are allowed to access and review the application individually and with considerable time. The assessment procedure in Korea may be insufficient in terms of the time available for individual review and so could hinder funding decisions. Furthermore, this possible unwelcome outcome is made more likely because in Korea an unsuccessful applicant's complaint is rarely accepted. By contrast, in the United States, ARPA-E even allows the applicants to read reviewers' comments and to provide a rebuttal that the Agency considers before making its funding decision. Benefits might be had if Korea modified the current practice, introducing a system whereby assessors can examine the applicant – the potential awardee – and his/her proposal for implementing a project, over a longer period of time and individually.

- *The link between different stages of evaluation might be strengthened.* KEIT has a thorough evaluation process as regards ongoing and completed projects. A mid-term review committee conducts a mid-term evaluation of the project every year, based on the project awardee's mid-term report, and based on an on-site evaluation by Programme Directors and external experts. It is also stipulated that the composition of the mid-term review committee, and the experts chosen to undertake a site visit, must include a member of the project awardee selection committee. KEIT also uses 'stop/continue' decisions based on mid-term evaluation results. However, the link between evaluation stages might be strengthened. In particular, the final evaluation committee does not include a Programme Director. The United States (ARPA-E) and the United Kingdom (TSB) may have better practices in this connection. At ARPA-E, Programme Directors are responsible for the entire project process, from selection, to mid-term and final evaluation. In the United Kingdom, a monitoring officer who is contracted by the TSB takes charge of the monitoring and of completing a final report on the project. KEIT could allow Programme Directors to participate in the final evaluation process, or appoint a project monitoring expert who participates in the final evaluation process as well as the monitoring.
- *Efforts might also be strengthened to connect technology to the market.* As with other case study countries, Korea puts an emphasis on the commercialisation of R&D projects. All of the criteria from awardee selection to final evaluation include points relevant to commercialisation. However, Korea could take lessons from the practice followed by ARPA-E. ARPA-E has in-house 'technology to market' advisors as well as Programme Directors. The advisors provide awardees with practical training and critical business information to equip projects with a clear understanding of market needs to guide technical development and help projects succeed. Awardees are required to provide a technology-to-market plan prior to receiving an award and to work closely with ARPA-E's technology-to-market advisors throughout the project, developing custom strategies to move projects toward the marketplace. In addition, ARPA-E facilitates relationships with investors, government agencies, small and large companies, and other organisations that are necessary to move awardees to the next stage of project development. In Korea, the implementation of MOTIE's commercialisation policy is conducted by KIAT, separately from KEIT's R&D support. Korea might benefit by enhancing cooperation between the two institutions or employing the in-house technology-to-market advisors in KEIT so that the technologies developed through public R&D support move efficiently toward the market.

Notes

1. KISTEP produces guidelines for meta evaluation for all ministries. It introduces these at the beginning of the calendar year in a public hearing. KISTEP also plays a key role in supporting MSIP to utilise evaluation tools.
2. MOTIE's industrial technology R&D does not include regional and energy technology R&D which is implemented by KIAT and KETEP respectively.
3. The pool of professional examiners consists of 100 to 150 experts from various fields and the pool is updated through public offering once every three to four years. The examiners can hold other jobs and receive the equivalent of USD 43 per hour. Vocational ethics are also emphasized and the pool is controlled and managed by Heads of Departments
4. The professional agent in OCS.
5. Such as efficient resources management and adaptation to climate change, clean, secure and efficient energy, industrial renewal, health and well-being, food security and demographic challenges, sustainable mobility and urban systems, information and communication society, innovative, inclusive and adaptive societies, freedom and security of Europe, its citizens and its residents
6. This overview draws on Oldsman (2004).
7. Quasi-experiments take many forms. The choice of statistical model must fit the type of data being analysed. Statistically equated controls use multivariate regression techniques to ensure that the target and control groups are as similar as possible with respect to outcome-related characteristics (selection bias is accounted for using two-stage regression, instrumental variable techniques or propensity score matching; Heckman and Robb, 1985). Regression discontinuity offers analytic insight by exploiting differences in the probability of selection to the target group. For example, applicants for an R&D grant might be ranked in terms of the quality of their submitted proposals. Assuming this can be done in a consistent way, a quality threshold could be set. Proposals below the threshold are rejected. The difference in outcomes between applicants with accepted proposals and those with rejected proposals is compared, statistically adjusting for the selection variable (proposal quality). Less sophisticated approaches use generic controls, for instance comparing a target group of firms with the entire population of firms in the sector concerned, or matched controls, identifying members of the control group based on their possessing key shared characteristics with the members of the treatment group (such as firm size, sector of operation, owner characteristics, enterprise age, geographic location, etc.).
8. This may be possible in some restrictive cases where causal links in the programme's operation are direct and self-evident – for instance the introduction of a new computer-controlled machine on an assembly line leading to faster throughput.
9. In a now well-known evaluation, Wallsten (2000) examines the United States' Small Business Innovation Research (SBIR) programme and suggests that each dollar of programme funding crowds out a dollar of private research funds, with no impact on the total amount of research undertaken. This follows from a focus on choosing projects likely to succeed in the market, the programme's performance standard.

10. Differences also exist across countries in the economic costs and benefits of patents (stemming for example from variations in the rigor of the patent examination, the size of the applicable market and subject matter coverage);
11. However, patents that are more frequently cited in other patents tend to be more valuable.
12. The consumer surplus is the benefit experienced by consumers from being able to purchase a product at a price less than the maximum that they would be willing to pay. The producer surplus is the benefit had by producers from selling at a price above the minimum that they would be willing to sell at.
13. This section, and the one that follows, draws especially on OECD (1998) and on World Bank (2006, 2009) and DfID (2013).
14. KISTEP works largely with quantitative input and output indicators; relevant data are provided by KISTI (Korean Institute for Science and Technology Indicators) and their NTIS (National Technology Indicator System). KISTEP said to be trying to develop methods for long term impact assessment (we are promised a paper).
15. A number of other research institutes similar to STEPI provide complimentary and independent evaluation research.
16. In this respect, KISTEP reported carrying out in-depth evaluations of performance for 5-6 programmes per year. These take on average about 7 months to complete.
17. See e.g. www.dfg.de/en/research_funding/programmes/excellence_initiative/.
18. See www.helmholtz.de/en/about_us/programme_oriented_funding/.
19. www.degeval.de/
20. www.fteval.at/en/platform/
21. A still broader point is that Korean policy makers wish research funding to help meet a number of long-term societal goals. The SIAMPI project, funded by the European Commission, has aimed at developing social impact assessment methods for research and funding instruments through the study of interactions between science and society (see www.siampi.eu). Various relevant papers are also contained in Donovan, C. (ed.) (2011)
22. It is noted in this connection that KOSBIR receives a large share of public funds for R&D (much larger for instance than its equivalent SBIR programme in the United States). No information was available to the OECD on the rates of success in KOSBIR projects. But the significant volume of support raises questions regarding these success rates and risk characteristics of the supported projects.

References

- ANR (2013a), “2012 Annual Report”, Agence Nationale de la Recherche, August 2013, France.
- ANR (2013b), “Guide for Applicants”, Agency Nationale de la Recherche, July 2013, France.
- ANR (2013c), “2014 Work Programme”, Generic Call for Proposals, July 2013, France.
- Arnold, E. (2004), “Evaluating research and innovation policy: a systems world needs systems evaluations”, *Research Evaluation* (2004) 13 (1): 3-17.
doi: 10.3152/147154404781776509
- ARPA-E (2011), “FY2010 Annual Report”, Advanced Research Projects Agency-Energy, United States.
- ARPA-E (2013a), “Strategic Vision 2013”, Report to Congress, Advanced Research Projects Agency-Energy, October 2013, United States.
- ARPA-E (2013b), “Funding Opportunity Announcement, Full-Spectrum Optimized Conversion and Utilization of Sunlight”, Advanced Research Projects Agency-Energy, July 2013, United States.
- Barber, J.M. (2009), “What lessons can evaluation of support for Innovation under ERDF learn from experience of National Innovation Policies?”,
http://ec.europa.eu/regional_policy/archive/conferences/evaluation2009/abstracts/barber.doc
- Cabinet Office (2013), “What Works: evidence centres for social policy”, March 2013, Cabinet Office: London.
- Cozzens, S.E., (1994), “Methods for evaluating fundamental science”, DRU-875/2-CTI, Critical Technologies Institute Report for the White House Office of Science and Technology Policy, Washington, DC.
- Davies, P., (2012), “The state of evidence-based policy evaluation and its role in policy formation”, *National Institute Economic Review* No. 219, pp R41-R52, January 2012, NIESR London
- Denrell, J. (2003), “Vicarious Learning, Under sampling of Failure, and the Myths of Management”, *Organisational Science*, 2003, v. 14 (3).
- DfID (2013), “International Development Evaluation Policy”, Department for International Development, London, May 2013.
- DfT (2013), “Monitoring and Evaluation Strategy”, Department for Transport, London, March 2013.
- Donovan, C. (ed.) (2011), “State of the art in assessing research impact: introduction to a special issue”, *Research Evaluation*. 20 (3): 175-179; doi: 10.3152/095820211X13118583635918

- Fernandez de Labastida, J.M. (2008), "Presentation to OECD Symposium on international comparison of the budget cycle in R&D and innovation policies", Madrid, July 2008.
www.oecd.org/gov/budgeting/symposiumoninternationalcomparisonofthebudgetcycleinrdandinnovationpoliciesjuly2008.htm
- Georgioui, L. and Roessner, D. (2000), "Evaluating Technology Programs : Tools and Methods, Research Policy", Volume 29, pp. 657-78.
- Glennerster, R. (2012), "The Power of Evidence: Improving the Effectiveness of Government by Investing in More Rigorous Evaluation", *National Institute Economic Review No.219*, pp.R4-R14, January 2012, NIESR London.
- Guellec, D. and Pottelsberghe (2004), "From R&D to productivity growth: do institutional settings and the source of funds matter?", *Oxford Bulletin of Economics and Statistics*, Vol. 66, pp 353-378.
- Harhoff, D., Narin, F., Scherer, F. and Vopel, K. (1999), "Citation frequency and the value of patented inventions", *The Review of Economics and Statistics*, Vol.81 (3), pp 511-515.
- Heinze, T., Shapira, P., Senker, J., Kuhlmann, S. (2007), "Identifying Creative Research Accomplishments: Methodology and Results for Nanotechnology and Human Genetics", *Scientometrics*, Vol. 70, No. 1 (2007) 125–152
- Heckman, J. and Robb, R. (1985), "Alternative Methods of Evaluating the Impact of Interventions: An Overview", *Journal of Econometrics*, Volume 30, pp 239–67.
- HM Treasury (2011), "The Magenta Book: Guidance for Evaluation", HM Treasury, London, April 2011.
- IEG (2007), "Institutionalising Impact Evaluation within the Framework of a Monitoring and Evaluation System", Independent Evaluation Group, World Bank, Washington DC.
- KEIT (2013), "Overview: R&D Evaluation and Management Process", Korea Evaluation Institute of Industrial Technology, 2013
- KIAT (2012), "Technology Innovation Policy in Israel", Korea Institute for Advancement of Technology, Korea
- Kuhlmann et al. (1999), "Improving distributed intelligence in complex innovation systems", Final report of the Advanced Science & Technology Policy Planning Network (ASTPP), a Thematic Network of the European Targeted Socio-Economic Research Programme; download at: <http://mpira.ub.uni-muenchen.de/6426/>.
- Lavis, J.N., D.Robertson, J.M.Woodside, C.B. Mcleod, J.Abelson (2003), "How can research organisations more effectively transfer research knowledge to decision makers?", *Milbank Quarterly*, 81(2), 221—248.
- Miles, I. (2005), "Innovation in Services", in Jan Fagerberg, David C. Mowery and Richard R. Nelson (eds.), *The Oxford Handbook of Innovation*, Oxford University Press.
- OCS (2003), "Work standard of the professional examiners", Office of the Chief Scientist, November 2003, Israel.

- OCS (2004), “Function regulations, as of the submission of the support application until termination of the R&D period”, Office of the Chief Scientist, December 2004, Israel.
- OCS (2005), “Submission of the applications for R&D program support”, Office of the Chief Scientist, November 2005, Israel.
- OCS (2010), “Administration of an R&D related accounting system and the submission of performance reports during the course of and upon completion of the R&D period”, Office of the Chief Scientist, January 2010, Israel.
- OCS (2013a), “R&D Incentive Programs”, Office of the Chief Scientist. Available at: www.moital.gov.il/NR/rdonlyres/83C79A59-DCCE-4950-8257-DE48B9D0B9DC/0/IncentivePrograms.pdf
- OCS (2013b), “Government Supported Incentive Programmes”, Office of the Chief Scientist, Israel.
- OECD (2007), *Innovation and Knowledge-Intensive Service Activities*, OECD Publishing. doi: [10.1787/9789264022744-en](https://doi.org/10.1787/9789264022744-en)
- OECD (1998), “Best Practice Guidelines for Evaluation”, PUMA Policy Brief No. 5, May 1998, available at www.oecd.org/gov, OECD, Paris.
- Oldsman, E. (2000), presentation to the ILO meeting “Measuring Employment Impact of Sustainable Enterprise Development”, Geneva, 22nd May.
- Pavitt, K. (1988), “Uses and Abuses of Patent Statistics”, in van Raan, A.F.J., *Handbook of Quantitative Studies of Science and Technology*, Amsterdam: Elsevier Science Publishers.
- Peretz, D. (2010), “Independent Advisory Committee on Development Impact (IACDI)”, Open Letter to Andrew Mitchell, DfID, 12 November 2010, accessed 5 December 2013 at <http://collections.europarchive.org/tna/20101216162935/http://iacdi.independent.gov.uk/wp-content/uploads/David-Peretz-Annual-Letter-20101.doc> .
- Rip, A. (2011), “Science Institutions and Grand Challenges of Society: A Scenario”, *Asian Research Policy*, Volume 2, Issue 1, 1-9.
- Rutter, J. (2013), “Evidence and Evaluation in Policy Making: A Problem of Supply or Demand?”, Institute for Government: London.
- Shapira, P. (2003), “Evaluating Manufacturing Extension Services in the United States: Experiences and Insights”, in Shapira, P. and Kuhlmann, S., *Learning from Science and Technology Policy Evaluation*, Edward Elgar, Northampton, Massachusetts and Cheltenham, the United Kingdom.
- Smith, J. (2004), “Evaluating Local Economic Development Policies: Theory and Practice”, in OECD, “Evaluating Local Economic and Employment Development: How to assess What Works Among Programmes and Policies”, OECD, Paris.
- The United Kingdom Government website: <https://www.gov.uk/what-works-network> (accessed on September 2013)
- TSB (2013a), “Delivery Plan Financial year 2013-2014”, Technology Strategy Board, the United Kingdom.

- TSB (2013b), “Enhancing Manufacturing through Automation, Competition for Collaborative R&D Funding”, Technology Strategy Board, January 2013, the United Kingdom.
- TSB (2013c), “Competition Guidance for Applicants, Infrastructure for Offshore Renewables-Collaborative R&D”, Technology Strategy Board, December 2013, the United Kingdom.
- Wallsten, S. (2000), “The effects of government-industry R&D programmes on private R&D: the case of the Small Business Innovation Research Program”, *Rand Journal of Economics*, Vol. 31, No. 1 (Spring 2000).
- World Bank (2006), “Impact Evaluation and the Project Cycle”, May 2006.
- World Bank (2009), “Making Smart Policy: Using Impact Evaluation for Policy Making Case Studies on Evaluations that Influenced Policy”, PREM Thematic Group on Poverty Analysis, Monitoring and Evaluation, June 2009.
- Wurzelmann, Sam (2012), “Advanced Research Projects Agency-Energy (ARPA-E): Innovation through the U.S. Department of Energy”, Center for Climate and Energy Solutions, April.

Chapter 4

Commercialising publicly supported research in Korea

This chapter reviews Korea's record on commercialisation of publicly supported R&D. The key policies and institutions that affect commercialisation are examined. Emerging international experiences in commercialising public research are described. Challenges for policy in Korea and possible ways forward are also discussed.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

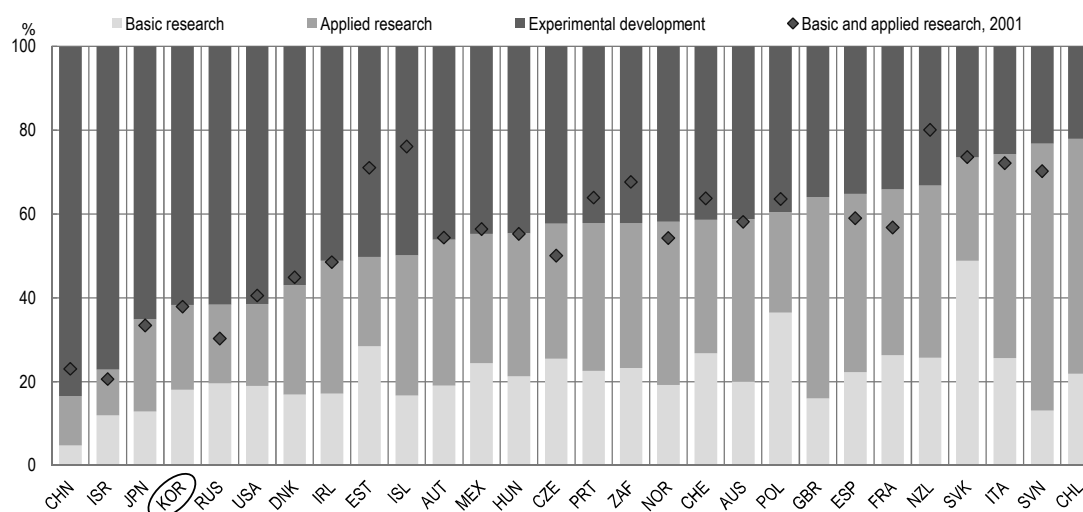
Korean policy makers wish to translate a greater share of publicly supported R&D spending into new products and services in the market. This reflects widespread concerns that high levels of public investment in R&D yield relatively low returns in terms of productivity and sustainable growth within and beyond the sectors that are presently strong.

The complexity and scale of innovation-related institutions and activities that bear on commercialisation is considerable: in 2011 there were a total of 41 619 government-funded R&D projects, implemented under 493 programmes, involving spending of KRW 14.85 trillion.¹ Accordingly, changing overall outcomes in this area could require alterations to a number of policy levers. Efforts have been made over recent years to improve the process. The 2000 Technology Transfer Promotion Act launched a major drive to improve the commercialisation of new technology. The Government is putting more support into technology start-ups and MOTIE is focusing its research projects to a greater degree on commercialisation. IP barriers are also being addressed through programmes such as Technology Transfer Offices and Technology Holding Companies. This chapter briefly reviews the record on commercialisation, describes the key policies and institutions in place, and then discusses challenges and possible ways forward.

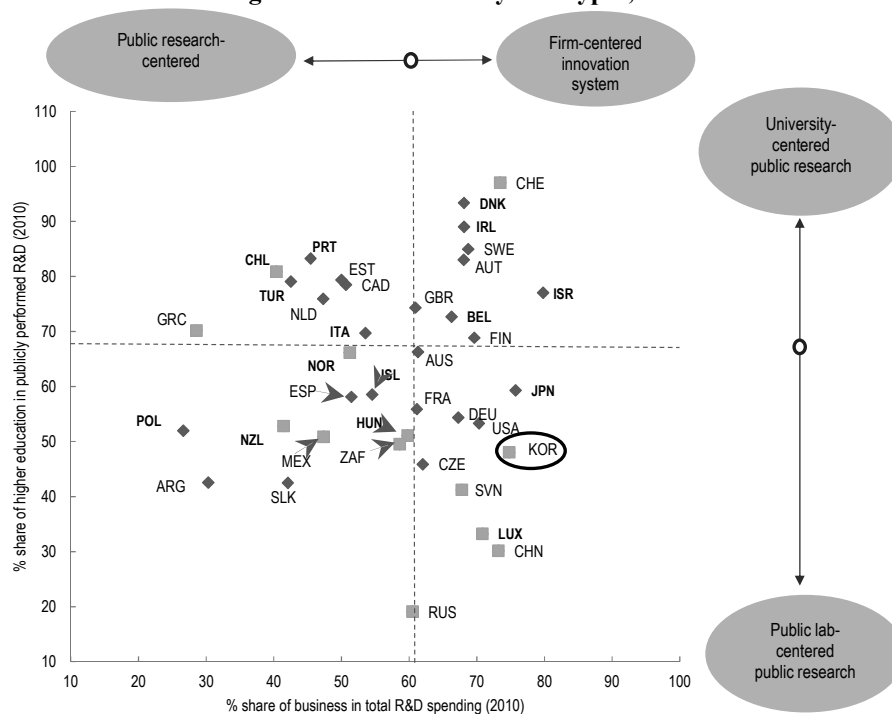
4.1. The commercialisation record

Commercialisation of publicly-supported R&D takes place through many routes. This section outlines performance measures for some of the main channels involved:

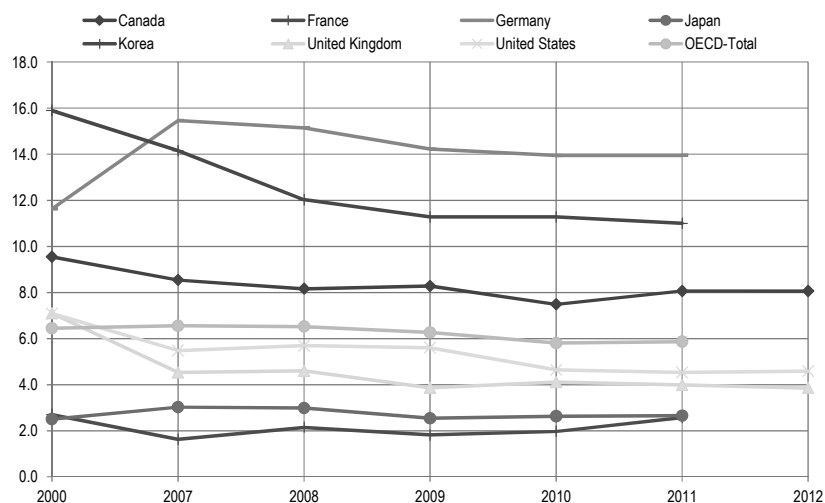
- *Korea's system of R&D investment.* For technology to be transferred or commercialised it needs to be created and accumulated in the first place. R&D expenditure in Korea has increased. The ratio of total R&D investment to GDP stood at 4.0%, near to the top-ranking Israel (4.4%) in 2011 (OECD, 2013a). Basic research comprised 18.1% of the total, applied research 20.3%, and experimental development 61.6% (see Figure 4.1). Investment in basic research in fact jumped from KRW 0.4 trillion in 2001 to KRW 1.69 trillion in 2010. The share of basic research in total R&D is higher than that in the United Kingdom, Japan and Israel. Meanwhile, Korean firms are by far the biggest contributor to the country's total R&D spending. Three quarters of Korea's R&D is conducted by firms. Most OECD countries near to the technological frontier have experienced a slow shift from a system where Public Research Institutes (PRIs) are the main knowledge production institutions to a system characterised by the research centrality of universities. However, in Korea, the PRIs spend slightly more public R&D than universities (52% and 48% respectively). Figure 4.2 shows that relative to other OECD member countries Korea's pattern of R&D spending is both firm- and public laboratory-centred.
- *Business funding of R&D in higher education.* Closer links between industry and academia tend to raise firm-level total factor productivity (Andrews and Criscuolo, 2013). These links can be proxied by the share of research in the higher education sector financed by industry. In 2010 this share stood at 11.3 % in Korea, considerably above the OECD average of 6.0% (Figure 4.3). The Global Competitiveness Index also ranks Korea 25th amongst 144 countries in terms of university-industry R&D collaboration.

Figure 4.1. Gross expenditure on research and development, by type of R&D, 2001 and 2011

Source: OECD (2013a), *OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth*, OECD Publishing, doi: [10.1787/sti_scoreboard-2013-en](https://doi.org/10.1787/sti_scoreboard-2013-en).

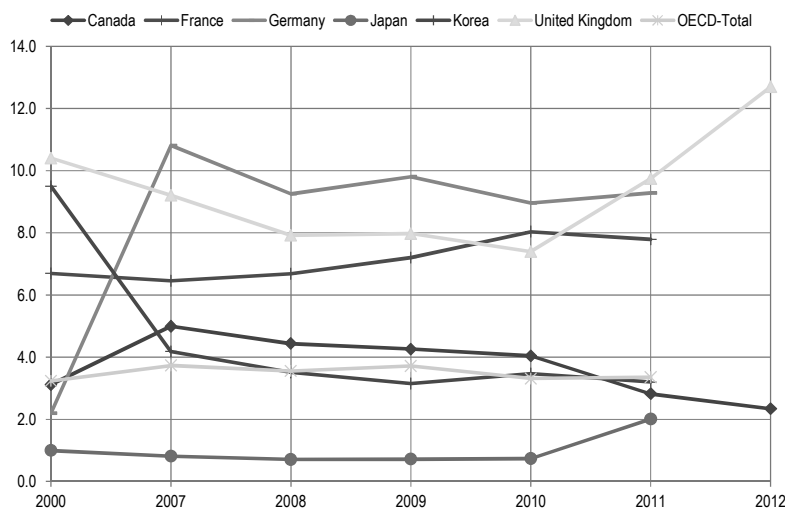
Figure 4.2. Innovation system types, 2010

Source: OECD (2013b), *Commercialising Public Research: New Trends and Strategies*, OECD Publishing, doi: [dx.doi.org/10.1787/9789264193321-en](https://doi.org/10.1787/9789264193321-en).

Figure 4.3. Business-funded R&D in the higher education sectors, 2000-12

Source: OECD (2014), Main Science and Technology Indicators, Vol. 2013/2, OECD Publishing, doi: [10.1787/msti-v2013-2-en](https://doi.org/10.1787/msti-v2013-2-en).

- Business funding of R&D in the government sector.** The picture differs when one considers business-funded R&D in the government sector (the GRIs). In Korea, the share of R&D funding in GRIs coming from industry has decreased considerably over recent years, and now stands at 3.2%, below the OECD average of 3.4% (in 2011). This decline points to an issue discussed later in this chapter, namely the future role of the GRIs in the innovation system.

Figure 4.4. Business-funded R&D in the government sector, 2000-12

Source: OECD (2014), "Main Science and Technology Indicators", Vol. 2013/2, OECD Publishing, doi: [10.1787/msti-v2013-2-en](https://doi.org/10.1787/msti-v2013-2-en).

- **Scientific publications.** Korea performs well in terms of the total number of scientific publications, ranking for some years around 12th globally (Table 4.1)

Table 4.1. Science and technology publications

Number and %

	2004	2005	2006	2007	2008	2009	2010	2011
Number of publications	22 705	27 839	28 436	27 420	35 662	38 776	39 834	44 718
Rate of increase, %	7.54	22.61	2.14	-3.57	30.06	8.73	2.73	12.26
World's total publications	1 065 932	1 229 149	1 236 865	1 251 588	1 483 110	1 538 727	1 528 541	1 649 531
Global share, %	2.13	2.26	2.3	2.19	2.4	2.52	2.61	2.71
Global rank	12	11	11	12	12	12	11	11

Source: NSTC (2013), “Science Citation Index (SCI) Analysis”, National Science and Technology Council, July 2013, Korea.
www.index.go.kr/egams/stts/jsp/potal/stts/PO_STTS_IdxMain.jsp?idx_cd=1334.

- **Patent applications.** Figures 4.5 and 4.6 show the share of patent applications of universities and PRIs in OECD countries under the Patent Co-operation Treaty (PCT) per billion GDP (in constant 2005 USD PPP), an approximation of the output performance of the public research system. Both figures show that Korea is a leading country internationally as regards the number of university and PRI patent applications. The University of California, with 351 applications published in 2012, was the largest patent filer among universities. Universities in the United States account for 27 of the top 52 patenting universities, followed by Japan and Korea with six institutions each (WIPO, 2013).

Figure 4.5. Patents filed by universities, 2001-05 and 2006-10

Patent applications under Patent Co-operation Treaty (PCT) per billion GDP (constant 2005 USD PPP)

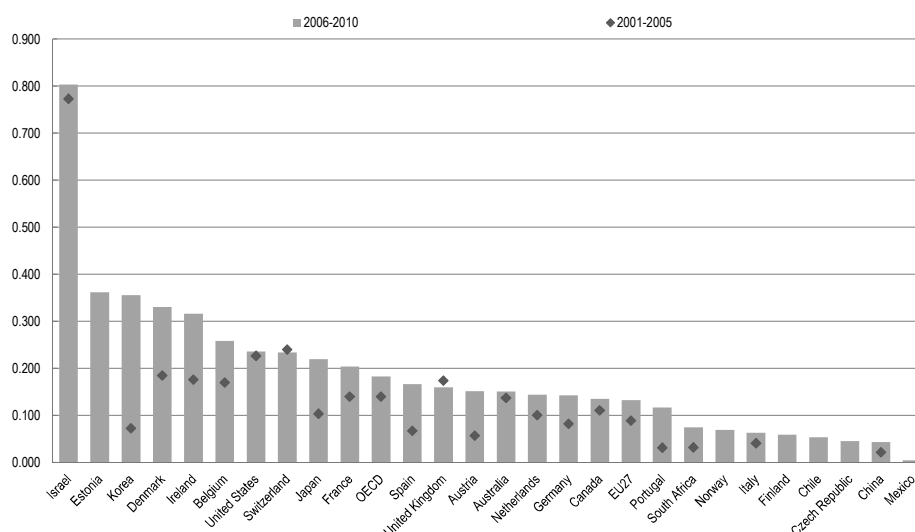
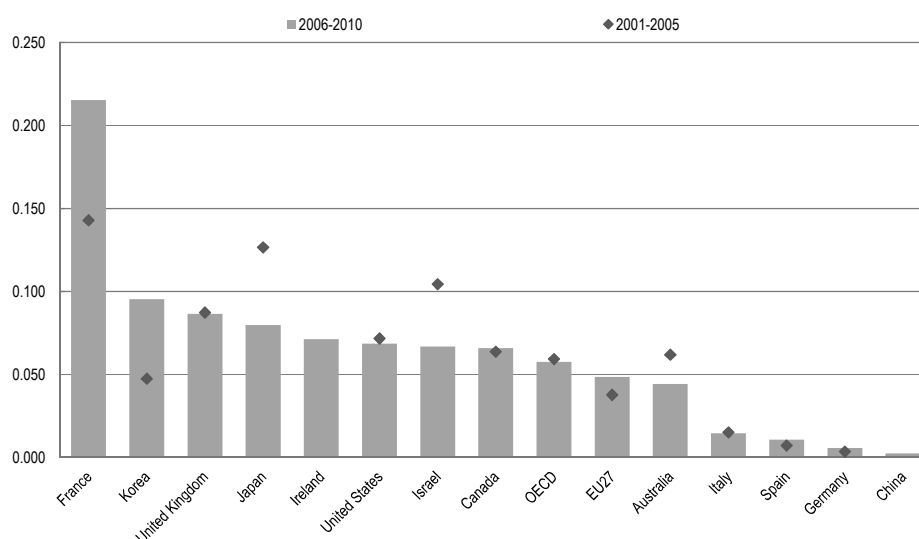
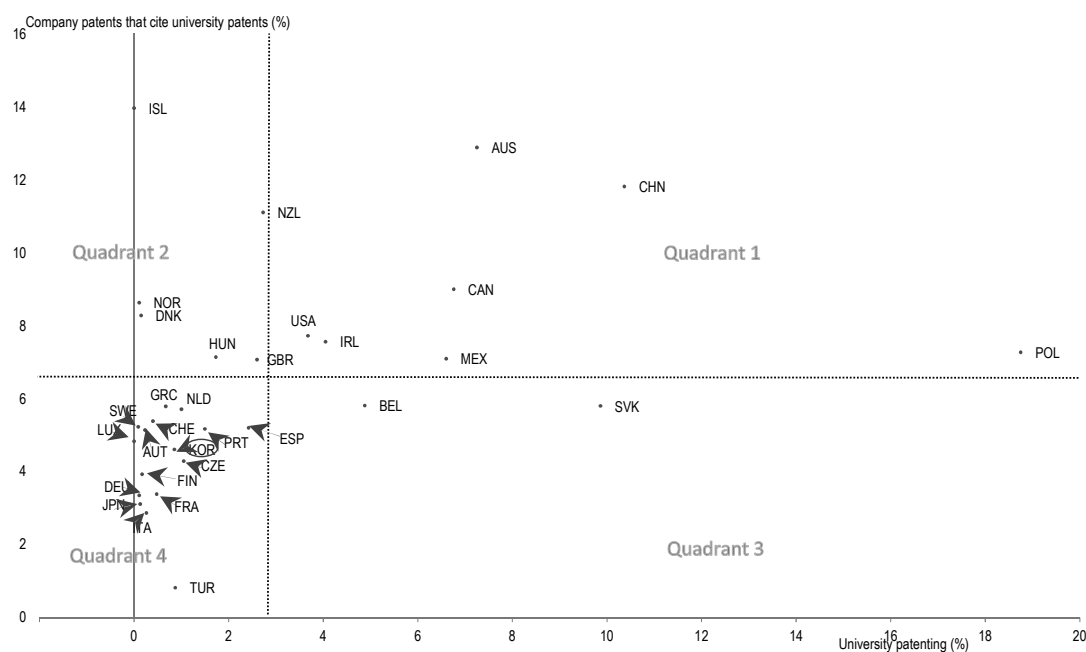


Figure 4.6. Patents filed by public research institutes, 2001-05 and 2006-10

Patent applications under Patent Co-operation Treaty (PCT) per billion GDP (constant 2005 USD PPP)



Source: OECD, (2013b), *Commercialising Public Research: New Trends and Strategies*, OECD Publishing, doi: [10.1787/9789264193321-en](https://doi.org/10.1787/9789264193321-en).

Figure 4.7. Percentage share of university patent applications and share of corporate patents citing university patents

1. *Quadrant 1*: high number of university patent applications (%) and high industry demand of university patents (%);
Quadrant 2: low supply but high industry demand of university patents;
Quadrant 3: high supply but low industry demand of university patents;
Quadrant 4: low supply and low industry demand of university patents.
2. The biggest share of university patents can be attributed to pharmaceutical patents.

Source: OECD (2013b), *Commercialising Public Research: New Trends and Strategies*, OECD Publishing, doi: [10.1787/9789264193321-en](https://doi.org/10.1787/9789264193321-en).

- **Corporate use of university patents.** National differences in citations in corporate patents to university technology are another measure of the extent to which the corporate sector incorporates public sector academic knowledge. Figure 4.7 shows that in Korea companies' patents do not often cite university technology as an important knowledge source for their patenting activities (5%). For many companies in Canada (9%), the United States (8%) and the United Kingdom (7%) university technology is an important knowledge source for their patenting activities. However, Korea exceeds the scores in France (3%), Japan (3%), Germany (3%) and Italy (3%). Overall, Korea is among a group of countries – along with Japan, Germany, France and Sweden – that have a low supply of and demand for university patents. For some countries (e.g. Germany) this can partly be explained by the existence of a strong public sector research system outside universities (as in Korea).
- **Faculty members' industry-academic collaboration.** Only a small share of faculty members in science and engineering are engaged in industry-academic collaboration. Few academics have recorded significant achievements in transferring technologies (STEPI, 2011).
- **Commercialisation expenditure.** The Korean government spent KRW 196.4 billion for technology transfer and commercialisation projects in 2012. This represents only 0.89% of total R&D expenditure. Government agencies, respected policy research and evaluation institutes, universities and their technology commercialisation representatives (technology holding companies) and industry representatives generally concur that available public resources to support technology commercialisation through patenting, licensing, and start-up creation are not large enough or sufficiently long-term.

4.2. Key policies and institutions

Besides supporting the creation of new technologies, it is important for government policy to facilitate the adoption, adaptation and further development of existing technologies, which helps firms to move their innovation from laboratories and demonstrations to commercialisation. Korea's technology commercialisation policy is based on the 1999 Technology Transfer Promotion Law, which aimed at the systematic promotion of technology transfer and commercialisation.² This Law includes provisions for the formulation of mid-term and implementation plans, and is the legal basis for inter-ministerial co-ordination of related policies led by MOTIE. The Law also provides for the building of intermediary and bridging organisations such as TLOs (Technology Licensing Offices), the launching of support programmes for commercialisation activities, financing support for technology-based firms, and efforts to foster a technology transfer and commercialisation culture.

Based on the Technology Transfer Promotion Law, four three-year Promotion Plans of Technology Transfer and Commercialisation have been formulated.³ The 4th Plan proposed four core strategic targets with 14 tasks aimed at raising the performance of the commercialisation policies. The four core strategic targets are: to strengthen activities on technology bridging; to enhance the capabilities of intermediary and bridging organisations; to promote open innovation; and to build up the infrastructure for transfer and commercialisation. MOTIE prepared the 5th Plan, which was announced in early 2014. The Korean government has been driving a variety of measures to promote technology transfer and commercialisation, based on the Promotion Law. The measures are outlined below:

Building institutions for technology transfer and commercialisation

The government established the Korea Technology Transfer Centre (KTTC) in 2000, a public institution responsible for promoting technology transfer by bringing together technology users and suppliers. KTTC conducted a range of activities, including technology transfer brokerage, technology valuation, M&A brokerage for SMEs, and domestic networking. However, in 2009 the KTTC was abolished as part of a public sector restructuring driven by the Lee government. The functions of the KTTC were absorbed into the newly-created Korean Institute for Advancement of Technology (KIAT), which now plays a role as a manager of technology transfer and commercialisation measures. Instead of the KTTC, MOTIE now designates TTOs (Technology Transfer Offices), both public and private, which have to meet specifications such as requisite qualified personnel, information networks, etc. There are 61 TTOs in operation as of 2013.

The Technology Transfer Promotion Law also requires public research institutes (PRIs) to set up separate TLOs to promote technology transfer from the PRIs to SMEs. Currently, there are a total of 172 TLOs (121 in universities and 51 in Government Research Institutes (GRIs) and other non-profit research institutes). The government selects well-performing TLOs every year to provide them with support for their employment and maintenance requirements. The government also encourages PRIs and universities to set up Technology Holding Companies (THCs) dedicated to facilitating the commercialisation of research results from universities.

During the past three years or so several THCs have been established to promote knowledge-based start-ups. The THCs have various organisational permutations, including companies belonging to single universities (e.g., SNU, Yonsei) and companies owned by several universities together as well as other organisations such as technoparks (e.g. Gangwon). Several universities maintain both a TTO for technology licensing and a THC to support technology-based start-ups. There are currently 23 THCs in all. The THCs also receive public subsidy. THCs can set up their own subsidiary companies to exploit specific technologies, or create joint ventures, and take equity in start-ups. Most are still in deficit (which is not unusual by international standards). A recent development is that THCs have started to work with business angels, although THCs report that even the business angels are generally reluctant to fund businesses at the earliest stages of development (so at this stage there are only own (university) funds to support the start-up).

In addition to TLOs and THCs, the government set up Regional Technology Transfer Centres (RTTCs) in Techno Parks aimed at providing technology consulting and brokerage services to SMEs in the provinces. Eight RTTCs were set up in 16 Techno Parks, and each RTTC builds networks with TTOs in its region so as to provide technology commercialisation services.

KIAT, mentioned above, is a key agency designing industrial technology policy. KIAT has a number of functions, including the promotion, transfer and commercialisation of developed technology. Other main functions include evaluation and management of regional industry support projects; upgrading innovation capability through international joint R&D and co-operation; and supporting MOTIE's industrial technology policy through research and statistical analysis, trend and competitor analysis, technology road mapping and other studies.

Supporting innovative firms to facilitate commercialisation

Even when a technology is developed through research, it takes time to develop the research result into a marketed product. Technology-based firms face a range of particular challenges, such as cash shortages in the process of introducing new products (e.g. for further research on the developed technology, business model development and market tests) after technology development or transfer from PRIs. To fill the gap, Korea introduced the R&BD programme in 2012. This programme is designed to encourage commercialisation of research results generated by technology-based firms and PRIs, and helps firms to successfully commercialise technologies through further research, business model and prototype development, field studies and trials. The R&BD programme was established in 2005, the government provided grants for the programme of about KRW 30 billion. The programme consists of three components:

- *Investment linkage activity.* A key criterion for funding is that firms must submit an investment plan from investing institutions, and formally collaborate with PRIs in the commercialisation.
- *Technology transfer activity.* This is primarily aimed at commercialising technology transferred from PRIs to firms. The government funds PRIs when they collaborate with firms to which they already transferred research for commercialisation.
- *Business model development.* This focuses on helping firms with weak business capabilities to develop a business model. It is composed of two components. The government provides funds when business accelerators (BA) propose good business models for technology-based firms, and when the technology-based firms work together with the BAs to commercialise the business models.

As part of the creative economy strategy, in July 2013 MOTIE announced the Plan to Develop Business Ideas. This Plan focuses primarily on developing business ideas into marketable products. MOTIE will designate institutions for supporting firms to develop business ideas in ten industries: home appliances; design engineering; household supplies; bio-health; knowledge services; information technology; automobile-aerospace; energy; machine shipbuilding plant, and platform services. The designated institution will help SMEs commercialise ideas through support in obtaining intellectual property, drawing up business models and building prototypes. In addition, MOTIE plans to introduce a certification system for the Good Business Idea Product. Once a product based on creative business ideas receives the certification, the government will promote sales of the product through a range of measures such as public purchasing.

Financing the commercialisation of research results

To address funding gaps faced by many technology-based firms, the government has created and provided funding for a number of funds. One is the “New Growth Engine Investment Fund”, aimed at promoting growth in 17 promising technologies and sectors. This fund comprises four components: green growth; high-tech convergence; bio-technology; and R&BD. The government has invested KRW 20 billion in each of those four areas, followed by a KRW 100 billion investment in each area by private investment institutions. The fund provides financing to technology-based firms so that they can commercialise their developed technologies.

In addition, MOTIE announced in April 2013 that it would create the so-called “Death Valley Fund”. This fund focuses primarily on firms which have succeeded in developing innovations based on public R&D and which intend to commercialise the research results. Unlike the New Growth Engine Investment Fund, the Death Valley Fund does not specify any investment areas. MOTIE plans to invest KRW 20 billion, select a fund manager, and start providing finances to firms during 2013.

Additionally, in 2013 the government introduced a programme called the “R&D Commercialisation Bank”. The programme reflects the fact that the government channels more than KRW 3 trillion of R&D funding every year, with interest from the deposits amounting to around KRW 20 billion. The government designates certain commercial banks as R&D Commercialisation Banks and makes a deposit of the R&D funding with them. The Bank utilises the returns from the deposit, and provides loans to firms at a reduced rate. The government has designated two commercial banks as R&D Commercialisation Banks and expects them to provide KRW 300 billion of loans every year.

Building infrastructures for enhancing commercialisation

Besides building institutions, offering supporting programmes and providing finance, the government is dedicated to strengthening infrastructure for facilitating commercialisation. Access to information on technology transfer and commercialisation, such as public research results, is another challenge for firms to address. Korea has developed the “Network of Tech Biz” (<http://ntb.kr>) aimed at fostering greater access among technology commercialisation players to a range of information types needed for the transfer and commercialisation process. The Network provides information both on-line and off-line. The information on the Network includes details of R&D projects, patents, technologies for sale, the technology market, support programmes, firms, PRIs and TLOs. The major technologies which providers want to sell are in the fields of electrics, electronics, communications and healthcare.

The government also set up Intellectual Discovery Co. Ltd, with the co-operation of business, which is Korea’s first intellectual property management company. The company purchases intellectual property (IP) owned by firms and PRIs and develops new and more valuable IP by establishing a pool of IPs and conducting further R&D. It also secures good ideas and techniques, files patent applications and obtains IPs. Based on the variety of IPs a company has, it also matches technology buyers and suppliers. The company is expected to contribute to facilitating transfer and commercialisation.

An Intellectual Property Right Fund has also been created with KRW 100 billion to invest specifically in IPR. The Fund consists of two parts, an invention capital fund and a venture capital fund. The invention capital-type fund is operated by a special purpose company (SPC) acting as a general partner (GP). Firms can sell their IP to the SPC, and buy or license IP from the SPC. The SPC can buy IPR-backed securities and can also invest in firms with excellent IP. The venture capital-type fund also can choose a GP and invest not just in firms that own or are developing IP but also firms which are working on commercialisation based on IP.

Government Research Institutes (GRIs)

Since 1966, GRIs contributed to developing technology and innovation capabilities in Korea through fundamental research as well as support to technology development and adaptation in Korean firms. The role of GRIs in the national research system was especially important in Korea during the catch-up phase of development, because

university research was initially relatively weak. As the innovation system has rapidly evolved, and industry has developed its own R&D capabilities, Korean firms have increasingly criticised the research support being provided by the GRIs as failing to meet their needs. At the same time, the Korean government has begun to favour the strengthening of R&D capabilities in universities, which are considered the “natural” sites of skills development and knowledge transfer. In trying to cover the entire waterfront from fundamental research to technical assistance programmes, the Institutes appear to lack clear direction. Moreover, their role, which is matched to industries, is changing as industry boundaries shift. More networking across research areas is needed in the new environment. GRIs may also need more flexibility in hiring excellent researchers, for instance around pay scales. Consequently, pressures to reform the GRIs have resulted in a succession of changes in their governance systems.

Currently, there are 27 GRIs with more than 13 000 employees in total. They are divided into two groups, based on their research areas – basic science or industrial technology (see Table 4.2). One group of thirteen GRIs operates under the Korea Research Council of Fundamental Science and Technology (KRCF). The remaining group of fourteen GRIs is under the Korea Research Council of Industrial Science and Technology (ISTK). MISIP is responsible for both Research Councils. Neither KRCF nor ISTK have their own research capabilities or fund-raising powers. KRCF and ISTK evaluate and manage the GRIs under their responsibility, perform annual evaluations aimed at assessing managerial performance and undertake three-year evaluations of research performance.

Table 4.2. Government research institutes in Korea

KRCF (13)	ISTK (14)
Korea Institute of Science and Technology (KIST)	Korea Institute of Industrial Technology (KITECH)
Korea Research Institute of Bioscience and Biotechnology (KRIBB)	Electronics and Telecommunications Research Institute (ETRI)
Korea Basic Science Institute (KBSI)	National Security Research Institute (NSRI)
National Fusion Research Institute (NFRI)	Korea Institute of Construction Technology (KICT)
National Institute for Mathematical Sciences (NIMS)	Korea Railroad Research Institute(KRRI)
Korea Astronomy and Space Science Institute (KASI)	Korea Food Research Institute (KFRI)
Korea Institute of Oriental Medicine(KIOM)	World Institute of Kimchi (WIT)
Korea Institute of Science and Technology information (KISTI)	Korea Institute of Geoscience And Mineral Resources (KIGAM)
Korea Research Institute of Standards and Science (KRISS)	Korea Institute of Machinery & Materials (KIMM)
Korea Ocean Research & Development Institute (KORDI)	Korea Institute of Materials Science (KIMS)
Korea Aerospace Research Institute (KARI)	Korea Institute of Energy Research (KIER)
Korea Polar Research Institute (KOPRI)	Korea Electrotechnology Research Institute (KERI)
Korea Atomic Energy Research Institute (KAERI)	Korea Research Institute of Chemical Technology (KRICT)
	Korea Institute of Toxicology (KIT)

Source: NSTC (2010), “GRIs Plans of S&T for Efficiency”, National Science and Technology Council, Korea.

GRIs are still the main recipients of public R&D and support. In 2011, GRIs received 38.4% of public R&D, while universities received 25.4% and companies 21.7%.⁴ In turn, the operation of GRIs is heavily dependent on public support. The proportion of government support in total R&D expenditure differs by type of research field, research institute and historical dependency. In 2011, on average, 37.8% of the GRIs’ budget came from a government core grant, while 50.9% came from contract research for government ministries, and only 11.3% from other contract research, such as for private companies.

Table 4.3. Government research institutes income

KRW billions

	Total income	Government grant	Contract research for government	Contract research for private sector
GRI under KRCF	1 873	890 (47.5%)	804 (42.9%)	179 (9.6%)
GRI under ISTK	2 049	592 (28.9%)	1 190 (58.0%)	267 (13.1%)
Total	3 922	1 482 (37.8%)	1 995 (50.9%)	446 (11.3%)

Source: NSTC (2011), “R&D Activity Survey”, National Science and Technology Council, 2011, Korea.

As the R&D capabilities of universities and firms have increased, some overlap has occurred in terms of the scope and quality of research performed. Accordingly, many in industry argue that the GRIs should now focus primarily on fundamental research, whereas many university researchers argue that the GRIs should return to their original purpose of supporting technology adoption and adaptation by Korean firms. Anecdotal reports suggest that the more academically oriented researchers in GRIs try to move to universities, but that few researchers leave for start-ups. The role and performance of GRIs has continued to be criticised by government, universities and firms alike. Criticisms centre upon apparent duplication of research domains, poor R&D project management, and perceived low R&D productivity.

The Korean government has therefore taken a variety of steps to try to make GRIs more efficient and effective. It introduced a contractual project-based management system (PBS) to replace the previous lump-sum system. In 2009, the Korean government announced the “Plan to make GRIs more efficient”. One measure in this plan was to set up a pension system for GRI researchers, many of whom had complained about relatively poor employment conditions (e.g. no pension and an earlier retirement age than university researchers). The plan also introduced the “block funding system” to reduce the negative effects of the PBS. GRIs complained that the PBS system forces them to shift their research focus away from basic research projects to short-term application-oriented projects as they seek more research contracts to cover their manpower costs. Under the new system, ministries will in 2014 increase the share of government grants in the total income of GRIs from 37.8% to 70%, so that GRIs can receive more long-term and stable funding, and conduct more fundamental research with greater flexibility.⁵ The plan also included the consolidation of similar functions and projects, encouraging GRIs to engage in work on platform technologies in co-operation with universities and firms, and allowing GRIs to have more autonomy in research.

Intellectual property (IP) rights

In an increasingly knowledge-based economy such as Korea’s the protection of IP rights is a key framework condition. Korea is one of the most active countries in the OECD in terms of creation of intellectual property. Historically, IP rights reforms in Korea – and particularly the strengthening of patent rights over recent decades - have been shown to have increased R&D expenditure and patent applications, and helped spur productivity growth in Korean manufacturing (Park, 2013).⁶ Copyright law has also been assessed as having a broadly positive impact on the growth of the music industry in Korea (Soh, 2013).

Korea's Basic Law on Intellectual Property was enacted in 2011 to strengthen the creation, protection and utilisation of IPs. After the law was enacted, the Presidential Council on Intellectual Property was established in September 2011 to act as an intermediary among government ministries. The Council's function is to plan IP policies and regulate and monitor Ministries' programmes related to IP. The Council has drawn up the National Plan to Protect Intellectual Property (2012-16). This Plan is organised around five themes: realising an IP system that creates more value; speeding the process of IPR acquisition; creating new industries using IPs; building IP-friendly social infrastructure; and establishing a new IP system. Based on the 5-year National Plan, an Action Plan is formulated each year setting out policy objectives for that year.⁷

The Korean Intellectual Property Office actively promotes the use of IP. KIPO operates local support centres to provide information, education and consulting services, and host competitions for inventors. To facilitate the use of existing IP KIPO has built an infrastructure for IP transactions and provides help to individuals, SMEs and public institutions in assessing the value of their IP.⁸

Korea Small Business Innovation Research programme (KOSBIR)

The Korea Small Business Innovation Research programme (KOSBIR) was introduced in 1998. In 2011, SMEs R&D support through KOSBIR amounted to KRW 1.5 trillion (about 10.5% of the total R&D budget KRW 14.41 trillion) (SMBA, 2012).

Other new initiatives

Plans also exist for a National Technology Bank, a databank of research outputs, open to industry and the research community, to serve as the basis of a brokerage system connecting the supply and demand sides of the technology market.

4.3. Emerging international experiences in commercialising public research

In recent years, across OECD member countries, numerous institutional and policy innovations have occurred relevant to the commercialisation of public research. Drawing on recent OECD work (OECD 2013b), this section reviews a number of developments relevant to the Korean case. A key driver of change in this area is that universities face increasing pressure to combine excellence in teaching and research with commercialisation and fund-raising activities. Indeed, the Shanghai ranking of universities now uses commercialisation and financial indicators such as academic patents and endowments. And Sweden has amended its Higher Education Act so as to introduce the building of external partnerships into the mission of higher education institutions, together with education and research, and to encourage them to actively exploit research outcomes.

Legislative initiatives on commercialisation and patenting

The drafting of new laws to incentivise the commercialisation of public research has intensified. Nearly all OECD countries have now adopted specific legislative frameworks and policies. For example, 92% of Japanese national universities had drawn up an IP policy by 2008, following the Japanese Bayh-Dole Act of 1999.

A policy convergence exists whereby IP rights are vested with universities. With the exceptions of Sweden and Italy, most OECD countries have removed the so-called "professor's privilege" which exempts professors from rules that grant universities rights over IP. Universities can often overrule national university IPR regulations through university

bylaws, for instance to negotiate different IP arrangements with third parties. In some instances, universities are allowed to develop internal patent rights regulations and processes.

Despite the rise of new channels for knowledge transfer in most countries, institutions and policy makers are still focused on promoting commercialisation through patenting and licensing. However, with the exception of a few leading universities and government labs, patenting and licensing are, and will remain, a minor activity for most universities and PRIs, at least in comparison with other channels such as business research contracts and staff mobility.

Access to public research results has become a key topic for policy discussion, reflecting increasing interest in improving the accessibility of scientific research findings in general and, in particular, the results of publicly-funded research. Governments, as key funders of public research, play an important role in developing the legal frameworks to foster greater access to and use of scientific research. The most common policy instrument is the requirement to publish in digital format. For example, the United States National Institutes of Health (NIH) has made its public access policy mandatory: all funded researchers must submit an electronic version of their final peer-reviewed manuscripts to Public Med Central. Similarly, the Canadian Institutes of Health Research (CIHR) states in its Policy on Open Access that “all research papers generated from CIHR funded projects are freely accessible through the Publisher's website or an online repository within 12 months of publication”. New Zealand and Spain also require publication of publicly-funded research results in digitised format in an open access repository. In early 2013, in the United States, the Office of Science and Technology Policy (OSTP) issued a policy memorandum to federal agencies that have more than USD 100 million in research expenditures to make their published research results and digital scientific data more accessible to the public. Public research funding in Estonia also covers the costs of publishing in open access journals. And the German Research Foundation (DFG), Germany's largest research funding organisation, runs programmes to facilitate open access publishing.

Institutional developments affecting commercialisation

New intermediaries for technology transfer. IP intermediaries such as IP-based companies or government-backed patent funds are increasing their role in matching supply and demand for intellectual property between universities and SMEs. A range of intermediary and bridging organisations have been created to facilitate knowledge transfer and commercialisation. These include technology transfer offices (TTOs); business incubators; business innovation centres; science parks; special agencies of chambers of commerce; Industry Liaison Offices (ILO); proof-of-concept centres (see Box 4.1); and libraries/institutional repositories. The missions of these entities differ considerably. For example, there is much variety in terms of the importance of patenting and licensing, and some organisations focus on regional development goals.

Box 4.1. Proof-of-concept centres: Two examples from the United States

Proof-of-concept centres aim to close funding gaps that can arise when business angels and venture capital companies focus their funding on larger and/or later-stage deals. A recent survey of European universities identified 59 proof-of-concept/seed funds, of which half are in the United Kingdom (19) and Belgium (11) (Toschi, 2013).

Gulbranson and Audretsch (2008) describe and assess two proof-of-concept centres in the United States, the von Liebig Centre at UCSD and the Deshpande Center at MIT (both of which were established with philanthropic donations). The von Liebig Center provides seed funding - in the range of USD 15 000 to USD 75 000 – to assess the commercial potential of research. The Center was then funding ten to twelve projects a year, representing from 35 to 60% of the proposals submitted. To be considered for funding, faculty must submit a Statement of Intent outlining the project. An advisor is then assigned to the faculty member to assist in preparing a presentation of the proposal to a review panel. The proposal must describe the project's goals, the commercialisation potential of the technology, the prior experience of the team members, any intellectual property related to the technology and an initial budget. The review panel comprises persons with both technical and business backgrounds. The review panel considers a number of factors when recommending a project to the Center, including: the technology's novelty and maturity; the potential size of the market; the usefulness of a grant; and the credibility of the project's proponent. If a grant is given, an advisor is assigned to work with the project to help prepare a commercialisation plan that will have technical and business milestones and associated budgets. Payments are released contingent on the achievement of each milestone. The advisors themselves have technical and business experience, and will have worked with start-up and early-stage technology ventures. The advisors will also have connections to local business and funding networks. The advisors and the staff from the Center also work with the university technology transfer office.

The Deshpande Center at MIT provides larger sums – up to USD 250 000 – to prepare projects for commercialisation. Grants are of two sorts: Ignition Grants – up to USD 50 000 – for exploratory and proof-of-concept activities; and, Innovation Grants – up to USD 250 000 – which aim to help take an innovation to final development. Only around 18% of proposals are accepted. Applications are assessed by a multidisciplinary committee. Once a proposal is accepted, a mentor is assigned to help prepare a fully-developed proposal. Grantees are obliged to receive mentoring, take part in events organised by the Center, secure intellectual property where appropriate, report on project progress and avoid conflicts of interest. The approximately 50 mentors who work with the Center are volunteers.

Both centres originally aimed to facilitate commercialisation of research at faculties of engineering. A restrictive technology focus – for instance on engineering – would make it more likely that review panels would have the necessary knowledge with which to assess proposals. The von Liebig Center has however opened its award process to all UCSD faculty members, but on the condition that faculty members partner with faculty from the school of engineering. The Deshpande Center allows faculty from across MIT to apply.

Gulbranson and Audretsch (2008) point to particular challenges in evaluating proof-of-concepts centres. One is that it is hard to define failure. A faculty member may receive a grant and the grant may help in determining that a technology has no commercial application. Nevertheless, despite the lack of commercial success, the grant could allow the faculty member to return to other promising areas of research more quickly than would otherwise have been the case. Student or faculty participation in training and events may affect behaviours many years later, which is again hard to measure and compare against the 'non-participation' counterfactual. However, evidence gathered through interviews indicates that both centres fill a funding gap. External investors have made follow-on investments after the commercial viability of concepts has been proved. At the time the review article was published, the centres had awarded grants totalling almost USD 10 million, from which 26 spinout companies had undertaken investments amounting to more than USD 159 million.

A number of lessons might be drawn from the experience of the two centres. One is that both centres operate in excellent research universities surrounded by many business angels and venture capital companies. Both centres also provide more than financial resources, offering services that encompass mentoring, training and wide-ranging advice, along with connections to external business networks, all of which are complementary. Furthermore, by being located in engineering schools, the centres are able to focus, initially, on research that has a high likelihood of commercial application. Successful replication of such centres may need similar starting conditions.

Sources: Gulbranson, C.A. and D. Audretsch, (2008), "Proof of concept centers: accelerating the commercialisation of university innovation", *Journal of Technology Transfer*, Volume 33, pp. 249-258 and Toschi, L. (2013), "Mapping University Seed Funds and Proof of Concepts Funds in Europe: Initial evidence from the FinKT project", Workshop Presentation on "Financing Knowledge Transfer in Europe", Bologna, February 06, 2013.

The modus operandi of TTOs is also changing. The most common goals and missions associated with TTOs are the enhancement of licensing revenues, the maintenance or expansion of industrial research support, faculty retention, technology transfer and, to a lesser extent, regional development (Mowery et al. 2004 and European Commission, 2011). Licensing revenue is typically the most important criterion by which TTO offices measure their success (e.g. Thursby and Thursby, 2001), although most TTOs do not generate positive net returns (or break even) from patenting and licensing (Bulut and Moschini, 2008). However, a small number of TTOs generate substantial revenues (see Box 4.2).⁹

Many TTOs have expanded their missions from administering technology transfer (invention disclosures, filing patents) to a range of IP management and supporting activities (e.g. patent-scouts, consulting), marketing non-patent services, administering proof-of-concept and seed funds and creating an innovation culture. There is some indication of a convergence across countries towards a common set of organisational and financial models for TTOs. Empirical evidence from Italy suggests that most universities tend to adapt the patent regulations applying in the most prestigious universities, which has led to a fairly standardised set of practices (Baldini et al. 2010).

Box.4.2. Developing a successful technology transfer office: The example of YEDA

Israel's Weizmann Institute is an example of a research organisation that has generated significant income from commercialisation of research. The Institute was founded in the 1930s in the Israeli countryside, without surrounding industries or public infrastructures. The idea behind this stand-alone institute was to establish basic science and advanced learning as an integral part of Israel's development. It grew rapidly and attracted talented researchers and funding from within and outside Israel. Success factors included concentration on high-quality basic scientific research, which was often multi-disciplinary, and an emphasis on PhD-level training. Today the Institute has 50 interdisciplinary centres, around 2 500 employees, including 250 professors and 1 000 mainly doctoral students on a small campus. More than half of the post-doctoral students are not Israeli citizens.

Weizmann representatives emphasise the focus on excellence in basic science and on the following elements: curiosity-driven research, a publish-or-perish performance environment and a long-term orientation. Scientists – many of whom live on campus – are also shielded from bureaucratic processes and devote only limited time for activities other than scientific research. A Vice President (VP) for Technology Transfer is part of the executive leadership of the Institute.

YEDA is Weizmann's TTO. It was founded in 1959 – decades before the US Bayh-Dole legislation – and it took several years to deliver returns. The office is responsible for identification, application, licensing and protection of all Weizmann's intellectual property (IP). Weizmann's VP for Technology Transfer is YEDA's chairman, and scientists' inventions must be disclosed to YEDA. YEDA is Weizmann's exclusive channel for patenting, commercialisation and IP protection. Life sciences are the most important source of patents and revenues. If YEDA does not submit a patent, inventors can seek to commercialise an invention on their own, but they still have to reimburse part of any profits to YEDA. If YEDA decides to take out a patent, it is in full charge of the process and – like nearly all TTOs – it focuses on licensing contracts, often with Israeli firms. For some firms, such as the pharmaceutical company Teva, Weizmann IP led to the development of highly successful products. Companies such as Adobe or Johnson and Johnson also profit from license agreements with YEDA. 40% of revenue is distributed to the scientists, and 60% to the Institute (minus a commission for the TTO).

YEDA has filed, or participated in filing, 1 400 patents, signed many licensing agreements and established around 50 spin-off companies based on Weizmann knowledge and IP. Currently YEDA owns 660 live patent families. Annual royalty-generating sales in 2010 amounted to USD 15 billion. .../...

Box.4.2. Developing a successful TTO: The example of YEDA (continued)

The Weizmann budget is approximately USD 300 million. A third comes from the Israeli government for basic funding, with the rest from international donations, international and national competitive funding, and revenues from the Institute's endowment. YEDA currently contributes USD 15-20 million a year to the Institute's budget, although this figure was significantly higher in the mid-2000s.

A key lesson from this experience is the need for a high level of professionalism in commercialising research. All Israeli TTOs have clear missions and well-qualified staff. YEDA representatives know what researchers have accomplished and undertake more than 1 000 industry meetings a year. Another lesson is that academic excellence and commercial success are not incompatible, but can be mutually reinforcing. Research from Sweden shows that there is a strong positive correlation between scientific excellence and the intensity of industry contacts of individual researchers (Bourelos *et al.*, 2012). A further lesson is that professional TTOs and a focus on licensing do not automatically preclude spin-offs. Patience is another important factor. Finally, the example of the Weizmann Institute shows that there is benefit in providing an academically excellent environment, which facilitates the attraction of leading research talent and industrial partners.

Source: OECD (2013c), *OECD Reviews of Innovation Policy: Sweden*, OECD Publishing, doi: [10.1787/9789264184893-en](https://doi.org/10.1787/9789264184893-en).

Many universities have sought to reform or replace the functions of TTOs, given their mixed record of success. Initiatives have focused on replacing or improving TTO structures and services, including but not limited to Technology Transfer Alliances, internet-based models, for-profit models or approaches to vest some rights with inventors, while maintaining some degree of university ownership (e.g. Free Agency models). Such initiatives and proposals are briefly outlined here:

- *Technology Transfer Alliances (TTAs)*. Given the limited ability of many universities to generate enough income to cover the costs of their TTOs, it has been proposed to share services through TTAs. In theory, this would allow the bundling of inventions across universities, lower unit operational costs and access to personnel with superior commercialisation expertise. It is also possible, however, that TTAs could raise some coordination/communication costs and create unhelpful competition among universities. An example of a TTA is the Innovation Transfer Network (ITN) in the United States. Established in 2006, with public support, the ITN serves as the TTO for 13 smaller colleges, each of which are represented on the ITN board. To reach a critical mass of technology transfer services at a regional level, the French National Research Agency (ANR) has established a fund to create Technological Transfer Acceleration Companies (SATT). These companies are mainly owned by a consortium of universities and PRIs and will assist in proof-of-concept funding and IP commercialisation. To date, 11 SATTs have been created across France.
- *For-profit models*. For both cost and efficiency reasons, some institutions have created privately-funded TTOs. These take the form of limited liability corporations. Some universities have operated such private TTOs since the late 1980s (an example is ISIS, at the University of Oxford, which was created in 1988). In Israel, the majority of TTOs operate under a limited liability model, partly or wholly owned by universities. Yisum, for instance, established as far back as 1964, is owned by the Hebrew University of Jerusalem, and submits a large number of PCT patent applications each year. In addition to its traditional TTO, Stanford University has established a separate and wholly-owned limited liability corporation (Stanford OTL-LLC) to allow Stanford's TTO to act as a licensing agent for other universities.

- *Internet-based models.* Advances in ICTs have also permitted the development of mechanisms that complement existing TTO structures with internet-based platforms. These platforms have been developed in response to the need of technology transfer professionals and application-oriented researchers to have easier access to information in their working environment, and to better showcase technologies to the corporate sector. One example is Flintbox, which was developed at the University of British Columbia as a platform to market the university's technologies. The France Technology transfer (FTT) platform, created by the French TTO association and the French national innovation financing agency (OSEO), takes a similar approach so as to increase the visibility of IP developed within French universities and PRIs.
- *Free Agency model.* Some researchers report dissatisfaction with the dominant TTO models. The TTOs are sometimes viewed as revenue maximisers reluctant to explore alternative commercialisation paths (Kenney and Patton, 2009). This has led some observers to propose that researchers could be allowed to choose between their university TTO or an agent elsewhere (i.e. Free Agency model) (Litan et al., 2008). In theory, the intended benefits should be to improve the efficiency and performance of TTOs by creating competition. However, many academics and practitioners question the usefulness of such an approach. These reservations focus on the extent to which TTO performance can be enhanced through competition, and unclear payout schemes, among other considerations.

The creation of spin-off companies has received substantial attention in academic and policy circles. However, the phenomenon is perhaps less prevalent than is often thought. For example, recent data from the United States Association of University Technology Managers show that the number of spin-offs per university per year among the top 100 US research universities is just two, with a maximum of 22 (at MIT). Data on spin-off companies show marked variations across OECD countries. On average, Europe (2.4 spin-offs per USD 100 million of research expenditure during 2004-2010) has a higher rate of spin-off formation than the United States (1.1 for 2004-2011), Canada (1.1 for 2004-2011) and Australia (0.7 for 2004-2011). Four factors have been identified as main determinants of spin-off formation:

- *Institutional factors, such as university IP policies, and particularly the flexibility of the licensing contract policy.* Based on a case study of MIT's institutional support, O'Shea et al. (2007) found that cultural norms that support commercialisation activity, and previous success in commercialisation, both facilitate spinoff activity. Müller (2010) found that the main obstacle faced by academics in establishing a venture is the need to acquire complementary skills and assemble the appropriate teams. However, this process is greatly facilitated if the founders have access to university infrastructure/services and receive formal and informal support through university networks.
- *Organisational factors such as sufficient TTO staff, the relationships between the TTO and external organisations, and support services provided by TTOs to faculty.* Evidence from universities in the United Kingdom also shows that spinoff activity is positively associated with R&D expenditure (Lockett and Wright, 2005).
- *The individual characteristics and motivations of researchers.*

- *External conditions such as the availability of venture capital and infrastructure.* Venture capital is crucial for the formation of high-technology spin offs. Some universities have therefore established university venture funds, either fully or co-funded with university resources.

Recent research also highlights the importance of student entrepreneurship, which is also being encouraged by universities and governments in many OECD countries. Åstebro *et al.* (2012) show that recent graduates are twice as likely as faculty to create a business and that these spin-offs are of high quality. Accordingly, university-level initiatives to foster student entrepreneurship, such as training, mentorships, business start-up services, competitions, and the promotion of an institutional entrepreneurial culture, could be a focus of policy attention.

At universities, legislative and administrative procedures targeting research personnel have also evolved. As universities can override existing national regulations by developing internal patent rights regulations and processes, some have experimented with alternative settings. For example, some have provided preferential treatment to researchers wishing to license technologies that they have developed. Others allow professors to establish new ventures, granting leaves of absence, or allowing tenure clock stoppage while faculty pursues commercialisation-related activities. And a 2012 study found that 16 universities of 64 surveyed in the United States and Canada consider patents and commercialisation in tenure and promotion decisions (Stevens *et al.*, 2012).

Universities in OECD countries also increasingly face the issue of ownership of IP by graduate students and other non-faculty/employees engaged in research. This may give rise to tensions between universities and students. Owing to these changes and to avoid IP disputes between students and universities, the University of Missouri (2011) in the United States established a policy that under certain conditions allows students to own inventions created during their enrolment.

The expansion of innovation challenge prizes

This section considers the merits of challenge prizes, with a view to a possible expansion of their use in Korea. Innovation challenge prizes focus on achieving a specific future innovation-related goal, rather than recognising prior achievement (as with, for instance, the Nobel Prize). Prizes can help to influence public perceptions, mobilise talent and capital, strengthen problem-solving communities and educate (McKinsey 2009). While the literature on commercialisation of the results from challenge prizes is minimal, such prizes can clearly yield innovations with commercial application. In Korea, challenge prizes have not been used extensively and only a few small-scale prizes exist.¹⁰

As a method for rewarding innovators, challenge prizes have been used since the 18th century, when the Longitude Prize, for instance, was offered by the British government for the invention of a way to measure geographical longitude (Williams, 2012). But as collaborative and open innovation have grown in importance, enabled by web platforms, new types of challenge prizes are being developed around the world, by governments, corporations and charities. The United States and the United Kingdom have been particularly active in using challenge prizes.

In the United States, the Ansari X-Prize, with a value of USD 10 million, was offered in 2004 by the X-Prize Foundation for private space flight. NASA has used challenge prizes to develop technology through the NASA Tournament Lab. And the White House Office of Science and Technology Policy has co-operated with NASA to set up a Center

of Excellence for Collaborative Innovation, focusing on challenge prizes. The United States government has also passed legislation to support the use of challenge prizes. The America COMPETES Reauthorisation Act of 2010 was signed into law in 2011. Based on this Act, all federal agencies need to carry out a programme to competitively award prizes to stimulate innovation that could advance the mission of the respective agency. There is also an online platform – challenge.gov – where federal agencies can post problems and open calls for solutions from all interested parties. Recent examples of prizes in the United States include the following:

- *X-Prize Foundation*. An XPRIZE is a large monetary award given to the first team to achieve a specific goal, set by the X-Prize Foundation, which has the potential to positively impact humanity. The Prize Development department within the Foundation designs competitions aimed at capturing the imagination of the public and spurring innovation. XPRIZES are developed in one of five different Prize groups: Energy & Environment; Exploration; Global Development; Learning; and Life Sciences.
- *The Google Lunar XPRIZE*. This is the largest international prize yet. The Google Lunar XPRIZE aims to create a new “Apollo” moment and spur continuous lunar exploration, with USD 40 million in incentive-based prizes. To win this money, a private company must land safely on the surface of the Moon, travel 500 meters above, below or on the lunar surface, and send back two “Mooncasts” to Earth. All of this must be completed by 31 December 2015.
- *The Qualcomm Tricorder XPRIZE*. This is a USD 10 million global competition to make reliable health diagnoses available directly to “health consumers” in their homes. The winner will be the team whose technology most accurately diagnoses a set of diseases independent of a healthcare professional or facility, and that provides the best user experience.
- *Challenge.gov/Challengepost*. Challenge.gov is a collection of challenge and prize competitions run by more than 50 agencies across the federal government. These include technical, scientific, ideation and creative competitions where the United States government seeks innovative solutions from the public, aimed at solving mission-centric problems. Challenge.gov is administered by the [US General Services Administration](http://www.gsa.gov) (GSA) in partnership with [ChallengePost](http://challengepost.com). Between September 2010 and September 2013, 58 federal agencies ran 288 challenge competitions. The use of this tool continues to expand (see <https://challenge.gov>, <http://challengepost.com>).

In the United Kingdom, NESTA’s Centre for Challenge Prizes was established in 2012 to develop the market for prizes among government, business and non-profit organisations. Challenge prizes designed by NESTA include:

- *Dynamic Demand Challenge Prize*. This prize seeks innovations to shift electricity demand to off-peak times or make better use of renewable energy generation. The challenge is to “create a new product, technology or service that utilises data to significantly improve the ability of households or small businesses to demonstrate measurable reduction in carbon emissions by shifting energy demand to off peak times or towards excess renewable generation.”
- *Cycling Challenge*. This challenge aims to increase the number of people cycling across the United Kingdom.

- *European Social Innovation Competition*. Three projects, of EUR 20 000 each, aim to find the best social innovations to help people move into work (www.nesta.org.uk/areas_of_work/challengeprizes).

In addition, National Health Service (NHS) **Innovation Challenge Prizes** were set up to tackle some of healthcare's biggest problems. There are three kinds of prize:

- *Innovation Challenge* (up to GBP 150 000). Innovation challenges reward innovative healthcare practices and ideas that have already demonstrated a positive impact in a local context but which have not yet received wider recognition. They are time-limited, with set dates for the entry and award processes. These prizes focus on finding solutions which improve both quality and productivity.
- *Breakthrough Challenge* (up to GBP 1 million). This challenge aims to find new ways to tackle major health problems such as dementia, stroke and diabetes.
- *Dementia Partnership Challenge* (up to GBP 150 000). This is a partnership to deliver integrated care that is making a difference to the lives of people with dementia, their careers and families (www.nhschallengeprizes.org).

The United Kingdom's innovation agency, the Technology Strategy Board, and the Design Council, have also used challenge-based programmes to spur innovation in technology.

One advantage of prizes is their ability to attract investments from competitors that are many times greater than the cost of delivering and awarding a prize (McKinsey, 2009). For instance, 26 teams participated in the X-Prize for suborbital spaceflight, together spending more than USD 100 million for a USD 10 million prize. Some non-pecuniary prizes – which offer medals or other forms of public approbation – also appear to have been effective in bringing about innovation. Inventors can benefit by, among other things, receiving free publicity or quality approval that might be of value when selling or licensing a technology (Brunt et al, 2011).

Kay (2011) recommends that several conditions be present for prizes to be effective. It is necessary to define exciting but feasible goals, understandable and simple rules, and plans for implementation and evaluation. The prizes need to be designed to attract entrants from diverse groups and be promoted to the public so as to increase the programme's visibility and take-up. There is no rule for deciding the proper size of the cash prizes, but ratios have been seen of one-fourth to one-third of the expected cost of the R&D needed to meet the challenge. It is important to define the intellectual property rights (IPR) of prize winners. The assignment and licensing of IPR might vary depending on the goals of the competition. Kalil (2006) also holds that the size of the prize should be related to the development costs of the innovation and the associated social benefits.

Financing the commercialisation of public research

Financing for the commercialisation of public research occurs at different stages of the business development cycle. Government support tends to focus on the pre-seed stage and later-stage public venture capital activity. In this connection, observations on venture capital finance, business angels and crowd funding are contained in Chapter 5 of this report. Funding is also needed for proof-of-concept and demonstration projects (see Box 4.1). Such support corresponds to the time between the final stage of R&D and the time when a business begins to move its innovations from laboratory and demonstration

phases to the realisation of commercial sales. Catering to this period – the so-called “valley of death” – universities and PRIs often provide support ranging from mentoring and incubation services, IP-assessment services and business development plans, all of which affect access to finance and its terms.

Financing techniques based on debt and guarantees, as well as mezzanine finance, have only limited relevance for research spin-offs. This reflects a variety of factors, including technological uncertainty, limited collateral and the fact that early-stage spin-offs have often not reached profitability. Theory and empirical data show that public research-based spin-offs and start-up firms in R&D-intensive and high technology industries face a higher cost of capital than their larger competitors and firms in other industries (Hall, 2009). In addition to higher capital costs, failures in financial markets and the inherent risks with regards to the outcomes of research have justified public support.

National-level support for financing commercialisation

There has been a rise in specific schemes that target certain stages of the spin-off process such as proof-of-concept, pre-seed and seed funding (Table 4.4), as well as funding for advisory and technical services. The different types of national support for research spin-offs vary in terms of their size, scope, and degree of interaction and can be distinguished between (1) proof-of concept, (2) pre-seed and (3) seed funding.

Table 4.4. The main characteristics of different types of government funding for university spin-offs

	Proof-of-concept	Pre-seed	Seed
Goal	Reduce technological uncertainty by verifying the technological feasibility of the project	Reduce organisational uncertainty by preparing the project organisationally for further investment	Reduce investment risk by providing funding that accepts a higher level of risk than do most private actors
Approach	Demand-side: increase the attractiveness of university spin-offs for investors	Demand-side	Supply-side: Increase the supply of early-stage funding
Type of government support	Usually 100% grant-based	Usually grant based but sometimes convertible to equity	Usually equity or loans
Manager of funds	Usually government agency	Varies, but often regional agent	Usually private agent or independent government unit
Funding decision	Usually by application and panel review, similar to research funding	Varies, but usually made at regional level	Investment decision accepting high risk
Type of activity supported	Technology development at project level	Market and management development by entrepreneurs or consultants	Venture launch
Main criteria for funding	Market potential of technology	Combination of individual and project characteristics	Growth potential of the new venture
Anticipated outcome	University spin-off or license to existing firm	University spin-off	High-growth university spin-offs

Source: Rasmussen and Sørheim (2012), “How governments seek to bridge the financing gap for university spin-offs: proof-of-concept, pre-seed, and seed funding”, *Technology Analysis & Strategic Management*, Vol. 24, pp. 663-678 (based on case studies from Canada, Finland, Ireland, Norway, Sweden and the United Kingdom).

Examples of national programmes that provide support to public research spin-offs include the following:

- **Australia.** Commercialisation Australia is a flagship initiative for Australian entrepreneurs. The programme provides finance and mentoring. It is competitive and merit-based and has four main components.
 - *Skills and knowledge.* This includes grants of up to AUD 50 000, to be used to access expert advice and services, on an 80:20 basis, for a period of up to one year.
 - *Experienced executives.* This involves grants of up to AUD 350 000 over two years to engage an experienced Chief Executive Officer (CEO) or other executives, on a 50:50 basis.
 - *Proof of concept.* Grants from AUD 50 000 to AUD 250 000 to assist with establishing the commercial viability of a new product, process or service, for up to 18 months, on a 50:50 basis.
 - *Early stage commercialisation.* Grants from AUD 50 000 up to AUD 2 million, to undertake activities focused on bringing a new product, process or service to market, for two years, on a 50:50 basis.
- **Austria.** In Austria the Federal Ministry for Transport, Innovation and Technology (BMVIT) supports new technology-based firms through the Seed Financing programme (operated by Austria Wirtschaftsservice – AWS). This programme promotes high-technology start-ups before and during the establishment phase. The criteria for allocations are technological novelty and intensity, development potential and willingness to take risk. The Seed Financing programme provides mezzanine capital for high-growth technology-based SMEs as well as guarantees for venture capital. As a sponsoring bank, the AWS – which covers all forms of business-related support for economic operators – offers several programmes in this context: subsidies, favourable interest rates on credit and advice. The AWS has a special funding programme named High-Tech Double Equity. This programme doubles private equity or venture capital via a 100% guarantee for a bank loan. Spin-offs are supported through the Academy plus Business programme (AplusB) operated by the Austrian Research Promotion Agency (FFG). This helps university researchers to create new firms.
- **Germany.** The EXIST Business Start-up Grant aims to support early-stage firms from universities and PRIs. Grants vary from EUR 800 to EUR 2 500 per month, depending on the level of study attained: doctoral students: EUR 2 500/month; graduates: EUR 2 000/month; undergraduates: EUR 800. Material expenses can be covered up to EUR 10 000 for individually-run start-ups, and up to EUR 17 000 for teams. Financing for start-up related coaching is available to the amount of EUR 5 000.

The EXIST Transfer of Research programme promotes technology-based business start-up projects in the pre-start-up and the start-up stage from universities and research institutes. It complements the broadly targeted EXIST Business Start-up Grant with an excellence-oriented instrument for high-tech start-ups. Support is provided in two phases: Phase I: up to EUR 60 000 is available at the pre-start-up stage for material expenses. Further support can be had to cover staff costs aimed at proving the technological feasibility of a product idea;

Phase II: up to EUR 150 000 is available at the start-up stage, as long as this does not exceed 75% of all project-related costs. This support is aimed at assisting product design and prototype development.

- **The Netherlands.** The Netherlands has experimented with several schemes for the creation of new firms and SMEs. The Dutch TechnoPartner Seed Facility was introduced in 2005 as part of the overall TechnoPartner programme to raise the number and quality of high-technology start-ups. It has aimed to do this by improving access to capital and providing specific information and coaching.
- **Norway.** Norway's FORNY2020 has been streamlined to two funding schemes: basic funding and proof-of-concept funding. The basic funding targets Norwegian TTOs. The aim of the proof-of-concept scheme is to reduce technological and commercial risks to a point where investors are willing to buy into the project. Projects applying for funding must originate from publicly-funded R&D institutions. Proof-of-concept funding from FORNY2020 requires that the projects aim to develop products, processes or services which are new to the international market. The scheme is technology neutral. Applicants can include TTOs receiving basic funding, other bodies focusing on commercialisation and representing publicly-funded R&D institutions, and micro enterprises originating from publicly-funded R&D institutions.

4.4. Factors hindering commercialisation of R&D in Korea and possible ways forward

Further progress in commercialisation would appear to be a key to success for Korea in achieving its objectives for the creative economy. Commercialisation outcomes reflect the interactions between a number of institutions and a range of policy settings (some of which are examined elsewhere in this report). Measures could include improving the incentives for the research community to undertake commercially oriented research, increasing the weight given to commercial criteria in research funding, reviewing IP arrangements in joint research programmes and addressing the cultural and other barriers that inhibit co-operation between the research base and private industry, particularly SMEs. There may be scope to make more use of SBIR-like funding mechanisms and/or to gear university funding allocation more towards knowledge exchange and success in commercialisation.

Strengthening business and academia interaction

Except for the larger technology-based companies many enterprises, particularly SMEs, appear to shy away from regular or intense collaboration with academic institutes.¹¹ The same holds, the other way around, for most academic researchers: public-private research and innovation collaboration is rather the exception than the rule. Quite likely, more than a single policy instrument will be required to overcome this situation. Rather a cultural change across the innovation system is required. Consequently, a variety of approaches/instruments should be established, complementing each other in a systemic manner, but always making sure that the essential university missions of basic research and teaching are not undermined.¹² Such approaches could include the following:

- *Facilitating commercialisation of university research, but without compromising basic research and teaching, the fundamental missions of the university sector.* The recent evolution of policy in Korea, focused around the creative economy,

appears to be moving in this direction (with MSIP overseeing government-wide programmes and policies). One example where a balance needs to be struck, requiring agreement between Ministries, relates to the incentives faced by universities. The “mindset” of researchers appears more focused on research than its commercialisation. Reports indicate that the system for evaluating Universities focuses on patents and academic citations, not on connection with business, leading to a situation in which commercialisation has lower priority (this is, of course, not surprising and is broadly similar across OECD member countries). Although Government funding is also to some extent dependent on success in commercialisation, the incentives are not always transmitted to the professors/researchers.¹³ Other Ministries, more directly concerned with commercialisation, might wish to see a shift in the structure of incentives offered. But the Ministry of Education and the National Research Foundation (NRF) on which universities rely for support are far removed from the market. And it is debatable whether they should be pushed closer to the market. Achieving the right balance in incentives between institutions that have differing mandates requires orchestration from the centre.

- Related to the preceding point, *there may be scope to gear university funding allocation more towards knowledge exchange and success in commercialisation*. An example of where this has been done is the United Kingdom Higher Education Innovation Fund (PACEC, 2012). Interviewees in Korea observed that until the beginning of this millennium there was little interest in commercialisation in universities. However, owing to the changing economic situation and jobs shortages for young educated people, there is much more interest in technology commercialisation. Universities reportedly want to do more on commercialisation, but are reluctant as their budgets are primarily determined by education and research objectives. Representatives of the Technology Holding Companies held that commercialisation is not weighted heavily in public resource allocations to universities.
- *The establishment of a more business friendly education system* (STEPI, 2012a). Such a system should be conducive to higher rates of technology-based start-up arising from the university sector. As discussed in the section of this report addressing entrepreneurship, particular emphasis should be placed on mentoring, access to finance and business networks for young entrepreneurs.
- *Cultural and other barriers to start-ups and to joint working between business and the research base need to be addressed*. Universities outside the top-rated group find it difficult to attract interest from the private sector. MSIP is reported to be taking action to facilitate university commercialisation, through improving the incentives for individual researchers and enabling university professors both to publish and to pursue commercially-oriented research. The Basic Plan for Science and Technology (NSTC on July 8th) includes ideas on improving the commercialisation of research. However, senior representatives of the Korean business sector also referred to a lack of trust between the corporate sector and universities. In particular, concerns exist that the arrangements for profit sharing between firms and researchers do not meet firms’ needs.¹⁴ Medium-sized firms also expressed concern that patents owned by the public sector are occasionally transferred to the private sector, but that such cases are exceptional. This was considered a problem since industry will not risk investing in technologies it does not control.

- *Ensure the presence and effective functioning of proof-of-concept centres.* As described earlier in this chapter, commercialisation support at the proof-of-concept stage aims to close funding gaps that can arise when business angels and venture capital companies focus their funding on larger and/or later-stage deals. Many policy initiatives in Korea will have an impact on this gap. However, it could be valuable to ensure that such support is available at all institutions undertaking research activities of significant scale.
- *Younger and highly trained students for industrial innovation.* Stimulate the secondment of undergraduate and graduate students to innovation-oriented companies, in particular SMEs. Universities can require (or at least stimulate) that graduation thesis research work (BA, MSc, e.g. in engineering sciences, management studies) is conducted in direct project-based collaboration with industry. This requires that professors are ready to define/accept thesis themes relevant for industrial innovators. In North-western European countries this has proven to be a major mechanism to bring graduates closer to companies – many such collaborations lead to subsequent employment of the student in the partnering company. This, in turn, helps to establish long-term personal links between companies and academics.

A broader but related issue concerns the disinclination among many Korean graduates to seek work in SMEs. This partly reflects low productivity (and wages) in the SME sector, as discussed elsewhere in this report, and the wider possibility of mismatch between the qualification profile of school leavers and the requirements of the labour market. However, graduates in many other countries also face the prospect of work in small firms with reluctance. Employment in large firms is usually associated with superior remuneration, conditions of work, contractual stability and prestige. At the same time, a bias exists in many small firms themselves against the recruitment of graduates, who are sometimes wrongly judged to possess inappropriate (excessively academic) experience. This labour market mismatch has a bearing on the development of innovative small firms – because graduates can be a source of innovative ideas and skills. Attempts might be made to reduce this labour market mismatch through policy, including though employee placement schemes for graduates targeted at small technology-based firms (Becher and Kuhlmann, 1995).¹⁵ However, getting significant numbers of young graduates in STEM disciplines to work in SMEs is most likely something that will follow growth in the population of high-tech SMEs, such that graduates have the chance to deploy and further develop their technical skills in a work environment.

- *Systematic support for public-private innovation partnership:* While there are some programmes in Korea to support public-private research and innovation collaboration, more systematic efforts should be made. A successful model in this connection is the United States' Manufacturing Extension Programme initiative, stimulating public-private research and innovation collaboration. Incentives for university researchers and the GRI to participate should be established.¹⁶ There are also a number of comparable approaches in Europe, such as the long-standing "industrial collaborative research" programme ("Industrielle Gemeinschaftsforschung"), fostering and publicly co-funding collaborative pre-competitive R&D and triggering subsequent bi-lateral competitive public-private R&D (Arnold, 2012).¹⁷

- *Knowledge transfer and commercialisation through individuals' career development*: Provided the settings sketched above do exist (i.e. government co-sponsoring of public-private R&D), industrially oriented contract R&D institutes as well as technologically oriented higher education institutions should be stimulated to make joint efforts to attract and train innovation-interested graduates as engineers and PhD candidates, working closely with industry (not least SMEs). Returning once more to the examples of the institutes of the German Fraunhofer Society, senior researchers of the institutes often also hold a professorial position at a university entitling them to award academic degrees (MSc, PhD). Many of their MSc and PhD projects are (co-) funded from public-private collaborative programmes and most of the actual research work is done by students working towards MSc and PhD degrees. Many of these students later continue their career with the private project partner, serving as a living link between public and private innovation and commercialisation projects. A similar model for the more medium-tech 'technical colleges' (universities of applied research) and their collaboration with SMEs is provided by the liaison facilities of the German Steinbeis-Foundation.

Refining the role of GRIs

Joint research between SMEs and the GRIs is reported to be particularly limited. The KRCF indicates that of all contract financing only about 3% comes from industry (the rest from public agencies). This problem could reflect constraints on both sides of this relationship: GRIs that produce too little research of use to SMEs, and SMEs that have capacity constraints as regards R&D and its absorption.

In spite of the reforms of recent decades, the role the GRIs should play in the Korean innovation system is still widely discussed (STEPI, 2012b). The current government has outlined its policy direction for GRIs in the 5-year Basic Plan for Science and Technology (July 2013), and more needs to be done to fully articulate the detailed set of measures involved. The Plan has proposed four tasks: to clarify the mission and identity of each GRI; to strengthen the role of GRIs in supporting SMES; to promote interdisciplinary research through collaboration with other PRIs both in and outside Korea; and, to enhance the autonomy and accountability of GRIs.

As suggested elsewhere in this report, *the mission and institutional and financial set-up of the GRIs should be re-considered* (ideally after a thorough "system-evaluation", in the light of comparable international experiences). As a result some of the GRIs – or subsets of them – could be turned into curiosity or problem-oriented public research institutes collaborating closely with universities, while others – and this is relevant for commercialisation – should be organised as industrially oriented contract R&D institutes with limited but reliable public funding and a relevant share of industrial income. The funding mode of institutes of the Fraunhofer Society (FhG) in Germany may serve as an interesting example (see also VTT in Finland; TNO in the Netherlands and Carnot in France). An ideal FhG institute will have some 40% of its income coming from industry, 30% funding from participation in public competitive funding programmes for collaboration between public sector and industry, and 30% from governmental block funding. In case the industrial income is lower, the government funding will be reduced too – such that the institute has to increase its efforts to collaborate with industry. In case the industrial income rises above a certain ceiling (say 60%) block funding will be reduced, too, because public funding is not meant to subsidise private research efforts that would have happened in the absence of support.

Improving government support programmes

- *Valuable lessons might be learned from SBIR-type initiatives elsewhere:* As mentioned above, SME support through KOSBIR already consumes 10.5% of the total (public) R&D budget. This is distributed among several ministries and GRIs with set aside ratios varying between 0.3% and 24%. Overall, this is a large programme. At the time of writing, the OECD has no appraisal of the type of research funded by KOSBIR. However, if it is assumed that KOSBIR follows the American model of funding high-risk research, then it is important to pay attention to the (last) commercialisation phase. This is typically unfunded. The United States' experience with SBIR commercialisation success varies widely across agencies. Those agencies that are closer in defining the “market” for the research they support – especially the Department of Defence and the Department of Energy – have higher rates of success in terms of innovation uptake than others which are further removed from the market.¹⁸ So, besides the degree of riskiness of research, it is important to consider what measures can be instituted at the final stage to increase technology uptake, such as additional dedicated funding or a close link to public procurement processes that will provide potential markets for such fledgling small companies.

As is well known, the perceived success of the United States' SBIR programme – introduced in the United States in 1982 - has inspired similar programmes in other OECD countries, including Korea. But risks are also associated with SBIR-type schemes. A key concern is that government funds might simply crowd out privately-financed R&D. Schemes should finance proposals not likely to receive funds from private sources if additionality is to be maximised (Wallsten, 2000). Achieving this outcome will in part be a function of the evaluation and programme monitoring metrics used. For instance, to raise the additionality of programmes, higher weightings might be assigned to outcomes affecting hard-to-serve groups such as smaller or geographically remote firms, or firms that have not performed R&D before.

- *Carefully evaluate the impacts of patent funds.* A number of governments and organisations around the globe are sponsoring the creation of patent funds as a policy instrument to promote the economic use of patented IP rights.¹⁹ For instance, in addition to Korea's Intellectual Discovery and IP Cube Partners funds, France operates 'France Brevets' and Japan runs the 'Life Sciences IP Platform Fund'. Recent OECD work in this area suggests that there is not enough evidence to make firm recommendations on the design features of such funds that might be considered best practice (OECD, 2013a). Indeed, the rationale for public patent funds is still subject to debate, and a number of objections have been raised regarding publicly-backed funds. For instance:
 - Constraints on the funds' IP assertion strategies may be difficult to define and implement, especially if a fund is operated at arm's length from public authorities. The acquisition strategies of funds may raise prices in the short term, without necessarily increasing the level of inventive activity.
 - The likely competition effects of public patent funds are difficult to predict, as they will depend on how the fund is implemented and on how the different components of the patent rights portfolio relate to each other.

- If they focus on specific technology domains, government-backed patent funds may unintentionally trigger technology lock-in if conducted at a sufficiently large scale.
- Co-ordination of various national funds could be costly and challenging, especially if the funds' strategies give some form of preferential treatment to domestic companies.
- From an international perspective, government-backed patent funds bring the risk that they may become instruments of support for national champions.

Given the limited international experience to date with public funds, it is essential to improve the evidence base before policy is scaled-up significantly. Complementary measures to improve the functioning of the IP ecosystem – such as database services – could be helpful and entail few if any downsides.

- *Create a systematic monitoring of commercialisation outcomes.* The extent to which systematic monitoring of overall commercialisation outcomes occurs is unclear: new metrics such as new registered trademarks, staff exchanges, student employment on funded projects, alumni in the workforce and services to external clients, or the number of licenses from university or government laboratories that are actively used in commercialised products (i.e. a new metric used by the United States Department of Defense) could be valuable in assessing the performance of the system.
- *Adopt suitably long timeframes.* Some programmes seem to have rather short time horizons, and perhaps even a misplaced low tolerance of failure. One instance of this is that significant near-term expectations have been placed on the Technology Holding Companies as regards commercialisation outcomes. Some of the Holding Companies are only two or three years old. Similar bodies in countries like Israel and the United States have taken many years to realise a substantial deal flow (and reach a break-even point). Nevertheless, some of the Holding Companies have already achieved investments and joint ventures in several start-up companies. Similarly, as discussed above, the R&BD programme focuses on the commercialisation of GRI technology. Industry selects the technology and then goes through several steps – including financial evaluation and securing Venture Capital investment – before receiving funding from KIAT. Interviewees were happy with the R&D phase of the programme, but felt that the commercialisation phase could be strengthened. Both the time and funding available were considered insufficient.
- *Ensure commensurate funding for commercialisation activities.* Various government programmes were critiqued by industry and programme managers on account of too little emphasis being placed on commercialisation. Many parties call for the amount of funding for the commercialisation element of programmes to be increased. Assessing the appropriateness of the balance of support is hard to do in an objective manner.
- *Further promote technology holding companies (THCs).* A very interesting development since 2010 has been the creation of THCs, for-profit organisations set up by individual universities or groups of universities to commercialise early-stage university technology through start-ups and joint ventures. A critical point to address is their potentially uneasy relationship with the technology transfer

offices (TLOs) responsible for university technology licensing. Another critical point is their relationship with external private funding from business angels and VCs. A third issue is the ability of public universities to accept high failure rates in the THCs. THCs will often be the only supporters of fledgling start-ups before the drafting of detailed business plans that business angels and VCs require. The THCs must be well equipped to advise start-ups in IP matters.

- *Review aspects of the intellectual property protection system that may be causing unnecessary uncertainty.* The IPR situation, especially with regards to intellectual property developed with public funding, appears to need some attention. In 2011-12 Korea ranked 40th on the World Economic Forum's IP protection indicator, which is based on responses from a survey of executives (WEF, 2013).²⁰ More than the need for new IP-related laws, industry representatives refer to the importance of more efficient enforcement processes. Korea may need additional capabilities in the public courts and more specialist IP attorneys. In several instances firms and academics expressed uncertainty regarding who owns what and what the appropriate compensation should be.
- *Assess whether more needs to be done to increase awareness of intellectual property among SMEs.* While survey data have not been seen to corroborate this view, many commentators note the lack of awareness of intellectual property issues among Korean SMEs. This problem is in fact common across OECD member countries. Steps are being taken to address this issue. The work of the Korean Intellectual Property Office has already been referred to in this connection earlier in the chapter. Some of the Technology Holding Companies also operate intellectual property 'clinics' where legal experts and law students help fledgling start-ups with IP issues. Other Holding companies react on a case-by-case basis to connect inventors to lawyers and consultants. However, the observation that SMEs lack sufficient awareness of IP is frequent, and a more comprehensive approach might be needed. For example, Germany's Federal Ministry for Economic Affairs sponsors a specific agency charged with raising IPR awareness and offering advice and support for SMEs in such areas as technology analysis, patenting and licensing support (see www.signo-deutschland.de). This is not to advocate for the creation in Korea of an agency responsible for raising IP awareness among SMEs. It may simply be that already valuable work on IP for SMEs performed by existing institutions in Korea – such as KIPO – should be expanded.
- *Examine where opportunities might exist to expand the use of innovation challenge prizes.* Innovation challenge prizes can help to influence public perceptions, mobilise talent and capital, strengthen problem-solving communities and educate. While the literature on commercialisation of the results from challenge prizes is limited, such prizes can clearly yield innovations with commercial application. In Korea, challenge prizes have not been used extensively and only a few small-scale prizes exist at present.
- *Seek to improve commercialisation-related expertise within public institutions.* Publicly funded research institutes (within and outside universities) whose research activities could be relevant for commercial purposes should build up their own expertise and networks to foster commercialisation. Government and regional authorities can support such efforts financially. Measures that could be taken include: create an institutional platform for all issues around commerciali-

sation in a (major) research organisation (e.g. a research university). This platform should run databases about commercialisation-relevant research units and projects; organise roundtables with researchers and industry; support inventors and founders of new tech-businesses; organise fairs and exhibitions, etc.. A relevant example is the Technical University of Dresden (see <http://tu-dresden.de/forschung/wissens- und technologietransfer>). In this case the university is itself also part of a wider commercialisation-relevant network of regional research institutes, all with their own commercialisation activities, together representing a cluster of high-tech and scientific knowledge attractive for industries (www.dresden-concept.de).

Notes

1. Of this amount, 38.4 % (KRW 5.7099 trillion) went to GRIs, 25.4 % (KRW 3.7672 trillion) to universities, 12.4% to SMEs (KRW 1.8469 trillion), and 9.3% (KRW 1.3861 trillion) to large corporations.
2. In 2006 the title of the law was changed to the ‘Technology Transfer and Commercialisation Promotion Law’.
3. These cover the periods 2001-05, 2006-08, 2009-11 and 2012-14.
4. The remaining 14.5% goes to ministries and public research bodies other than the 27 GRIs.
5. The higher share of government grants does not come from more investment, but from the transfer of some existing government contract research conducted by GRIs to the grants. Under this system, ministries decide only the ceiling on the block funding and broad research directions for each GRI (NSTC, 2011). A question arises however whether all GRIs should receive such an increase in grant funding irrespective of their basic science or applied orientation. The various GRIs serve quite different ‘markets’, which could be reflected in different modes of public funding.
6. Park (2013) shows that in 2000-2001 the most favored means of protecting innovations were market pre-emption and secrecy. By 2005 the gap between these mechanisms and patent protection had narrowed.
7. Major policy emphases for 2013 are: strengthening linkage between R&D and IP; fostering content and software creation; counteracting IPR violations; securing proper IP infringement damages; enhancing the IP dispute resolution system; facilitating IP financing and investment; spreading fair practices in IP trade; raising IP social awareness and manpower; promoting just compensation for investors and creators; building a co-operative IP governance; nurturing local and regional IP competencies; and preparing for emerging IP issues.
8. Park (2013) provides a description and assessment of a number of IP promotion policies in Korea (up to 2006). While the data only permitted preliminary conclusions, the author could not find a significant relationship between the size of the budget allocated to IP promotional programmes and user satisfaction. One initiative, the invention class programme, was found to have helped students better understand IP and assist with career choices. Policies for promoting the utilisation of IP amongst SMEs were judged not to be working as effectively as they might.
9. In the United Kingdom higher education institutions generated external income of more than £3 billion in 2011/12. However, only 2-4% of that amount was from licensing or the sale of shares in spin-out companies. Most of the revenue came from collaborative and contract research, consultancy and professional training (House of Commons, Science and Technology Committee, 2013).

10. However, as part of efforts to foster the creative economy, the Korean government has created a platform which contains various challenge prizes and makes it possible for the public to upload and share creative ideas ([see www.creativekorea.or.kr](http://www.creativekorea.or.kr)).
11. The government is of course aware of this problem and is trying to address it. KRCF reports that the new government has announced that 10% of KRCF core funding must be spent with SMEs. SME support is expected to be one of the major GRI missions in the future.
12. However, research now suggests that academic entrepreneurship does not detract from research productivity or lower the disposition to undertake basic research. For example, based on data from the University of Leuven in Belgium, Van Looy *et al.* (2004) show that, overall, when faculty engage in entrepreneurship there is no change in the type of research undertaken and the number of publications actually increases. Illustrative of complementarities between commercialisation and research, Colyvas *et al.* (2002) and Lam (2011) show that, more than income from intellectual property, the scientists who contribute the most to technology transfer are often motivated by the challenge of addressing interesting problems that also serve to further develop their research programmes.
13. Evidently, for universities, some differentiation is needed: commercialisation incentives should be offered to those universities' faculties which are active in areas that have significant commercial potential – other entities should not be under pressure to achieve commercialisation.
14. In case of government funded R&D projects, the tangible outcomes of the project (such as research equipment, research facilities and prototypes) belong to the organisation conducting the project, according to the 'Operating Manual on Technology & Innovation Projects of the Knowledge Economy.' However, outcomes can be shared between the project conducting organisation and participants based on project characteristics. The intangible outcomes such as IP, copyrights and research notes are owned only by the research organisation, and in the case of co-operative research outcomes belong to both organisations. For private R&D projects, the profit share among project participants can be determined by the participants themselves.
15. In the 1980s and 1990s Germany ran such a scheme with some success. It should be noted however that Germany's industrial structure is rather different from Korea's, and that for some time German graduates would have found significant numbers of potential SME employers active in technologically sophisticated fields. Westhead (1998) also analyses an employee placement scheme for graduates targeted at small firms - the Shell Technology Enterprise Programme – which sought to reduce recruitment and job-search biases. The results here are however somewhat equivocal. The research found that participating graduates came to look more favourably on a career in a small business - although this effect was not strong and many participants used their increased employability to join large firms (after graduation, participants were significantly more likely to be offered full-time jobs than similar non-participating students). However, while three-quarters of the host SMEs indicated that they had benefited from the programme, their graduate hiring practices were effectively unchanged after twelve months. Westhead's assessment concluded that to bring about the greatest attitudinal change schemes should target firms that do not already employ a graduate. Incentives are also needed to expand the supply and small-firm take-up of such programmes, especially as the provision of training for graduates may not be in the short-term interest of the companies involved.

16. ISTK spends around USD 6m a year on a Korean version of the manufacturing extension programme. This, however, represents a rather small allocation when considered nationally.
17. In Europe a major instrument stimulating the mobility (inward and outward) of highly skilled brains in public research and industry have been the Framework Programmes, which for decades have required both public-private and international collaboration (see for example Arnold, 2012)
18. The major issues across agencies, also expanding on commercialisation, have been summarised in Wessner, C.E. (ed.) (2008) *An Assessment of the SBIR Program*, The National Academies Press. Important aspects of the SBIR programme, including commercialisation, have also been appraised elsewhere (see for example Wessner, 2000).
19. Patent funds can be defined as entities that invest in the acquisition of titles to patents from third parties, with a view to achieving a return by monetising these patents through sale, use of security interest, licensing or litigation.
20. Executives are asked “How would you rate intellectual property protection, including anti-counterfeiting measures, in your country? [1 = very weak; 7 = very strong]”. Korea scores 4.3. (World Economic Forum, 2013).

References

- Andrews, D. and C. Criscuolo (2013), “Knowledge-Based Capital, Innovation and Resource Allocation: A Going for Growth Report”, *OECD Economic Policy Papers*, No. 4, OECD Publishing. doi: [10.1787/5k46bh92lr35-en](https://doi.org/10.1787/5k46bh92lr35-en).
- Arnold, E. (2012), “Understanding the long-term impacts of R&D funding: The EU Framework Programme”, *Research Evaluation*, 2012.
- Åstebro, T., N. Bazzazian and S. Braguinsky (2012), “Startups by recent university graduates and their faculty: Implications for university entrepreneurship policy”, *Research Policy*, Vol. 41, pp. 663–677.
- Baldini, N. et al. (2010), “The institutionalisation of university patenting activity in Italy: Diffusion and evolution of organisational practices”, SSRN—id1632430 paper.
- Bulut, H. and G. Moschini (2009), “US universities’ net returns from patenting and licensing: a quantile regression analysis”, *Economics of Innovation and New Technology*, Vol. 18, pp. 123-137.
- Becher, G. and S. Kuhlmann, (eds.), 1995, “Evaluation of Technology Policy Programmes in Germany”, Boston/Dordrecht, London 1995, Kluwer Academic Publishers
- Bourellos, E., M. Magnusson and M. McKelvey (2012), “Investigating the complexity facing academic entrepreneurs in science and engineering: the complementarities of research performance, networks and support structures in commercialisation”, *Cambridge Journal of Economics*, Vol. 36, No. 3, pp. 751-780.
- Brunt, L., J. Lerner, and T. Nicholas, (2011), “Inducement Prizes and Innovation”, Harvard Business School Working Paper 11-118, December 5, 2011
- Colyvas, J., M.Crow, A.Gelijns, R.Mazzoleni, R.R. Nelson, N.Rosenberg and B. N. Sampat (2002), “How Do University Inventions Get into Practice?”, *Management Science*, Volume 48 January: 61-72.
- European Commission (2012), “Interim Findings 2011 of the Knowledge Transfer Study 2010-2012”, Bonn/Maastricht/Solothurn.
- Fini, R., R. Grimaldi and M. Sobrero (2009), “Factors fostering academics to start up new ventures: an assessment of Italian founders’ incentives”, *The Journal of Technology Transfer*, Vol. 34, pp. 380-402.
- Gulbranson, C.A. and D. Audretsch, (2008), “Proof of concept centers: accelerating the commercialisation of university innovation”, *Journal of Technology Transfer*, Volume 33, pp. 249-258.
- House of Commons, Science and Technology Committee (2013), “Bridging the valley of death: improving the commercialisation of research”, London: The Stationary Office Limited.
- Kalil, T. (2006), “Prizes for Technological Innovation”, The Brookings Institution.
- Kay, L. (2011), “Managing Innovation Prizes in Government”, IBM Center for the Business of Government.
- Kenney, M. and D. Patton (2009), “Reconsidering the Bayh-Dole Act and the current university invention ownership model”, *Research Policy*, Vol. 38, pp.1407-1422.

- Lam, A. (2011), “What Motivates Academic Scientists to Engage in Research Commercialisation: ‘Gold’, ‘Ribbon’ or ‘Puzzle’?”, *Research Policy* 40: 1354-68.
- Litan, R.E., L. Mitchell, and E.J. Reedy (2007), “Commercialising University Innovations: Alternative Approaches”, National Bureau of Economic Research Working Paper.
- Lockett, A., and M. Wright, (2005), “Resources, capabilities, risk capital and the creation of university spin-out companies”, *Research Policy*, Vol. 34, pp. 1043–1057.
- McKinsey (2009), “And the Winner is ...”, McKinsey & Company.
- Mowery, D. C., R.R. Nelson, B.N. Sampat, and A.A. Ziedonis, (2004), “Ivory tower and industrial innovation: University-industry technology before and after the Bayh- Dole Act in the United States”, Stanford, California: Stanford Business Books, Stanford University Press.
- Müller, K. (2010), “Academic spin-off’s transfer speed – Analysing the time from leaving university to venture”, *Research Policy*, Vol. 39, pp. 189-199.
- NSTC (2010), “GRIs Plans of S&T for Efficiency”, National Science and Technology Council, Korea.
- NSTC (2011), “R&D Activity Survey”, National Science and Technology Council, 2011, Korea.
- NSTC (2013), “Science Citation Index Analysis”, National Science and Technology Council, July 2013, Korea.
www.index.go.kr/egams/stts/jsp/potal/stts/PO_STTS_IdxMain.jsp?idx_cd=1334
- O’Shea, R. P., T.J. Allen, K.P. Mores, O. O’Gorman, and F. Roche, (2007), “Delineating the anatomy of an entrepreneurial university: The Massachusetts Institute of Technology Experience”, *R&D Management*, Vol. 37, pp. 1–16.
- OECD (2014), “Main Science and Technology Indicators”, Vol. 2013/2, OECD Publishing. doi: [10.1787/msti-v2013-2-en](https://doi.org/10.1787/msti-v2013-2-en)
- OECD (2013a), “OECD Science, Technology and Industry Scoreboard 2013: Innovation for Growth”, OECD Publishing. doi: [10.1787/sti_scoreboard-2013-en](https://doi.org/10.1787/sti_scoreboard-2013-en)
- OECD (2013b), “Commercialising Public Research: New Trends and Strategies”, OECD Publishing, Paris. doi: [10.1787/9789264193321-en](https://doi.org/10.1787/9789264193321-en)
- OECD (2013c), “OECD Reviews of Innovation Policy: Sweden”, OECD Publishing, Paris. doi: [10.1787/9789264184893-en](https://doi.org/10.1787/9789264184893-en)
- PACEC (2012), “Strengthening the Contribution of English Higher Education Institutions to the Innovation System: Knowledge Exchange and HEIF Funding: A report for HEFCE”, April 2012.
- Park, K (2013), “The Effectiveness of Patents and the Determinants of Patenting Activities in Korea, in WIPO”, *The Economics of Intellectual Property in the Republic of Korea*, WIPO Publication, No.1031 E.
- Rasmussen, E. and R. Sørheim (2012), “How governments seek to bridge the financing gap for university spin-offs: proof-of-concept, pre-seed, and seed funding”, *Technology Analysis & Strategic Management*, Vol. 24, pp. 663-678.

- SMBA (2012), “2011-2012 KOSBIR Report for NSTC”, Small and Medium Business Administration, 2012.
- Soh, B., J. Lee, and D. Kim, (2013), “The Impact of Copyright Law on the Musical Industry in Korea, in WIPO”, *The Economics of Intellectual Property in the Republic of Korea*, WIPO Publication, No.1031 E.
- Stevens, A. J., G. A. Johnson and P. R. Sanberg (2012), “The role of patents and commercialisation in the tenure and promotion process”, *Technology & Innovation*, Vol. 13, pp. 241-248.
- STEPI (2011), “Analysis of university faculty members’ collaborations with industries in Korea: Policy implications for promoting University-Industry links, Science and Technology Policy Institute”, *Policy Research* 2011-30, 2011.
- STEPI (2012a), “Vitalisation of Technology-based Startup by Inspiring Entrepreneurship”, Science and Technology Policy Institute, *Policy Research* 2012-11.
- STEPI (2012b), “Redesigning New Role and Management System of Government Supported Research Institutes”, Science and Technology Policy Institute, *Policy Research* 2012-02, 2012
- Toschi, L. (2013), “Mapping University Seed Funds and Proof of Concepts Funds in Europe: Initial evidence from the FinKT project”, Workshop Presentation on “Financing Knowledge Transfer in Europe”, Bologna, February 06, 2013.
- Thursby, J., and M. Thursby (2001), “Objectives, characteristics and outcomes of university Licensing”, *Journal of Technology Transfer*, Vol. 26, pp. 59–72.
- Van Looy, B., M.Ranga, J.Callaert, K.Debackere and E.Zimmerman (2004), “Combining Entrepreneurial and Scientific Performance in Academia: Towards a Compound and Reciprocal Matthew-effect?”, *Research Policy*, 33, 425-41.
- Veugelers, R. et al. (2012), “The participation of universities in technology development: do creation and use coincide? An empirical investigation on the level of national innovation systems”, *Economics of Innovation and New Technology*, Vol. 21, pp. 445-472.
- Wallsten, S. (2000), “The effects of government-industry R&D programmes on private R&D: the case of the Small Business Innovation Research Programme”, *Rand Journal of Economics*, Vol. 31, N°1 (Spring 2000).
- Wessner, C.E. (ed.) (2000), “The Small Business Innovation Research Programme (SBIR): An Assessment of the Department of Defense Fast Track Initiative”, The National Research Council.
- Williams, H. (2012), “Innovation Inducement Prizes: Connecting Research to Policy”, *Journal of Policy Analysis and Management*, Vol. 00, No.0, 1-25.
- WIPO (2013), “PCT Yearly Review”, World Intellectual Property Organisation, Economics & Statistics Series, 2013.
- World Economic Forum (WEF) (2013), “The Global Competitiveness Report”, available at: www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf.

Chapter 5

Encouraging more start-ups and SME growth in Korea

This chapter examines selected indicators of entrepreneurship and SME development in Korea. Key framework conditions are examined, along with policies and programmes in fields ranging from entrepreneurship education and SME finance to business incubation. An assessment is made of possible ways forward for policy.

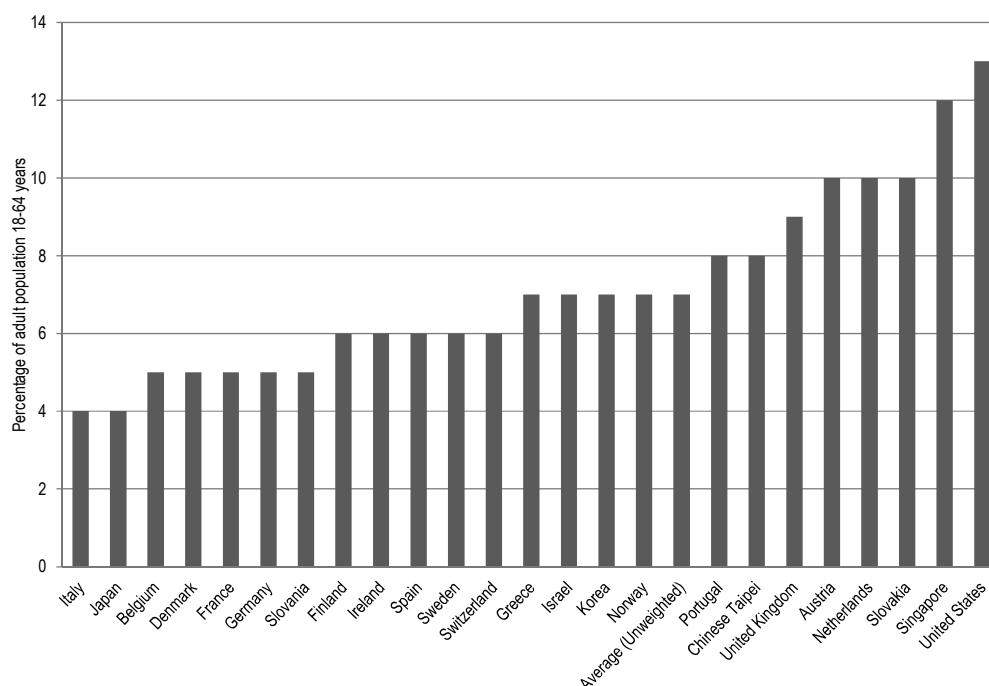
The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

The Creative Economy Strategy seeks to invigorate entrepreneurial activity in Korea. This change is aimed at increasing rates of business creation and the presence of fast-growing young and small firms. A wide range of policies and support programmes are envisaged or already underway. Section 5.1 briefly examines selected indicators of the state of entrepreneurship in Korea. Section 5.2 describes a number of framework conditions and examines key policies and programmes being pursued by the government in fields ranging from entrepreneurship education to business incubation. Section 5.3 considers some ways in which existing initiatives might be modified and possible ways forward for policy overall.

5.1. Salient features of entrepreneurship in Korea

- *Entrepreneurial activity.* The rate of total entrepreneurial activity (TEA) refers to the percentage of individuals aged 18–64 years who are in the process of starting, or are already running, a new business. The TEA in Korea stands at 7%, far below the United States (13%) and Singapore (12%), but above a number of European countries such as France and Belgium (Figure 5.1).

Figure 5.1. Total entrepreneurial activity (TEA) rates

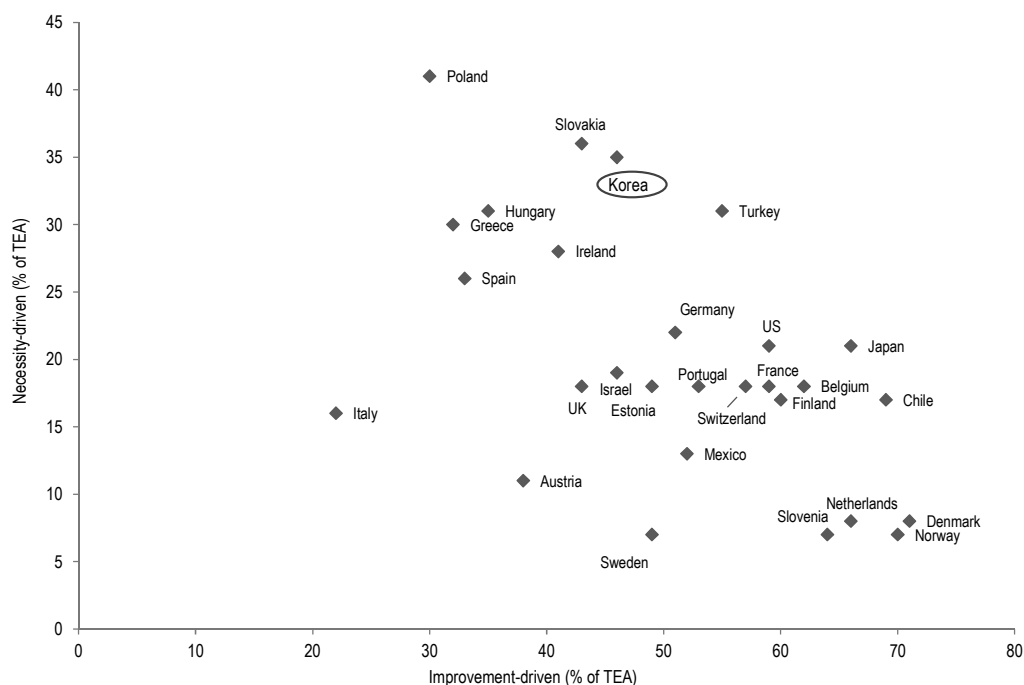


Source: GEM (2012), “Global Entrepreneurship Monitor 2012 Global Report”, www.gemconsortium.org/docs/2645/gem-2012-global-report

- *The incidence of new firms which are employers.* Compared to non-employer firms, new firms that take on employees are more closely related to the concept of entrepreneurship as a driver of job creation and innovation. In this connection, Korea performs well: around 15% of new firms were employers in 2010 and 2011, the highest figure amongst OECD countries with available data (and comparing to just 3% in the United States in 2011).

- *Types of entrepreneurial activity.* Entrepreneurial activity can be divided into necessity-driven entrepreneurs who start a business because there are no other options, and improvement driven entrepreneurs seeking to realise opportunities. Compared to other OECD countries, Korea shows a relatively high level of necessity-driven entrepreneurship (35%) and a correspondingly low rate of improvement-driven entrepreneurship (46%) (Figure 5.2). As discussed in Chapter 6, necessity-driven entrepreneurship appears especially prevalent in the services sector, where among other developments retirees and persons laid off from their companies during the crisis started new low-skill low-capital requirement businesses.

Figure 5.2. Percentage of improvement- and necessity-driven entrepreneurs

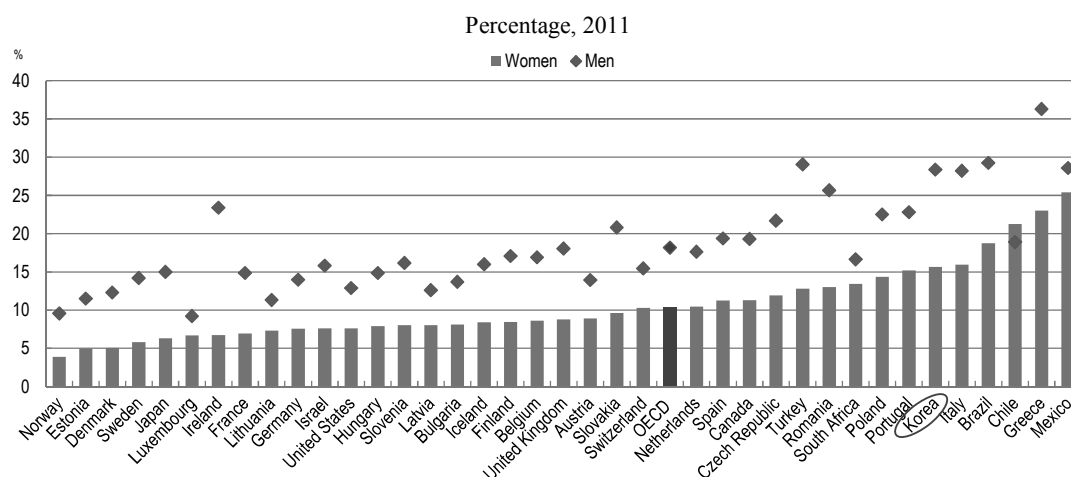


Source: OECD, based on data from GEM (2012), “Global Entrepreneurship Monitor 2012 Global Report”, www.gemconsortium.org/docs/2645/gem-2012-global-report

- *Enterprise deaths.* The death of enterprises is an integral part of the phenomenon of entrepreneurship. Knowing the percentage of firms that die in a given year, and how this measure changes over time, is of interest to policy makers seeking to understand the process of creative destruction (many studies now show the economic importance of the total process of firm births and deaths, linked as it is to resource reallocation to higher-value uses).¹ The *employer enterprise death rate* corresponds to the number of deaths of employer enterprises as a percentage of the population of active enterprises with at least one employee. Illustrative of a process of considerable entrepreneurial dynamism, Korea again has a high reading on this indicator, at 12.6% (in 2010). Among OECD countries for which data are available only Australia (13.5%) and Hungary (18.5%) registered higher figures that year.

- Female entrepreneurship.** Entrepreneurship among women is a key source of employment creation and innovation. Given their widespread availability, self-employment data are often used to monitor women's entrepreneurship. Across the OECD area overall, around 8.3% of the self-employed were employers in 2011. Of this figure, 6 percentage points were accounted for by male employers, and 2.3 percentage points by female employers. In Korea, the equivalent figures are 3.2 (female) and 8.3 (male). Scope clearly exists for augmenting female entrepreneurship in Korea. Data from 2010, collected as part of the Global Entrepreneurship Monitor study, show that female entrepreneurs, as a percentage of all entrepreneurs, are fewer in Korea than in any other OECD economy except for Turkey.² OECD data also show that the share of self-employed women in Korea was 15.7% in 2011, above the OECD average (10.4%) but some way behind the rate for self-employed Korean men (28.4%) (Figure 5.3).

Figure 5.3. Share of self-employed men and women



Source: OECD (2013), *Entrepreneurship at a Glance 2013*, OECD Publishing. doi: [10.1787/entrepreneur_aag-2013-en](https://doi.org/10.1787/entrepreneur_aag-2013-en).

- Youth entrepreneurship.** International data on rates of youth entrepreneurship that also include Korea are not plentiful. However, OECD (2011a) shows that 48.6 % of Korean entrepreneurs were less than 45 years old in 2010. This figure is below the OECD average of 55.2%.³ Most countries ranking highly on this indicator are lower-income economies with relatively young populations. It is striking, therefore, that Korea has a relatively low rate of entrepreneurship among under-45s, while also having one of the youngest populations in the OECD area.
- Entrepreneurial perceptions, opportunities and skills.** The position of the entrepreneur in Korean society may not currently be as esteemed as in some other OECD member countries. Survey data from 2012 indicate that only 34% of Korean adults hold a 'broadly favourable image of entrepreneurs'. Only two OECD countries register a lower figure (Hungary and Japan) (OECD, 2013). Data from the Global Entrepreneurship Monitor and McKinsey also suggest that in 2012 South Koreans were among the least likely to see opportunities to open a business, and were among the least confident in their entrepreneurial skills. But about 60% of Korean adults consider that schools help to understand the role of entrepreneurs in society, a figure exceeded by only four other OECD member countries (Finland, Iceland, Portugal and Turkey).

Table 5.1. Perceptions and attitudes towards entrepreneurship in selected economies

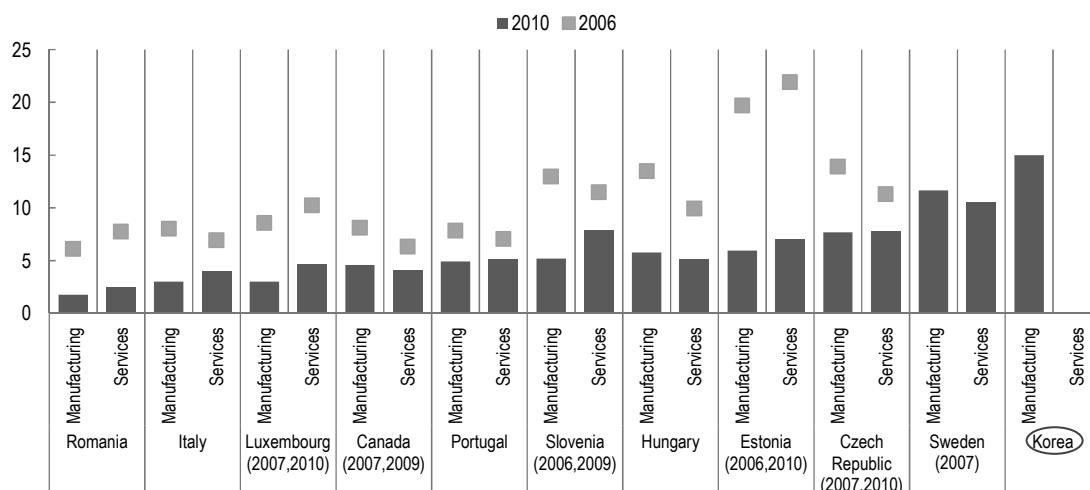
% of respondents, 2012

	Interested in entrepreneurship	Perceived opportunity and capability in entrepreneurship	
	Consider entrepreneurship an interesting career	See good opportunities to start a business	Believed to have skills, knowledge to start business
United States	65 ¹	43	56
Netherlands	79	34	42
United Kingdom	50	33	47
Germany	49	36	37
France	65	38	36
Israel	59	31	29
Singapore	50	23	27
Chinese Taipei	70	39	26
Korea	59	13	27

1. 2010 data.

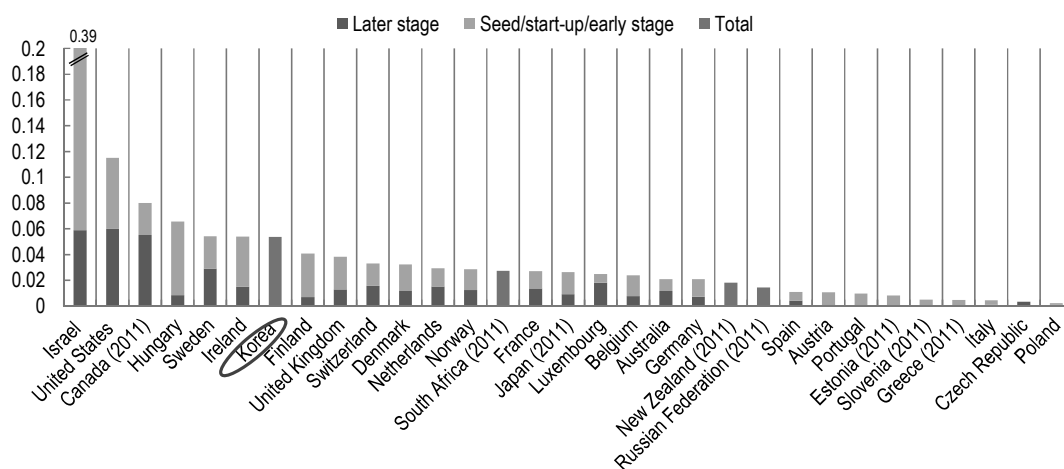
Source: GEM (2012), *Global Entrepreneurship Monitor 2012 Global Report*,
www.gemconsortium.org/docs/2645/gem-2012-global-report

- *Enterprise size and contributions to value added.* In all OECD countries between 70% and 95% of all firms are micro-enterprises, i.e. firms with less than ten persons employed. In 2010, over 96% of all firms in Korea were micro-enterprises, the second highest rate among OECD member countries (after Turkey). However, the share of total value added contributed by micro-enterprises, at just 5.4 % - in 2006 – was the second lowest in the OECD area after Japan (OECD, 2013). Large firms, with over 250 employees, contribute almost 55% of total value added – the highest share among OECD member countries. These data together indicate a particular structural feature of the Korean economy, namely that large firms predominate in terms of output and value creation, and operate in the midst of large numbers of relatively unproductive microenterprises.
- *A significant incidence of high-growth firms in manufacturing.* High-growth enterprises are firms that by their exceptional growth make major contributions to net job creation, despite typically representing a small proportion of the business population. High-growth enterprises, as measured by turnover, are enterprises with average annualised growth in turnover greater than 20% a year, over a three-year period, and with ten or more employees at the beginning of the observation period. Recent data on this indicator that also include Korea are only available for 11 (mostly small) OECD economies. Nevertheless, among countries for which data exist, in the manufacturing sector in 2010 Korea's percentage of high-growth firms, at 15%, was the highest (the next highest figure is Sweden, at 11.6%, in 2007) (Figure 5.4).

Figure 5.4. Percentage of high-growth enterprises (by turnover growth)

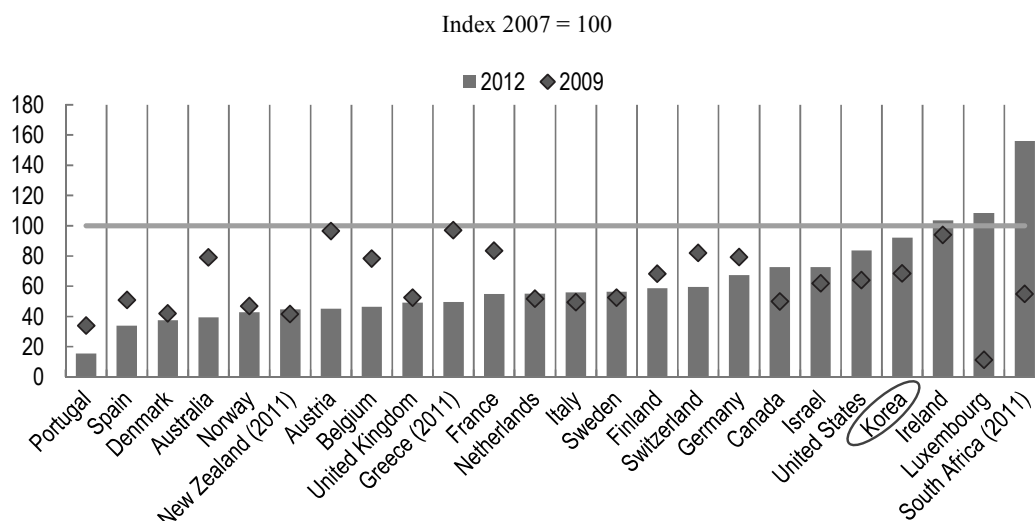
Source: OECD (2013), *Entrepreneurship at a Glance 2013*, OECD Publishing. doi: [10.1787/entrepreneur_aag-2013-en](https://doi.org/10.1787/entrepreneur_aag-2013-en).

- *Total venture capital activity is relatively high.* Overall venture capital investment reached almost .06% of GDP in 2012, the seventh highest among countries for which data are available, although far behind the outliers of Israel (0.5% of GDP) and the US (0.2%) (Figure 5.5).

Figure 5.5. Venture capital investments as a percentage of GDP, 2012 or latest available year

Source: OECD (2013), *Entrepreneurship at a Glance 2013*, OECD Publishing. doi: [10.1787/entrepreneur_aag-2013-en](https://doi.org/10.1787/entrepreneur_aag-2013-en).

- *The economic crisis severely affected the venture capital industry in Korea, but recovery has been quicker than in many other OECD countries.* In 2012 the level of venture capital investment in most countries was around 60% of that in 2007. In Korea the corresponding figure was 92% (Figure 5.6). Venture capital firms in Korea reported raising the equivalent of USD 191 million in the first quarter of 2013, up slightly from USD 189 million a year earlier. The high penetration of smart mobile devices has also enabled entrepreneurs in Korea to launch start-ups through mobile platforms.

Figure 5.6. Trends in venture capital investments

Source: OECD (2013), “Entrepreneurship at a Glance 2013”, OECD Publishing. doi: 10.1787/entrepreneur_aag-2013-en.

- *The Korea Angel Investment Association was formed, led by angel investors, in 2012.* The number of angel investors in 2011 registered in the Angel Investment Support Centre, established at the end of November 2011, is over 2 390. Fifty-seven angel clubs are registered at the same centre. Angel investment in Korea decreased extremely rapidly with the collapse of the IT boom in 2000 (Table 5.2).⁴ The share of angel investment in all venture and early-stage equity investment is extremely small.

Table 5.2. Business angel investment in Korea, 2000-11

Year	2000	2001	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011
Number of firms invested in	1 291	1 007	573	453	194	174	238	220	152	87	83	39
Investment (KRW 100 mil.)	5 493	3 409	1 109	3 013	463	820	971	897	492	346	326	296
Number of angels making investments	28 875	12 002	4 717	3 964	2 246	2 107	2 727	2 170	1 742	1 243	748	619

Source: SMBA (2012), “The Era of Angel Investment, Small and Medium Business Administration”, Press, 10 December.

5.2. Key policies and institutions

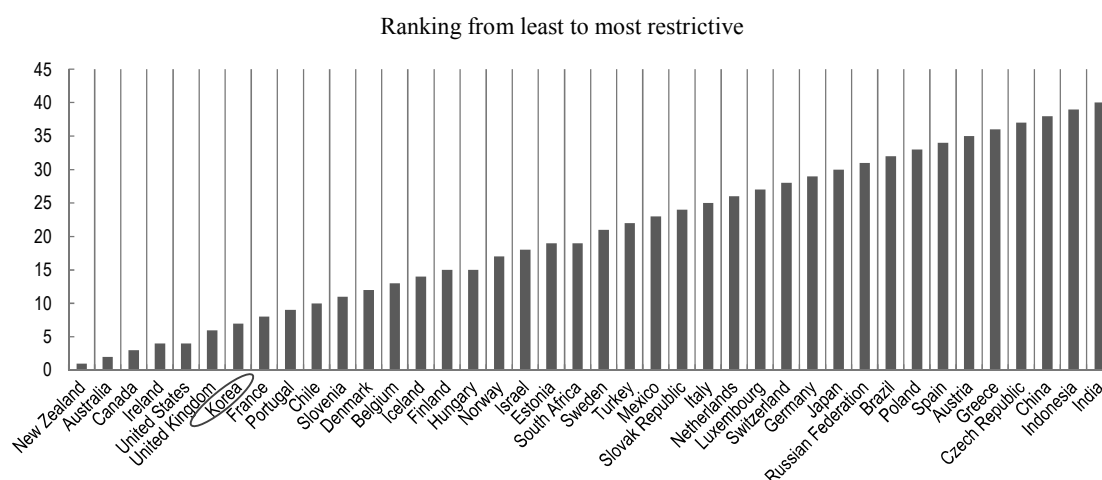
Regulation and other framework conditions

The OECD’s Product Market Regulation database indicates low barriers to entrepreneurship in Korea. Among OECD member countries, the least restrictive country in terms of barriers to start-up is New Zealand. Korea is ranked 7th among OECD countries (the indicator is a composite measure of the procedures, time and costs necessary to register and operate a new business) (Figure 5.7). Other data also suggest that establishing a company in Korea is straightforward and that regulatory barriers are relatively low.

Rules also appear to be clear. According to the World Bank's *Doing Business*, starting a business in Korea requires just five procedures, takes seven days, costs 14.6% of average income per capita and requires no paid-in minimum capital. *Doing Business* places Korea 24th globally in terms of the ease of starting a business (and 8th globally as regards the ease of doing business more generally).

The government is taking steps to lower regulatory burdens on business more generally, not just at start-up. All regulations now have to pass through the Special Commission for deregulation and consideration is being given to the introduction of a 'one-in-one-out' approach to new regulations.

Figure 5.7. Barriers to starting a business, 2011



Source: OECD (2012a), *Entrepreneurship at a Glance 2012*, OECD Publishing, doi: [10.1787/entrepreneur_aag-2012-en](https://doi.org/10.1787/entrepreneur_aag-2012-en).

The Industrial Convergence Promotion Law was established in 2011 to address the problems of regulation affecting industries whose innovations entail 'convergence' across technologies. The legislation was driven largely by perceived flaws in the existing system for product standards and approvals. In a recent case, approvals for a truck-forklift hybrid were held up owing to uncertainty whether to classify the item as a truck or a forklift vehicle. In another case, a company was poised to commercialise a "wing ship" design (an airplane-like marine vessel) but was stalled by the lack of pertinent safety standards. The new statute aims in part to remove such hitches.⁵

Corporate tax and the R&D tax credit

The Corporate Income Tax (CIT) rate is already quite low. The rate of capital gains tax on dividends is above the OECD average, but not greatly, and the capital gains taxation of shares is lower than the average (Harding, 2013). Current policy also seems supportive of patient capital: Korea is one of a few OECD countries that do not tax capital gains derived from assets held for longer than a set time period (with Belgium, Chile, the Czech Republic, France and Hungary).

Korea has for some time operated a sizeable R&D tax credit. R&D tax incentives – a market-based tool to reduce the marginal cost to firms of R&D activities – are present in 27 of the 34 OECD member countries (as well as non-member countries such as Brazil, China, India and the Russian Federation). Korea actually provides a wide range of tax

incentives. These include: deduction from income and corporate tax up to a certain percentage (25% for SMEs and 3~6% for non-SMEs) of research and human development costs related to general R&D activity; deduction from income or corporate tax of up to 10% of spending on research and human development facilities; exemption from local tax on real estate owned by corporate in-house R&D institutes; and no tax charge on researchers' income when this derives from a research activity. Also, to strengthen the 17 new growth engines, more generous tax incentives are given for companies involved in those sectors (a deduction from income and corporate tax of up to 30% for SMEs and 20% for non-SMEs for research and human development costs related to the new growth engines).

The total amount of R&D tax credits is provisionally estimated at KRW 2.85 trillion in 2012, an 8.8% (KRW 231.4 billion) increase compared to 2011 (Table 5.3). The R&D tax credit now represents 9.6% of total national tax credits, the highest rate ever. In 2010 59.8% of the R&D tax credits went to large firms, a proportion which has decreased since 2008. There are indications that the current government may reduce tax incentives for large companies.

Table 5.3. Annual R&D tax incentives, Korea, 2007-12

KRW 100 million

	2007	2008	2009	2010	2011	2012 (provisional)
R&D tax incentives (A)	16 388	18 598	18 660	21 307	26 231	28 545
National tax incentives (B)	229 652	287 827	310 621	299 997	296 021	297 317
Rate of R&D incentives(A/B)	7.1%	6.5%	6.0%	7.1%	8.9%	9.6%
Rate of increase in R&D tax incentives	25.5%	13.5%	0.3%	14.2%	23.1%	8.8%

Source: KOITA(2013), “2012 White Paper on Industrial R&D”, Korea Industrial Technology Association.

Bankruptcy procedures

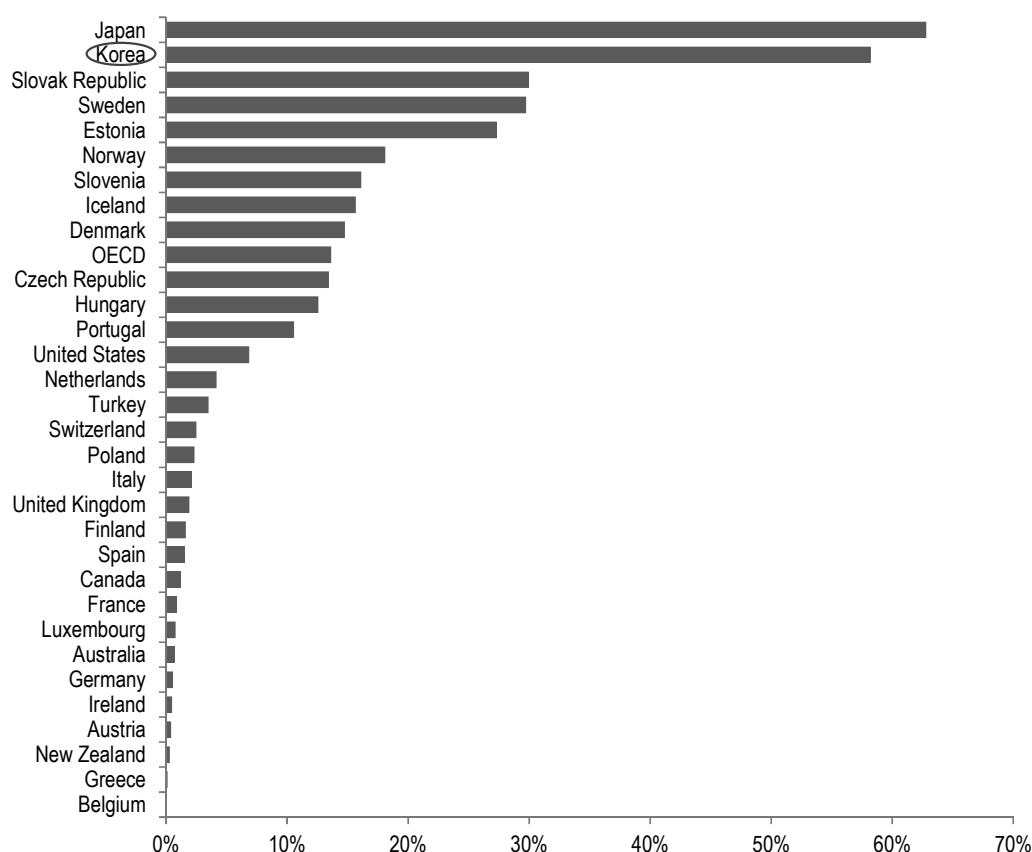
According to *Doing Business 2013*, Korea stands 14th out of 185 economies on the ease of resolving insolvency. This ranking is higher than the OECD average, which is 25.

Korea's “joint liability system” in its bankruptcy law has also recently undergone changes aimed at encouraging entrepreneurship. Under the “joint liability system”, when a company (principal borrower) requested loans from financial institutions, it was required to obtain a written agreement from a co-guarantor to assume secondary debt if it defaults. Once the co-guarantor signed, the co-guarantor assumed the same obligation as the principal borrower to repay debts. In addition, even though the company was exempted from the debt after declaring bankruptcy, the liability of the co-guarantor was not. For SMEs, most of the co-guarantors were the owner of the company, relatives or friends. As a result, the joint liability system was blamed for creating a chain of defaults and making it difficult to recover from failure and start again. In 2012, aware of those problems, the Korean government made changes to the system. It completely abolished the joint liability system for self-employed businesses. For corporations in both the banking and non-banking sectors, only executives and their business partners will be bound to the joint guarantee contracts.

ICT infrastructure

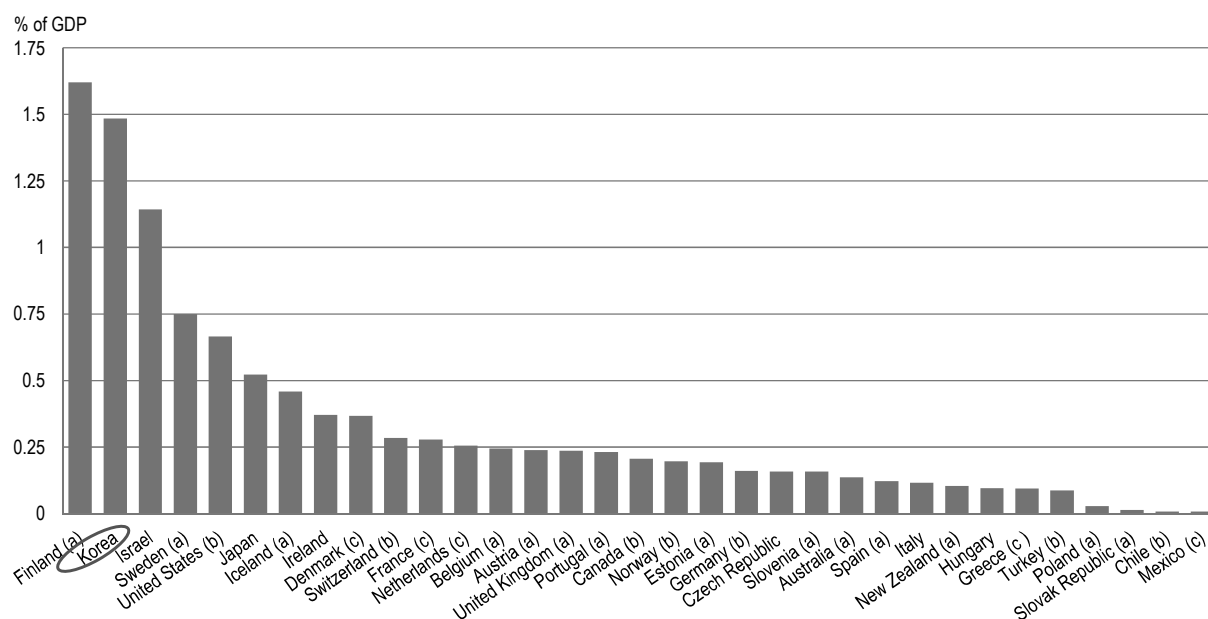
ICT infrastructure supply is an essential complement to business and growth in general and to Internet-based start-ups in particular. Research across the OECD area suggests the existence of a strong positive correlation between ICT infrastructure development and the development of local content, which is clearly relevant to the Creative Economy Strategy. Korea has one of the world's highest rates of broadband penetration. Indeed, Korea's rate of fibre-based broadband connection is the second highest in the OECD area (Figure 5.8).

Figure 5.8. Fibre broadband penetration, 2011



Source: OECD (2012b), *OECD Internet Economy Outlook 2012*, OECD Publishing. doi: [10.1787/9789264086463-en](https://doi.org/10.1787/9789264086463-en).

Relative to their counterparts in other OECD member countries, ICT-based firms in Korea also spend intensively on R&D. As a share of GDP, such R&D expenditure in Korea (1.48%) is exceeded only by that in Finland (1.62%) (Figure 5.9).

Figure 5.9. ICT business' expenditure on R&D (percentage of GDP), 2010 or latest available year

a. 2009; b. 2008; c. 2007

Source: OECD (2012b), *OECD Internet Economy Outlook 2012*, OECD Publishing. doi: [10.1787/9789264086463-en](https://doi.org/10.1787/9789264086463-en).

In Korea, the ongoing shift to a digital economy and growth of the ICT industry laid the foundation for many venture companies to start and grow. Indeed, in many (but not all) years over the past decade, the ICT sector has been the largest recipient of venture capital investment (Table 5.4).

Table 5.4. Venture capital investment by industry in Korea

Unit: number, KRW billions

	2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013	
	Company	Amount	Company	Amount	Company	Amount	Company	Amount	Company	Amount	Company	Amount	Company	Amount	Company	Amount	Company	Amount	Company	Amount	Company	Amount
IT	298	291.4	255	275.7	307	300.6	271	271.3	227	313.7	163	210.5	140	197.0	150	295.6	164	340.9	208	351.1	130	2 534
Manufacturing	110	113.5	103	129.9	99	137.8	106	150.3	141	270.1	96	180.8	121	268.7	129	310.2	148	369.6	132	342.7	71	1 161
Culture & content	126	145.7	122	152.9	133	194.6	131	165.7	126	199.7	142	167.7	159	210.6	185	267.7	209	309.7	246	347.8	149	1 408
Biotechnology	22	17.7	14	12.7	33	65.1	46	60.9	35	58.5	23	40.0	36	63.8	40	84.0	43	93.3	59	105.2	31	572
Services/education	33	31.5	22	15.7	25	27.3	34	43.3	46	96.1	34	51.1	23	39.7	24	63.3	35	53.0	31	23.4	29	178
Distribution	32	21.4	19	12.7	30	22.0	22	29.3	35	35.4	24	34.1	30	49.4	17	31.1	22	74.0	24	31.7	18	284
Recycling	2	2.5	3	1.2	2	2.3	0	0.0	3	5.0	2	1.6	5	9.4	4	6.5	1	1.0	3	10.3	2	30
Others	8	6.9	8	3.6	15	7.6	16	12.5	11	13.2	19	38.9	14	28.5	16	32.6	10	19.3	11	21.1	4	16
Total	630	630.6	544	604.4	635	757.3	617	733.3	615	991.7	496	724.7	524	867.1	560	1 091	613	1 260.8	688	1 233.3	416	6 183

Source: KVCA (2013), "Summer Report, KACA Statistics – 2013.2Q", Korea Venture Capital Association.

Investment by business angels

In November 2011 SMBA established the Angel Investment Support Centre. The Centre is intended to expand the base of the angel investment market by finding and developing angel investors and systematically supporting their investment activities. SMBA has also raised KRW 70 billion for an Angel Investment Matching Fund, which matches the investment that an angel makes in a company (under the same conditions).

Entrepreneurship education

A stated policy goal of the Korean government is to encourage more young people into entrepreneurship. In May 2013 the Ministry of Education announced plans to strengthen university education. KRW 262 billion will be allocated to improve curricula and create advanced education models. Universities must allocate 30% of the amount received to promote start-ups, jobs and industry-university linkages. These resources can also be used to develop start-up education and spread entrepreneurship. In addition, the SMBA is responsible for entrepreneurship education outside of the formal curriculum.

Government support for advice to start-ups

The Korean government operates a wide number of schemes to augment the supply of information and advice to young and small firms. For instance, among the many initiatives, the LINC project – Leaders in Industry-University Co-operation – is cited by civil servants as a good example of support for start-ups. LINC is a project created to foster co-operation between universities and corporations.⁶ Management consultancy advice had been made available for small companies and start-ups via a voucher system. However, evaluations criticised this voucher initiative for attracting some low-skilled unprofessional consultants and funding has been reduced. And an ongoing voucher programme makes it possible for SMEs to use university or research institute-owned research equipment for conducting R&D. The voucher covers up to 70% of the total costs of using the research equipment (up to a ceiling of KRW 50 million). The budget for this programme has been raised gradually since 2007.

The incubation network

Korea's SMBA operates an incubation network. This incubation scheme was established in 1998 with 29 incubation centres. By 2013 there were 275 incubation centres, most of which are run by universities (Table 5.5).⁷ The number of business incubation programmes is reported to be increasing.

Table 5.5. Incubation centres in Korea, 2013

	University	Research institute	Local government	SMC (Small and Medium Business Corp.)	Other	Total
Number of incubation centres	209	25	12	5	24	275

Source: SMBA (2013), "Start-up Incubation Status", Small and Medium Business Administration, Korea.

MOTIE also operates TechnoParks – a form of business incubator funded by central and local government. SMBA Support for incubators takes three forms: business premises, consultancy services on technology and business management, and education and mentoring services. It is reported that the focus was on business incubator premises but is now switching to the advisory and information functions. This funding switch reflects the new creative economy orientation and emphasis on job creation. It is also reported that the SMBA is planning to support more ICT and knowledge-related services.

Policies affecting growth thresholds

A notable aspect of Korea's corporate landscape is the weak presence of medium-sized companies.⁸ One reason for this is the abrupt discontinuation of government support once companies graduate from the SME category (a phenomenon sometimes referred to as the "Peter Pan syndrome"). Under the current law, a company loses its SME status when it has 300 or more regular workers on its payroll or its annual revenue exceeds KRW 150 billion on average for three years. Firms that graduate from the SME class lose access, for instance, to bank loans at low interest, finance from the technical guarantee fund, and a range of tax benefits. In all, such companies can be excluded from, or receive reduced support from, 47 government support measures on tax, marketing and the workforce. With the loss of such support, some SMEs could find themselves in difficult competitive circumstances, for instance with respect to *chaebol* affiliates.

To address this problem, the Korean government has been trying to establish a support system to foster middle-sized companies (MSCs). The Growth Ladder for Middle Sized Companies was announced in September 2013. Middle-sized companies can still benefit from participation in public procurement and R&D tax benefits (which will see an increase in the size of target firms, from less than KRW 300 billion in three-year annual turnover to firms with KRW 500 billion). The government R&D investment for middle-sized companies will be increased from 2.95% (2012) to 5% of all public support for R&D by 2017, and the R&D, human resources, finance and global marketing of middle-sized companies will also be supported through the World Class 300 Project.⁹ Furthermore, a KRW 700 billion fund for middle-sized companies will be established for their global market development.

In addition, Korea's inheritance taxes exemption tends to inhibit SMEs growth. Korea allows business owners to pass on businesses without paying inheritance taxes if the company has been in business for ten years and has operated under a certain level of revenue.¹⁰ The exemption was introduced to encourage owners of small businesses and their children to keep firms in operation, but it has been blamed for discouraging the owners to invest in the R&D and innovation that would help companies grow and become competitive. Also, the owners tend not to seek outside partners to help them expand or look for merger opportunities. Realising those problems, in August 2013 the Korean government announced a plan to increase the maximum revenue requirement for the application from KRW 200 billion to KRW 300 billion.

5.3. Reflections on policy and ways forward in Korea

Building on the description of policies and programmes in section 5.2, this section considers possible ways forward for the key initiatives adopted in Korea to encourage entrepreneurship and SME growth. As emphasised elsewhere in this report (Chapter 6), achieving supportive framework conditions must be the overarching priority. These provide the essential context without which no number of targeted programmes is likely to bring efficient long-term outcomes. Such framework conditions include: competitive markets for products, services (including capital market services) and labour; stable and supportive macro-economic conditions; a predictable and non-punitive system of corporate taxation; education and training policies that allow the efficient matching of the supply and demand for skills; bankruptcy legislation that protects the rights of creditors without imposing excessive exit costs on entrepreneurs; and high quality infrastructure.

The R&D tax credit

A broad discussion of the merits of R&D tax credits is not intended here. However, in the light of new OECD analyses of R&D tax credits, a number of points may need to be borne in mind by Korean policy makers when considering the use of this instrument and its relevance to the Creative Economy Strategy:

- R&D tax credits might be of greatest benefit to firms and forms of innovation that are not the primary focus of the Creative Economy Strategy. Direct evidence of the positive impact of R&D tax incentives on innovation is somewhat mixed. Some research shows a positive effect of R&D tax incentives on incremental innovations but not on innovations new to the market. This suggests that such a policy may primarily benefit incumbent firms, possibly slowing the reallocation of resources towards more innovative entrants. These findings are clearly relevant to the aims of the Creative Economy Strategy, which seeks to encourage and assist radical innovation in new firms.
- *Policy makers should examine design features of R&D tax credit programmes that could make them hard to access by firms in creative industries.* For example, NESTA (2013) points out that R&D tax relief may be hard to access for games businesses, because innovation in games companies is usually organised around collaborative projects across multiple teams, rather than being housed in a single R&D department (as happens for instance in the pharmaceuticals sector). Because R&D and production are intertwined, it is difficult to account for staff time when preparing R&D tax relief claims. Furthermore, NESTA (2013) observes that the success of innovative games technologies, software and designs is frequently a function of tests with users, but that such testing does not – in the United Kingdom at least – qualify for the R&D tax relief.
- *Design features of the R&D tax credit are also directly relevant to Korea's aim to strengthen radical innovation in small (often service sector) firms.* In particular, R&D tax credit programmes that lack carry-over provisions or cash refunds may provide less assistance to young and small firms than other forms of innovation support, as such firms typically lose money in the early years of an R&D project. The use of payroll withholding tax credits for R&D-related wages, whereby firms receive an immediate refund for expenditure on the wages of R&D personnel, is another way to provide support for (young) firms in a loss position.
- *The effectiveness of R&D tax incentives also depends on the stability of the policy regime over time.* This consideration merits mention on account of the rapid development of new policies and programmes in Korea linked to the Creative Economy Strategy. New OECD evidence shows that in countries that have experienced a large number of R&D tax policy reversals, the impact of R&D tax credits on private R&D expenditure is greatly diminished. Accordingly, if alterations are envisaged to R&D tax credit arrangements in Korea, these should follow thorough evaluation, with alteration only occurring when there is compelling evidence for the benefit of change.
- *With a view to encouraging the commercialisation of research, attention might be given to the use of the R&D tax credit to encourage industry-university collaboration.* The latest information available to the OECD indicates that Korea's R&D tax credit system includes R&D subcontracted to academic institutions. However, it appears that no additional benefit is had when the R&D is

undertaken collaboratively. By contrast, R&D tax credit arrangements in a number of other countries offer significant additional incentives for collaborative research, above and beyond the tax credit received when R&D is undertaken in-house. In Hungary, for instance, a company's taxable income is reduced by up to 300% of the amount spent in collaborating with academic institutions. Various strands of evidence point to the benefits of collaborative R&D. Collaborative R&D has been shown to positively affect the technological capacity of firms even controlling for the possibility that more dynamic firms might also collaborate more often (Barajas, Huergo and Moreno, 2012). Block and Keller (2009) demonstrate a dramatic rise in the United States of domestic award-winning innovations that involve inter-organisational collaborations. Collaboration can reduce the costs of R&D – and help avoid the inefficiency of duplicative research – while creating skills-related synergies that are particularly large when collaborators possess significantly different skills and knowledge (Sakakibara, 1997).

Government support for advice to start-ups

Korea ranks only 46th on World Economic Forum's indicator 'Government provision of services for improved business performance'. This indicator, used in a survey of executives, asks the question: "To what extent does the government in your country continuously improve its provision of services to help businesses in your country boost their economic performance?". It is of course difficult to draw conclusions from such a generally-framed single item of data. However, the fact that there may be unmet demand in terms of the quantity or quality of government-provided support services does highlight that policy makers may wish to re-examine the service offering, while bearing in mind some findings from the (albeit limited) international evaluative literature on general business advisory services. Of particular relevance to the current Korean context might be the following:

- *Market need must be tested before the introduction of new programmes.* Many persons starting a company have only a vague conception as to how they will undertake the formation of the enterprise and its management. There is abundant evidence that superior management capabilities are central to enterprise survival and growth. Access to information and advice is a key aspect of sound management. But whether the market works well in providing advisory and information services to new and small firms is a contested subject, and market failure may be less frequent than is claimed (after all, the Internet is augmenting information supply to small firms, and many providers of technical and managerial information have a strong interest in demonstrating products, equipment and services to potential small-firm clients). This highlights the need for some sort of demand assessment prior to the introduction of new programmes.
- *Attending to market signals is likely to increase the relevance and quality of programmes.* The need for policy initiatives is often assumed rather than tested.¹¹ Even cash-constrained start-up firms are often willing to express a market demand for services they consider meet a genuine need.
- *Information should be available to entrepreneurs on where they can find high-quality privately provided advice and mentoring.* Firms use a wide variety of sources for obtaining information and advice, from banks and accountants, to solicitors, suppliers, customers, trade associations and social-professional groupings. Private sources predominate in terms of frequency of use, which may

in part reflect the specialist knowledge possessed by private sources as well as the confidence engendered by the (self)-regulation that governs professions such as banking and accounting. Different information sources appear to be used for different purposes. A multipurpose and particularly highly valued information source is a small firm's network with other firms. Indeed, in many surveys business owners maintain that they would profit from greater contact with entrepreneurs who operate companies similar to their own. All of this points to the fact that governments would do well to orient their support to facilitating a well-functioning on-call referral service to privately provided advice and mentoring.¹² Many different sorts of providers of advice could be included in a referral system. As well as mainstream for-profit providers, industry associations, chambers of commerce, non-governmental organisations and business mentors could all play important roles. The institutional idiosyncrasies of different countries mean that there is no optimal model of delivery.¹³ Entrepreneurs should not face time-consuming procedures in finding advice. Authorities should prepare easily comprehensible guides to business support services as well as contacts directories. Steps should also be taken through local media to ensure awareness that this information exists.¹⁴

- *Of direct relevance to the Creative Economy Strategy is that there may also be a tendency for government agencies to provide survival rather than growth-oriented advice.* This is because clients often approach government services when they are in difficulty, while survival-oriented advice is also appropriate to most firms (Mole, 2000). While evidence on the impact of advisory services is limited, growth in recipient firms may be most closely associated with private sources of advice such as lawyers, accountants, customers, and friends in business.
- *Advice for SMEs/start-ups on developing overseas markets could also be valuable, because high-tech start-ups in particular need to cater to an international market and, more generally, survival rates are positively correlated with the distance over which one trades.*

Business incubation

Policy makers must carefully choose the evaluation criteria used to assess business incubators, as this could affect programme performance in important ways. Evidence demonstrating the efficacy of business incubators as an instrument to develop successful spin-offs is limited (Salvador, 2011). This heightens the importance of robust evaluation. In Korea, programme managers report that the main indicators used to evaluate incubation programmes in Korea are business turnover and job creation. Across countries, job creation is a frequently used metric of the performance of incubation schemes. However, it is relevant to the Creative Economy Strategy to note that if business development and growth are principal objectives, job creation might not be the most suitable short- or medium-term indicator of incubator performance. By evaluating and monitoring schemes against inappropriate criteria, the chances of eventual success could in fact be reduced. The focus of incubation should be on enterprise development rather than employment growth. Most job creation often occurs after tenant firm's graduate from incubators. Employment growth will generally follow successful commercial outcomes. Therefore, measures of incubator performance should focus on different dimensions of enterprise development. These might include, for example, the time that enterprises need to establish market niches or develop new products, the adoption of advanced management practices, and the use of superior technologies. A concentration on job counting in programme evaluations might result in schemes being classified as unsuccessful when they could in

fact create jobs over a longer time period. Employment-oriented evaluation undertaken in the early stages of an incubation programme could yield particularly misleading results.

Youth entrepreneurship

Especially in the digital economy, and across a number of OECD countries, some young business founders have helped to create entirely new industries, and this group needs to be facilitated. But promoting youth entrepreneurship can involve some important trade-offs. It is the case that in some countries schemes explicitly aimed at young entrepreneurs, such as the Prince's Youth Business Trust in the United Kingdom, have established a considerable record of success.¹⁵ However, young entrepreneurs generally face a number of obstacles that are more severe than for older cohorts. For example, working from home, the start-up site of choice for many entrepreneurs, is often problematic for young people. Social skills needed for business may be lacking (for instance, younger people can feel uneasy attempting to sell to older people). The key constraints reflect inadequate human and financial assets, and limited work and business experience. The human capital constraint is evidenced in many studies showing that the age of the entrepreneur is an important determinant of enterprise survival.¹⁶ These stylised facts tend to the conclusion that, at least as a remedy for unemployment amongst disadvantaged youth, the promotion of entrepreneurship will have limited effect.

How then should policy makers approach the challenge of assisting youth entrepreneurship in ventures with significant growth potential, which is the focus of the Creative Economy Strategy? Establishing separate public schemes for youth might be inefficient (adding unnecessarily to administrative overhead costs). Rather, existing programmes might be adapted and advertised in a variety of specific ways. Training and mentoring networks will be critical in helping to compensate for inadequate prior experience in business. And because young people generally have limited financial resources of their own, assistance in the preparation of business plans and loan applications is particularly important. Business advisors might need to possess, or be able to call on, specialised sectoral knowledge, as young people sometimes develop business ideas in fields such as the music industry and aspects of information technology that may be less common among older entrepreneurs.

With respect to entrepreneurship education, unconfirmed reports indicate that there are too few teachers of entrepreneurship in Korea. If this is the case, this situation would need to be remedied. More generally, realistic expectations are needed about what entrepreneurship education can achieve. Entrepreneurship education is unlikely to greatly affect the share of the student body that engages in entrepreneurship, but is more likely to have effects on the timing of start-up decisions and eventual project quality.

Social enterprise

Korean policy makers might also consider steps to enable social enterprise. Little mention is made of social enterprise in current Korean policy statements on entrepreneurship. This sector should not be forgotten, given its growing role in some countries in generating jobs, invigorating the supply of services and helping to meet social needs).¹⁷

Entrepreneurship among women

Research suggests a number of distinctive characteristics to female entrepreneurship, which could usefully be reflected in the design of support programmes. One goal of policy in Korea is to increase women's involvement in start-ups. As derived from studies in countries other than Korea, there are some stylised features of women's entrepreneurship which may need to be taken into account in the design of policy and support programmes. For example, women frequently elect business opportunities that can be combined with family responsibilities. And for a number of reasons women tend to initiate smaller projects than men and often commence with lower growth expectations. The smaller size of female-owned businesses may also explain some research – which is not unanimous – showing higher rates of enterprise failure in these firms. Also relevant to Korea is that entrepreneurship among women is often concentrated in service sector businesses (reflecting broader sectoral patterns of women's labour market participation). The fact that women-owned businesses are disproportionately present in the service sector can also raise financial hurdles if the assets of these firms are less tangible and more difficult to value as collateral. Other research suggests that women are more likely to create and work in (mixed gender) start-up teams rather than sole proprietorships.

A number of considerations would likely need to be borne in mind if trying to increase rates of female entrepreneurship. In the first instance, government is critical in enabling the provision of high-standard, reliable and affordable childcare services, without which entrepreneurship will be an excessively demanding challenge for many women. Policy makers in Korea will also need to guard against circumstances in which women face a bigger reduction in wages than men should they try self-employment and then switch back to waged employment (an outcome for which there is evidence in the United States). Societal attitudes may also need to shift. If sexism is an obstacle, the economic importance and achievements of women's entrepreneurship should be publicly highlighted and equal treatment enshrined in law and actively enforced (studies in a number of countries indicate that women are more likely to be asked for (co)-guarantors, are more frequently requested to provide collateral, and also have the perception of not being taken seriously by bank staff). Enterprise development organisations can play a role in changing attitudes in the business community. There are also reasons for selectively adapting support programmes in a variety of ways.¹⁸

Access to Finance

Qualitative data gathered by the World Economic Forum suggest that access to credit is problematic (Korea ranks 115 of 144 countries in this respect). However, further evidence is required to corroborate and interpret this particular indicator. Korea has for many years implemented large-scale initiatives to ease access to affordable credit for the business sector. As described in Chapter 2, new programmes and policies in Korea aimed at easing access to all forms of enterprise finance are many and large. A full review of the merits of these multiple initiatives is beyond the scope of this report. However, a number of policy-relevant observations can be made:

- *Given the objectives of the Creative Economy Strategy, the current focus on facilitating access to early-stage equity is appropriate.* This is also where market failures and/or gaps are most likely to be binding. This policy orientation is also welcomed by the private sector.

Box 5.1. Policies to develop venture capital in OECD countries

According to a recent questionnaire (Wilson and Silva, 2013), most OECD countries have some type of government equity programme in place. These programmes vary across countries but typically fall into three main areas: direct investment through government funds, fund-of-funds and public/private co-investment funds.

Direct public funds

These are funds with 100% public capitalisation and which, like venture capital funds, invest directly in start-up firms. Many early efforts to support venture capital followed this approach. However, for the most part the results were not positive. Issues such as crowding out, lack of proper incentives, and lack of investment skills often prevented these funds from achieving their goals (Lerner, 2009).

Fund of funds

A “fund of funds” is an investment strategy that consists in holding a portfolio of other investment funds. Rather than investing directly in start-up firms, public funds of funds invest in private venture capital firms, often with the requirement that other private institutional investors also invest. This approach has become more prevalent the past five years (Wilson and Silva, 2013).

Co-investment funds

Co-investment funds use public money to match private investment. Typically these programmes work by matching public funds with those of private investors (on the same terms – *pari passu*), who are approved under the scheme. These programmes appear to have increased in the past five years (Wilson and Silva, 2013). Co-investment schemes are often seen not only as a way to leverage private finance but also a means to build, grow and professionalise the seed and early stage investment market by providing a more structured investment process.

Overall considerations

Evidence shows that the design and implementation of these funds plays a key role in how well they meet their objectives (EC, 2012). The design of the programme needs to fit the local context, including the existing financial ecosystem. Also, the linkage between these programmes and other support schemes is important. Often, multiple financing programmes are managed by a single organisation. These could be for various stages (seed, early stage, growth or expansion) using different instruments (debt, equity and/or non-financial).

The way in which funds operate is critical to their success. For instance, if decision-making processes are overly cumbersome or time-consuming, promising companies might choose not to apply. The way in which public and private collaboration is co-ordinated is likewise important, as is the relationship and interaction between programme managers and supported companies.

Programmes should be designed so that they can be adjusted over time based on their effectiveness and changing market conditions. However, sometimes programmes are started or stopped for other reasons, including political ones. A significant period of time in planning (and, in many cases, securing all the necessary approvals) is often necessary before such programmes are launched.

Research has shown that public funds should only be utilised where a tangible or imminent market failure in the private sector is evident. These vehicles should have a commercial orientation. When public funds are deployed, it is most efficient to channel these through existing market-based systems, namely private funds (Lerner, 2010). In addition, public contributions should strive to encourage private funding from both individual and institutional investors (EVCA, 2010).

It is also key to focus on development of the market, rather than just the provision of financing. This requires creating the proper incentives and supporting the development of the necessary quality, skills and experience in venture firms and among angel investors to match international norms (Lerner, 2009).

Source: Wilson K. and F. Silva (2013), “Policies for Seed and Early Stage Finance: Findings from the 2012 OECD Financing Questionnaire”, *OECD Science, Technology and Industry Policy Papers*, No. 9, OECD Publishing. doi: [10.1787/5k3xqsf00j33-en](https://doi.org/10.1787/5k3xqsf00j33-en).

Box 5.2. Policies to support angel investment in OECD countries

Tax incentives

One of the ways in which policy makers can encourage angel investment is through tax incentives for private individuals investing in specified types of investments and businesses (Mason, 2009). This includes tax relief on investment, capital gains and losses (including write-offs and roll-overs). The goal of these tax incentives is to increase both the number of angel investors and the amount of capital invested. The most cited example of a successful tax incentive scheme is the Enterprise Investment Scheme (EIS) in the United Kingdom.

While tax incentives can have a positive effect in terms of increasing both the number of investors and the amount of investment, there are some potential downsides, including fiscal considerations (particularly given the budgetary circumstance of many countries following the recent financial crisis).

Tax schemes can also be complex and may have unintended consequences. Providing greater incentives for high net worth individuals may increase the number of financial investors but not “angel” investors (those providing expertise and contacts in addition to money). In addition, there is a danger of intermediaries distorting tax schemes to reduce investment risks (Mason *et al.*, 1988). It is important therefore that programmes are evaluated on a periodic basis and that incentives are adjusted as necessary.

Co-investment funds

In some countries, policy makers have launched co-investment funds to address the seed/early stage equity financing gap and to help develop and professionalise the angel investment market. Co-investment funds have become increasingly popular in recent years, due in part to the perceived success of the Scottish Co-investment Fund, which some countries have used as a model. New Zealand has operated co-investment funds for a number of years. Initially, it set up a co-investment fund for venture capital investment (VIF in 2002) and later created one focused on angel investment (SCIF in 2005), modelled on the Scottish experience. The rationale for the funds was based on the financing difficulties of start-ups with high growth potential (innovative, technology-based firms) at the seed and early stages.

Co-investment funds can help develop the local financial community by increasing the deal-making capacity of investment partners and attracting new investors. Co-investment schemes can also be important in building and professionalising the angel market by providing a more structured investment process.

However, models working in one country should not necessarily be copied directly into another country. Local conditions need to be taken into account. Both the timing (i.e. making sure there is already a functioning angel market in the country) and the structure of the terms of the co-investment fund can make the difference between success and failure.

Support to angel networks/groups or national associations

Over the past decade, a number of governments have supported the development of the angel investment market by providing financing for angel networks, groups and associations. In most cases, the goal of the funding has been to address information asymmetries in the market between angel investors and entrepreneurs. Much of the support given was intended to help start these organisations, with the goal of having them later transition to the private sector.

Training and development of angel investors

Training of angel investors is extremely important for professionalising the industry and attracting new angel investors. However, this is an area often overlooked by policy makers. Because angel investors are typically experienced entrepreneurs and business people, it is assumed that they also know how to invest. However, investing in start-ups is a very specific task and training and learning from experienced angel investors is therefore an important part of the process. Being an investor requires different perspectives, understanding and skills to being an entrepreneur.

Source: OECD (2011b), *Financing High-Growth Firms: The Role of Angel Investors*, OECD Publishing, doi: [10.1787/9789264118782-en](https://doi.org/10.1787/9789264118782-en)

With respect to the market for venture finance, it seems that the venture capital sector is not too small. Rather, the problem is that too few firms receive seed and early-stage (SES) finance. An important issue concerns the reported demand and supply-side barriers to M&A activity, which is underdeveloped compared to other OECD countries that have a significant venture capital industry. This issue will not be assessed here, except to say that the government is taking targeted measures to address the problem and that, at the same time, some of the constraints appear specific to Korea. For instance, it is variously reported that: M&A activity in Korea historically meant ‘restructuring a company’ and was associated with bankruptcy proceedings; culturally, Korean CEOs often want to stay with the company they have created; aversion to the sale of young firms may also be linked to acrimony over the behaviour of some larger companies towards SMEs (with respect to intellectual property, for instance); and Korean legislation places limits on diversification by the *chaebols*, which may dampen M&A activity).

In regard to the forms of public support for venture finance, the emphasis on co-investment and fund-of-fund approaches clearly accords with identified good practice internationally (Box 5.1). Furthermore, in many countries, the magnitude of the resources allocated to such programmes has been too small. This appears not to be the case in Korea (the Korea Fund of Funds (KFoF), established in 2005, manages KRW 1.8 trillion in commitments to 251 funds, including funds for local SMEs and M&A, start-ups and regional development, overseas market expansion, and commercialisation (until 2035)).

- The focus on support for business angels is also appropriate. This class of investors can be extremely important both in terms of the aggregate scale of their investments, which in some countries exceeds that of the entire venture capital sector, and the expertise, networks and close interaction they bring to investee firms. Government support for business angels has been available in Korea for some time. The KVIC manages the KFF (capitalised by the Small Business Corporation) and has eight matching funds for business angels. Box 5.2 reviews international experience in public support for business angels.
- While this initiative is not among the largest in the current set of programmes, Korean policy makers should nevertheless note that there is some scepticism that equity crowd-funding could become a significant vehicle for increased entrepreneurship and research commercialisation. The government plans to introduce a crowd-funding system, through which new ventures can raise seed money from a number of small investors. Globally, this is a relatively new area of financial development, so there is little internationally comparative policy analytic material available. Crowd-funding initially started for philanthropic projects (in the form of donations) and then spread to consumer products (in the form of pre-funding orders) and lending.¹⁹ More recently, equity crowd-funding, which allows ordinary citizens to fund companies in exchange for shares in a business, has been touted as a tool that could allow more entrepreneurs to raise finance for their businesses. Proponents hold that a benefit of equity crowd-funding could include the ability to raise capital faster and more efficiently. Gaining hundreds of investors via websites could also increase online popularity for a start-up because investors would tweet and post about the company so as to protect their investment. Such effects might also serve to signal to larger investors that there is a potential market for a public research-based technology. An additional effect of crowd funding is that scientists

might become more active in disclosing their ideas and promoting research findings to potential investors and society.

However, critics note that an average business angel spends a lot of time and money on due diligence before investing, whereas equity crowd-funding involves little meaningful due diligence by investors, who are mostly member of the general public (Isenberg, 2012). This is likely to result in losses that could be avoided if due diligence had of been performed. In addition, entrepreneurs turned away by experienced investors after detailed due diligence might turn to equity crowd-funding (Forbes, 2013). Companies that turn to equity crowd-funding would also lose out on the guidance and networks provided by seasoned angel investors. For such reasons, equity-based crowd-funding is not currently allowed in most OECD countries. However, active equity crowd-funding platforms exist in Belgium, France, Germany, the Netherlands and the United Kingdom (Wilson and Silva, 2013). In the United States, the JOBS Act, which was passed in 2012, allows businesses to raise equity capital from crowd-funding (thus providing an exemption from Securities and Exchange Commission (SEC) regulations). But crowd-funding will be allowed only for accredited investors (investors with a net worth of at least USD 1 million or annual income of at least USD 200 000).

- *Much emphasis is placed on supporting the supply side of the early-stage equity market, and consideration should be given to whether demand-side conditions are now a limiting factor.* In a number of OECD countries the orientation of policy is shifting towards measures that strengthen the demand side of the market for early-stage equity finance. Such demand-side programmes seek to enhance the quality of the business proposals that entrepreneurs present to potential private-sector funding sources. Historically, furthermore, development of the venture capital industry has followed rather than preceded the availability of deal flow. In this connection, the Korean Venture Capital Association (KVCA) indicates that it is becoming increasingly hard to find good investment opportunities. One symptom of this is that some of the Association's members are starting to establish themselves overseas, in countries such as China and Vietnam. This would suggest that a greater demand-side focus may be needed. At the same time, it is recognised that elements of demand-side policy do already exist. For instance, as regards matchmaking, KVCA organises monthly investor relation conferences to bring investors and entrepreneurs together. But a broader assessment may be needed of whether, all initiatives considered, the right balance has been struck between demand and supply-side programmes.

Using data as a source of economic value

Creating economic value from large data sets is at the leading edge of business innovation, while companies that base key decisions on data analytics outperform other firms.²⁰ The potential importance of so-called 'big-data' is recognised in the government's Creative Economy Strategy. But a considerable technical gap still exists between many Korean companies and global best practice.

The government will create a Big Data Analysis and Utilisation Centre as part of the Creative Economy strategy. The Centre would help develop the hardware and software infrastructure required to analyse big data and will make public data available through the Public Data Portal (data.go.kr). Data users will also have access to education in this area.

The government is also reported to be developing a programme aimed at helping young people develop digital apps.

As yet, among OECD economies, there is no clearly optimal policy for supporting the private-sector creation of economic value from data. Complex, and sometime country-specific, policy interactions need to be assessed in such fields as data security and privacy. The availability of information and communications technology (ICT) infrastructure and ICT-related skills are clearly critical. A key issue also concerns the terms on which public-sector data are made available to the public. In this connection, importance guidance is presented in the OECD's 2008 Recommendation of the Council for Enhanced Access and More Effective Use of Public Sector Information (OECD, 2008).

Innovation-oriented public procurement

Since 1996 the Korean government has implemented the New Technology Purchasing Assurance Programme for innovation-oriented SMEs and has increased procurement of innovative goods based on new technology. The legal basis for this programme is the Promotion of Small and Medium Enterprises and Encouragement of Purchase of Their Products Act, implementation of which is the responsibility of the SMBA. Under this programme, if the technological products of SMEs are certified as “goods for purchasing assurance”, SMBA can recommend that all public institutions including central and local government, and state-owned or funded companies and institutions, procure these products with higher priority. To make sure that all public institutions procure those innovative goods, the institutions are required by law to submit their purchasing plans for the coming year – and the purchasing results of the previous year - to SMBA. The plans and the purchase results are reported to the Ministerial Meeting chaired by the President.

According to the Law and Programme, “Goods for purchasing assurance” comprises five components:

- *NEP (New Excellent Product)*. A product based on a totally new technology developed in Korea or one that has significantly improved existing technologies, and the product could have a large impact on the economy and society (as defined by MOTIE).
- *NET (New Excellent Technology)*. A product based on a new excellent technology, as defined by MOTIE, MOLIT and MOE.
- *GS (Good Software)*. A product based on Good Software (as defined by MOTIE).
- *EPC (Excellent Performance Certification)*. A product whose performance has been certified by SMBA.
- *GPP (Excellent Procurement Product)*. An intellectual property-based product the excellence of which has been certified by the Public Procurement Agency).

The new Park administration announced in May 2013 that it would expand the scope of the “goods for purchasing assurance” scheme to include other technological products (such as green technologies).

SMEs can use certification as a marketing tool. Departments have a target that 50% of all procurement (goods, services etc.) should be from SMEs, and 10% of goods should be from the list of New Technology products.

While this report does not aim to examine the procurement system in detail, a number of observations may be relevant:

- Research indicates that while the public purchase market in Korea is not large, the proportion of small and medium sized companies engaging with this market – about 65% – is three times greater than in the United States and perhaps twice that of France. This indicates that getting policies on procurement right might have a significant effect on innovation in SMEs (STEPI, 2011).
- The comprehensive certification process described above seems a rather different approach than the approaches adopted in other countries. This certification system may provide an incentive for innovation, and may be catalytic in the sense of providing firms with early market support and acting as a signalling device (i.e. broadening demand, beyond just the procurement market, for products and services that are still in an early stage of development or diffusion).
- *Consideration might also be given to making general public procurement more likely to induce innovation through introducing a greater focus on performance metrics, rather than on specific features of the procured items (defined a priori).*²¹ This method can be applied for a vast number of products and services purchased by public authorities, from construction, transport, energy and catering services, to health products and equipment. New procurement criteria, beyond price, can emphasise innovative outcomes, and can be added in the tender specifications and in the assessment of tender documents. Policy must ensure an adequate availability of expertise, with staff having knowledge for instance of regulations, technologies and markets. Shortages of expertise may be exacerbated by budgetary pressures to restructure public procurement organisations, often reducing the number of procurement professionals and standardising procurement processes.
- *Of greatest relevance to the Creative Economy Strategy is that benefits of different sorts could possibly be had from introducing competition processes in tendering for R&D.* Pre-commercial procurement is aimed at purchasing R&D, design, prototyping and testing services for products or services that do not yet exist on the market. Across countries there appear to be somewhat different approaches to pre-commercial procurement, with variation existing (among other parameters) around whether there is a restricted focus on SMEs as the suppliers of R&D services, and whether there is some prior commitment from the public sector to purchase solutions developed during the pre-commercial phase. Whatever the precise institutional design, because a number of firms compete during the different stages of a pre-commercial procurement – from solution designs to prototypes to test series – a variety of benefits are likely to result. For instance, the price of the first products coming out of the process can be significantly lower than when the procurement is done with a single supplier in the development phase. A second benefit is that risks might be reduced: in some sectors, a large percentage of public procurements do not achieve the expected results. However, in pre-commercial procurement, when multiple companies compete and test options during various development stages, useful information is generated regarding the drawbacks of different possible products. Furthermore, because any firms compete in the procurement, problems further down the road of supplier lock-in might be mitigated. The efficiency of public support for R&D might also be increased (at least support for applied R&D that aims to address a stated public need) by replacing a share of applied R&D grants with pre-commercial procurement processes. An additional benefit is that pre-commercial procurement might also assist companies in shortening the time to market. This is because immediate feedback is given from a

potential customer at multiple stages of the product development cycle. First-mover advantage is extremely commercially beneficial in high-technology markets, enhancing the possibility that a firm becomes a market leader. R&D procurement programmes in the United States, in particular, have been instrumental in helping a large number of companies, across a variety of sectors, become market leaders (Connell, 2006).

Growth thresholds

This chapter has already noted the limited presence of medium-sized companies in Korea, and has also described how the abrupt discontinuation of government support once companies graduate from the SME category may depress the ambition to grow. Earlier text likewise described the possible role of inheritance taxes in inhibiting SME growth. Korean policy makers are well aware of these problems and have shaped policy responses to try to address them. The task now is to monitor the efficacy of those policy responses.

Box 5.3. Business support simplification: The experience of the United Kingdom

A number of OECD countries have taken steps to rationalise the available public support so as to make it easier for companies and entrepreneurs to understand and access. One such example is the United Kingdom's Business Support Simplification Programme. Prior to the Programme there were over 3 000 publicly-funded business support schemes available in the United Kingdom. Businesses said they were confused by the number of schemes and discouraged from applying by both the complexity and the cost. The then Government also believed that it would obtain better value for money from a leaner system.

In the 2006 Budget, it was announced that the 3 000 schemes would be reduced to 100 or less by 2010. Work began to radically reduce the number of schemes and simplify delivery channels. It was decided in 2007 to make a single programme - Business Link - the primary access route for individuals and businesses seeking support, and the 2008 Budget announced a timeline for the transfer of brokerage services to Business Link.

In simplifying the portfolio of available schemes, the criteria used to decide whether support should continue to be provided included:

- Rationale – whether there was a market failure in provision, or some wider social or environmental justification for intervening,
- Likely effectiveness – whether an intervention could effectively address the objectives.
- Business need – whether there was a genuine demand from business for the type of support offered.

Relevant products were then developed or amended and grouped around a number of common business themes. Businesses were consulted before the 'Solutions for Business' package was finalised. Products in the agreed portfolio help with activities such as accessing finance, innovation, R&D, training and skills, exporting and overseas trade and efficient use of natural resources. An independently chaired Board was set up to prevent the proliferation of new schemes and ensure value for money.

Although elements of the programme were overtaken by the need to respond to the economic and financial crisis in 2009 and the change of Government in May 2010, substantial rationalisation was achieved. Companies and entrepreneurs can now also obtain guidance on available support through an online tool, the business support and finance finder (see <https://www.gov.uk/business-finance-support-finder>).

Source: BERR (2008), "Simple Support, Better Business: Business Support in 2010", UK Department of Business, Enterprise and Regulatory Reform, March.

Achieving overall coherence in public support

The Korean government is implementing a vast array of entrepreneurship and SME support measures. Over time, in many countries, with the introduction of new policy initiatives the number of support schemes available to businesses easily proliferates, creating a complex and potentially confusing landscape for start-ups and SMES. It is not possible to determine, without further assessment, whether the number of schemes is excessive in Korea. However, *given that the supply of programmes is already diverse and numerous, consideration should be given to whether some degree of streamlining could be beneficial.* Measures of this sort have been undertaken in a number of countries (Box 5.3 briefly describes the United Kingdom's experience). One way of bringing about a streamlining might be to create an inventory system that allows policy makers to see the benefits that individual SMEs receive from the different programmes, thereby indicating if there is significant overlap between programmes.

Notes

1. This is not to say, of course, that policy should not seek to limit or remove some conditions that give rise to enterprise failure.
2. SMBA data indicate, however, that the number of corporations run by women has increased somewhat from 1.19 million in 2007 to 1.22 million in 2009.
3. Data compiled by Korea's Small Business Administration indicate that the number of start-ups among Korean adults under 30 increased by 24% between 2010 and 2012, and in 2012 stood at around 4.7% of all start-ups (SMBA, 2012).
4. In fact, the official data show such a precipitous decline that questions arise as to whether a change in data collection method might also be involved.
5. Under the new law, the maker of a new convergence product may apply to the relevant government agency for a certification of compatibility with applicable standards. The agency must procure review by the suitable institute of standards, and determine compatibility, within 6 months after the application. The agency may attach conditions to better ensure safety, or require insurance to be taken.
6. The LINC project is focused on narrowing the gap between education and industry and promoting the mutual development of universities and local industry by improving the college education system. In 2013 there were 51 universities selected for the project, receiving between KRW 4.3 and 5.7 billion per university on average. In addition, 30 colleges receive between KRW 0.3 and 0.7 billion each. The Ministry of Education is in charge of the project and supports universities in curriculum development, strengthening training, providing education programmes for start-ups and giving post-graduation support. See the LINC programme for universities (<http://linc.nrf.re.kr/>) and colleges (<http://linc.kiat.or.kr/>).
7. A number of criteria must be met to be considered an incubation centre. There must be more than 500m² of office area, testing or measuring equipment and more than two professional staff must be available. Incubation centres in Korea can be supported by the SMBA through various direct grants and indirect support measures such as tax benefits (income tax reduction for three years after income is first received and 50% corporate tax reduction). Incubatee firms can benefit from participation in marketing projects, the receipt of consulting services and various tax benefits.
8. SMEs in manufacturing industry are defined as companies with less than 300 of workers and KRW 8 billion or less in capital or sales according to article 2 of the Framework Act on SMEs and article 3 of the Enforcement Decree of the Act.
9. This is a programme to develop 300 competitive middle-sized companies by 2020 through a package of measures including R&D, human resources development, finance and global marketing programmes.
10. The exemption applies to businesses with revenue of less than KRW 200 billion and inheritances of less than KRW 30 billion.

11. For instance, Kitching and Blackburn (2002) surveyed over one thousand firms in the United Kingdom to examine why companies fail to participate in government training initiatives. More than a quarter of respondents asserted that initiatives were simply irrelevant to their needs.
12. Furthermore, from a practical standpoint, a comprehensive system of public outreach will be expensive, especially if attempting to provide one-to-one service in a country such as Korea, which contains large numbers of micro-enterprises.
13. Countries like Denmark and Finland, among others, have also instituted accreditation and quality assurance programmes for providers of business services.
14. It might not be enough simply to publicise the availability of advisory services. The value of using such services could also be made known. For instance, various studies show low take-up of advice among women (Carter, 1997). Part of the reason for low take-up might be a lack of understanding of the potential benefits of service use. It is reasonable to assume that this problem will be most severe in the smallest firms.
15. A survey and assessment of youth-oriented schemes is provided in OECD (2001).
16. For instance, in France, INSEE (2000) showed that if a new entrepreneur is 50 years of age or older there is a 66% probability of the venture surviving for three years. This probability falls to 50% if the entrepreneur is younger than 25.
17. Once operational, social enterprises require access to some of the same services needed by for-profit companies. However, entrepreneurs in social enterprises can face particular challenges. These can include managing a financial structure that might be based on a number of uncertain and activity-specific revenue streams, determining the appropriateness and level of charging for selected services, deciding the degree of cross-subsidisation between different beneficiaries and income sources, negotiating contracts with third-party payers, and overcoming aversion among banks to working with an unfamiliar form of enterprise. However, management methods characteristic of for-profit ventures must also be adopted by social enterprises. In this regard, training services might be particularly valuable, especially because externally recruited commercial managerial expertise can be excessively expensive. Tax advice will be helpful in some jurisdictions. And services to foster business networks – including with for-profit companies – might help compensate for the small size of social enterprises, for instance in making joint approaches to banks. In some countries, including France and Italy, national financial bodies have established investment and loan funds as well as guarantee programmes and other measures to facilitate the financing of social enterprises.
18. This is especially so with respect to peer-group support and networking. Women often have experience of shared challenges and difficulties in establishing and managing firms. Practitioners note that important benefits – such as increased confidence and improvements in the quality of projects – can stem from discussion and analysis among women engaged in enterprise creation. Information, training, and consultation material might also be adapted to the needs of female entrepreneurs. For example, as women tend to establish smaller ventures advice might examine how the disadvantages of small scale could be compensated for by the adoption of niche business strategies. Female staff might also be included among the providers of business advisory services, as some women feel more comfortable in seeking information from other women.

19. According to Crowdsourcing.org, almost USD 1.5 billion was raised world-wide in 2011 by crowd-funding platforms, some of them operating to fund public research ventures. #SciFund Challenge, for example, brings scientists together to raise money directly from society at large and aims to fund research activities in new ways and to connect ordinary citizens to science. In 2013 the University of Utah's Technology Transfer Office entered into an exclusive agreement with the crowd-funding platform RocketHub. The aim is to streamline university crowd-funding under a new web portal and to showcase promising university spin-offs.
20. For example, Brynjolfsson *et al* (2011) examine detailed survey data on the business practices and information technology investments of 179 large publicly traded firms. They show that business performance is higher in firms that emphasise decision making based on data and business analytics. Such firms exhibit levels of output and productivity 5-6% higher than what would be expected given their other investments in and use of information technology.
21. In some cases, procurement might involve the specification of performance and product characteristics. For instance, a new drug might need to produce specified biochemical outcomes (performance), but not contain certain chemical compounds (product characteristic).

References

- Barajas, A., Huergo, E. and Moreno, L. (2012), “Measuring the economic impact of research joint ventures supported by the EU Framework Programme”, *Journal of Technology Transfer*, December 2012, Volume 37, *Issue 6*, pp 917-942.
- BERR (2008), “Simple Support, Better Business: Business Support in 2010”, UK Department of Business, Enterprise and Regulatory Reform, March 2008.
- Block, F. and Keller, M.R. (2009), “Where do innovations come from? Transformations in the US economy, 1970-2006”, *Socio-economic Review*, Volume 7, pp.459-483.
- Brynjolfsson, E., Hitt, L.M. and Kim, H.H. (2011), “Strength in Numbers: How Does Data-Driven Decision making Affect Firm Performance?”, Available at SSRN: <http://ssrn.com/abstract=1819486>.
- Connell, David (2006), “Secrets of the World’s Largest Seed Capital Fund: How the United States Government Uses its Small Business Innovation Research (SBIR) Programme and Procurement Budgets to Support Small Technology Firms”, Centre for Business Research, University of Cambridge.
www.cbr.cam.ac.uk/pdf/SBIR%20Full%20Report.pdf.
- European Commission (2012), “Evaluation of Member State Policies to Facilitate Access to Finance for SMEs”, Centre for Strategy and Evaluation Services & EIM, United Kingdom, June 2012.
- EVCA (2010a) “Closing gaps and moving up a gear: The next stage of venture capital’s evolution in Europe”, White Paper, March 2010, Brussels: European Private Equity & Venture Capital Association.
- GEM (2012), “Global Entrepreneurship Monitor 2012 Global Report”,
www.gemconsortium.org/docs/2645/gem-2012-global-report.
- Harding, M. (2013), “Taxation of Dividend, Interest, and Capital Gain Income”, *OECD Taxation Working Papers*, No. 19, OECD Publishing. doi: [10.1787/5k3wh96w246ken](https://doi.org/10.1787/5k3wh96w246ken)
- INSEE Premiere (2000), “Creation d’entreprises: les facteurs de survie”, No.703, March 2000.
- Isenberg, D. (2012), “The Road to Crowdfunding Hell”, *Harvard Business Review*, April.
- Kitching, J. and Blackburn, R. (2002), “The Nature of Training and Motivation to Train in Small Firms, Department for Education and Skills”, Research Brief No.RB330, March 2002.
- KOITA (2013), “2012 White Paper on Industrial R&D”, Korea Industrial Technology Association, Korea.

- KVCA (2013), “Summer Report, KACA Statistics – 2013.2Q”, Korea Venture Capital Association, Korea.
- Lerner, J. (2009) “Boulevard of Broken Dreams: Why Public Efforts to Boost Entrepreneurship and Venture Capital Have Failed – and What to do About It”, Princeton: Princeton University Press.
- Lerner, J. (2010) “The Future of Public Efforts to Boost Entrepreneurship and Venture Capital”, *Small Business Economics*, July 2010.
- Mason, C.M., J. Harrison and R.T. Harrison (1988), “Closing the Equity Gap? An Assessment of the Business Expansion Scheme”, Small Business Research Trust, London.
- Mason, C. (2009) “Public Support for the Informal Venture Capital Market in Europe: A Critical Review”, *International Small Business Journal*, vol. 27.
- Mole, K. (2000), “Gambling for growth or settling for survival: The dilemma of the small business adviser”, *Journal of Small Business and Enterprise Development*, Volume 7, Number 4, pp.305-314.
- NESTA (2013), “A Manifesto for the Creative Economy, National Endowment for Science, Technology and the Arts”, London.
- OECD (2013), *Entrepreneurship at a Glance 2013*, OECD Publishing, doi: [10.1787/entrepreneur_aag-2013-en](https://doi.org/10.1787/entrepreneur_aag-2013-en).
- OECD (2012a), *Entrepreneurship at a Glance 2012*, OECD Publishing, doi: [10.1787/entrepreneur_aag-2012-en](https://doi.org/10.1787/entrepreneur_aag-2012-en).
- OECD (2012b), *OECD Internet Economy Outlook 2012*, OECD Publishing, doi: [10.1787/9789264086463-en](https://doi.org/10.1787/9789264086463-en).
- OECD (2011a), *OECD Science, Technology and Industry Scoreboard 2011*, OECD Publishing, doi: [10.1787/sti_scoreboard-2011-en](https://doi.org/10.1787/sti_scoreboard-2011-en).
- OECD (2011b), *Financing High-Growth Firms: The Role of Angel Investors*, OECD Publishing, doi: [10.1787/9789264118782-en](https://doi.org/10.1787/9789264118782-en).
- OECD (2008), “OECD Recommendation of the Council for Enhanced Access and More Effective Use of Public Sector Information”, *C(2008)36*, OECD, www.oecd.org/sti/44384673.pdf.
- OECD (2001), “Putting the Young in Business: Policy Challenges for Youth Entrepreneurship”, OECD Publishing, doi: [10.1787/9789264188648-en](https://doi.org/10.1787/9789264188648-en).
- Sakakibara, M. (1997), “Heterogeneity of Firm Capabilities and Cooperative Research and Development: An Empirical Examination of Motives”, *Strategic Management Journal*, Vol. 18 (Summer Special Issue), 143–164.
- Salvador E. (2011), “Are science parks and incubators good ‘brand names’ for spin-offs? The case study of Turin”, *The Journal of Technology Transfer*, Vol. 36, pp. 203-232.
- SMBA (2012), “The Era of Angel Investment, Small and Medium Business Administration”, Press, 10 December, 2012, Korea.
- SMBA (2013), “Start-up Incubation Status”, Small and Medium Business Administration, Korea.

STEPI (2011), “Evaluating SME’s Innovation Capability and Analysing SME Innovation Policy”, Science and Technology Policy Institute, Korea.

Wilson, K. and F. Silva (2013), “Policies for Seed and Early Stage Finance: Findings from the 2012 OECD Financing Questionnaire”, *OECD Science, Technology and Industry Policy Papers*, No. 9, OECD Publishing. doi: [10.1787/5k3xqsf00j33-en](https://doi.org/10.1787/5k3xqsf00j33-en).

Chapter 6

A new balance between manufacturing and services in Korea

This chapter examines the economic performance of the services sector in Korea and analyses reasons for the sector's relative weaknesses. Recent policies to strengthen the sector are described. Possible ways forward for policy are also considered, from framework conditions to the design of targeted policy initiatives.

Improving the size, productivity and knowledge-content of the Korean services sector is a key challenge facing Korean policy makers. Korean economic development to date has placed great emphasis on manufacturing, initially in light industry (the initial surge in Korean exports during the 1960s was in industries such as footwear and textiles), and more recently in technology-based industry such as electronics. There is widespread recognition that, in the face of low-cost competition from China and others, the next phase of economic development needs to put more emphasis on manufacturing-related services and other knowledge-intensive services that will help strengthen competitiveness, improve the quality of life, help address societal challenges and aid the creation of (high-wage) jobs.

Progress on high-value service-sector job creation is especially important given that domestic job creation by large firms has slowed on account of the fact that their productivity has risen, while the share of their production occurring abroad has grown (the share of large firms in domestic employment has fallen from 18% to 12% from 1995 to 2010, while large corporations' overseas operations have expanded significantly). Evidently, given the overall economic weight of the services sector, raising productivity in services is also an important step in achieving higher aggregate productivity growth (it is recognised however that, other things unchanged, raising productivity in services will put pressure on employment over the short-term).

6.1. Underdevelopment of the service sector

Korea possesses a number of globally competitive service sector firms, such as in air transport and engineering, which also pay high wages and offer high-value added services. The Korean entertainment industry has also recently gained worldwide attention. However, a number of key indicators describe important weaknesses in the service sector:

- Service-sector productivity is one of the lowest among OECD economies. Value added per employee is less than a third, and less than a half, of levels in the United States and the United Kingdom respectively. The ratio between productivity in services and manufacturing is also below the levels in major comparator countries (Table 6.1).

Table 6.1. Labour productivity in manufacturing and the service sector

Value added per employee, USD

	Services(A)			Manufacturing(B)			Services/Manufacturing(A/B)		
	2000	2005	2010	2000	2005	2010	2000	2005	2010
Korea	20 964	29 866	28 001*	31 726	49 819	54 928	0.66	0.60	0.51
United States	65 003	80 571	94 352	80 380	107 813	143 878	0.81	0.75	0.66
United Kingdom	40 915	61 083	60 772	50 011	74 771	79 050	0.82	0.82	0.77
Japan	76 894	74 732	79 449*	82 781	89 140	90 577	0.93	0.84	0.88
Germany	42 454	61 784	68 690	48 812	76 656	90 603	0.87	0.81	0.76

* Korea (2009); Japan (2008).

Source: OECD (2012a), "STAN Database for Structural Analysis ISIC Rev.4", *STAN: OECD Structural Analysis Statistics* (database) (accessed 10 September 2013).

- In line with experience in other countries, output growth in services has for some decades lagged behind employment growth in services (Park and Shin, 2012). The employment share of services has grown at a remarkable rate, from 37% in 1980 to 67.8% in 2009, which may have been too fast (Eichengreen, Perkins and Shin, 2012).
- The share of services in GDP in Korea (61% in 2009) is lower than in many relevant comparator (OECD) countries (79.2% in France, 72.7% in Germany and 77.4 % in the United States, in the same year, for example). Furthermore, the share of the service sector represented by high-end services is somewhat smaller than in relevant comparator countries.¹ EU KLEMS data indicate that in 2007 such high-end services contributed around 33% of service sector output, as compared with around 36% in the EU15 and 37% in the United States.
- The share of service sector R&D in total business expenditure on R&D, and the share of researchers in services, have for some time also been low compared to other OECD economies (see Tables 6.2 and 6.3).
- The share of services in exports in Korea is the fourth lowest in the OECD, with only Mexico, Chile and Norway having lower shares (with the low shares for Chile and Norway being in part explained by the dominant role of exports of primary products such as oil and minerals). In turn, Korea's relatively low share is partly explained by the significant presence of manufactured goods in its overall exports.

Table 6.2. Share of the services sector in business expenditure on R&D (BERD): Korea and selected countries

Percentage

	2000	2006	2007	2008	2009	2010	2011
Korea	10.5	7.1	7.2	7.9	9.4	9.0	8.8
Japan	6.7	10.4	10.3	11.3	11.2	11.2	10.7
United Kingdom	16.5	23.2	24.4	24.7	24.1	25.7	..
United States	36.9	29.6	29.1	29.1	30.0	28.0	..
Germany	7.9	9.4	10.6	10.3	13.5	13.3	13.8

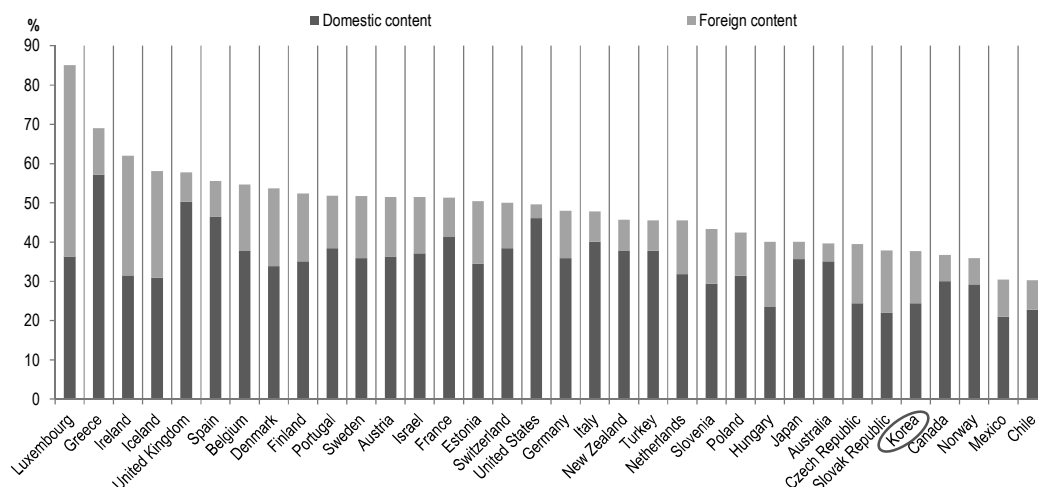
Source: OECD (2013a), *Main Science and Technology Indicators*, Vol. 2013/1, OECD Publishing. doi: [10.1787/msti-v2013-1-en](https://doi.org/10.1787/msti-v2013-1-en).

Table 6.3. Researchers in services: Korea and selected countries

Per thousand employed

	2000	2006	2007	2008	2009
Korea	1.1	1.4	1.6	1.7	1.9
Japan	1.0	1.8	1.9	2.2	..
United States	3.6	3.3	3.2	..	..
Germany	..	..	1.6	..	2.1

Source: OECD (2013b), “Research and Development Statistics: Business enterprise R-D personnel by industry”, OECD Science, Technology and R&D Statistics (database) and OECD (2012a), “STAN Database for Structural Analysis ISIC Rev.4”, STAN: OECD Structural Analysis Statistics (database) (accessed 10 September 2013).

Figure 6.1. Services value added in total exports (percentage), 2009

Source: OECD (2013c), “Interconnected Economies: Benefiting from Global Value Chains”, OECD Publishing, doi: [10.1787/9789264189560-en](https://doi.org/10.1787/9789264189560-en)

Table 6.4. Services trade balance: Korea and selected countries

Exports minus imports of services, 2004-11, USD billion

	2004	2005	2006	2007	2008	2009	2010	2011
Korea	-6.0	-10.0	-13.3	-12.0	-5.7	-6.6	-8.6	-4.4
Germany	-51.1	-48.8	-38.3	-39.4	-37.4	-23.1	-24.2	-31.6
Japan	-34.3	-24.0	-18.2	-21.2	-20.7	-20.4	-16.1	-22.1
United Kingdom	51.0	60.4	76.2	105.8	111.8	97.0	103.5	122.4
United States	58.2	72.1	82.4	122.2	131.8	126.6	150.4	178.5

Source: OECD (2013d), “Trade: Key Tables from OECD”, *OECD Factbook* statistics.

6.2. Reasons for weaknesses in the Korean services sector

Many factors contribute to the weakness of Korea’s services sector. These are likely to include:

- Repercussions from the fact that manufacturing and the development of the tradeable sector have been central to Korea’s post-war economic development strategy. Attention to the services sector has been of lesser importance. For instance, much R&D and innovation policy has focused on manufacturing, with the effect that services have benefited less from advances in technology. Service-sector firms have not all enjoyed other forms of policy support given to manufacturers (such as exemption from land ownership taxes). The rise of the services sector in Korea has been relatively recent and, as noted above, extremely rapid (Eichengreen, Perkins and Shin, 2012).
- Regulatory burdens and lack of competition, with restrictions on entry, and other barriers to inward investment and competition from abroad. The OECD’s Product Market Regulation scores show Korea to be performing somewhat better than the OECD average as regards barriers to entry in services (2.31 as against an OECD-

wide score of 3.24 in 2008 [a higher score indicates higher barriers]). Korea's economy-wide PMR score is 1.48, a little higher than the OECD average and other major economies (although the PMR database indicates low barriers to entrepreneurship in Korea). But barriers to trade and investment were higher than the OECD average (Korea's score is 1.30 as compared with the OECD average of 0.49) (Table 6.5). An often cited competition concern is the high degree of internal trade in services that occurs within the large conglomerates. Korea's 2012 Fair Trade Commission report asserts that more than half of IT services in Korea are purchased by large corporations from 'captive' supplier companies operating in their groups.² McKinsey (2013) notes that lack of competition also hinders productivity growth among services companies that do supply the *chaebols*, citing as evidence that the leading systems integrators in Korea have low – between 5% and 8% – shares of overseas sales.

- Regulations also weigh on many service-sector companies. For instance, restrictions exist on the number and size of outlets in some lines of business. Firms in service sectors considered as luxury businesses are not eligible for certain forms of financial support. A competitive market in electricity is also not yet established. Korea introduced a whole-sale power market in 2001 and eased entry restrictions for private power generation firms, but this exchange market system did not bring greatly increased competition because of structural problems in energy trading (KDI, 2012).

Table 6.5. Product market regulation indicators: Korea and selected countries, 2008

	Korea	Germany	Japan	United States	United Kingdom	OECD average
Product market regulation	1.48	1.27	1.14	0.84	0.79	1.35
1. State control	1.99	1.96	1.43	1.10	1.50	2.12
1) Public ownership	2.76	2.76	2.01	1.30	1.90	2.92
2) Involvement in business operation	1.22	1.16	0.85	0.90	1.11	1.32
2. Barriers to entrepreneurship	1.14	0.31	1.37	1.24	0.82	1.45
1) Regulatory and administrative opacity	0.00	2.05	1.13	0.19	1.11	1.06
2) Administrative burdens on start-ups	1.57	0.47	0.74	0.99	0.59	1.62
3) Barriers to competition	1.85	1.43	2.24	2.53	0.77	1.66
4) Barrier to entry in services	2.31	3.44	3.36	3.64	1.69	3.24
3. Barriers to trade and investment	1.30	0.53	0.62	0.17	0.04	0.49
1) Explicit barriers to trade and investment	1.00	0.39	1.24	0.34	0.08	0.70
2) Other	1.60	0.67	0.00	0.00	0.00	0.28

Source: OECD (2008), Product Market Regulation Statistics (database) (accessed on September 2013).

- Relating to the state of competition and other enabling conditions, the effects of an economic dynamic whereby productivity growth is driven largely by within-sector productivity change, rather than resource allocation to higher productivity activities. Indeed, Eichengreen, Perkins and Shin (2012) estimate that around 70% of overall productivity growth in Korea during the period 1970 to 2007 was attributable to within-sector increases. This phenomenon is likely to have been exacerbated by cyclical entry in subsectors with low initial capital and skill requirements – as workers laid off from large corporations during the crisis

entered necessity-driven entrepreneurship.³ In addition to such crisis-related conditions, necessity-driven entrepreneurial activity is likely to have been spurred over the long-run by the early age of retirement from firms. The mandatory age of retirement set by firms in 2010 averaged 57 years (95% of firms with more than 300 workers set the age below 60). Many workers also leave firms prior to the mandatory retirement age, with firms encouraging workers to retire through incentives or penalties (OECD, 2012b).

- The productivity-inhibiting effects of some policies aimed at assisting SMEs, many of which operate in the services sector. For instance, much financial (credit) support for SMEs is aimed at bolstering employment, in a country where social welfare expenditures are low as a share of GDP (indeed, the share of SMEs in services employment rose significantly between 2011 and 2009). This helps to keep low productivity firms in operation (and bundles social and economic policies, which likely need to be unbundled).
- Structural features of the Korean economy, in particular that the share of micro-firms and SMEs is large. Indeed, 99.9% of firms in the service sector have less than 250 employees and 98.4% are micro-firms with no more than 10 employees in 2010 (OECD, 2013e). As is common in many countries, such firms typically have a local orientation and often have difficulties in attracting skilled graduates.
- As described above, an R&D intensity of service sector activities that is below the OECD average.
- Sector-specific barriers that are reported in the medical, tourism and education sectors (MOSF, 2013).
- Limited growth aspirations among entrepreneurs.⁴ An aggravating factor in this regard may be that some policies create growth thresholds (see Chapter 5 in this report on entrepreneurship and SME growth).
- The possibility – suggested by various Korean commentators – that new but as yet unexploited opportunities for the service sector could arise from improving the regulatory environment (for example, testing services based on the setting of appropriate standards and/or certification requirements).

6.3. Recent targeted policy initiatives

In July 2013 the Government announced a service sector development plan, ‘Service Industry Policy Directions and Measures’. Two major goals were set for developing the services sector: creating high-quality service-sector jobs to support a 70% employment target; and, boosting productivity and fostering high value-added service industries. Box 6.1 describes the key measures included in the government initiative.

Targeted policy towards the services sector must be seen as welcome, even if it is not entirely new.⁵ Previous work on innovation in services by the OECD’s Working Party on Innovation and Technology Policy found that, in many countries, including Korea, service sector firms are often under-represented in innovation programmes (Sheehan et al., 2005). A few countries are nevertheless developing innovation policies that focus on services. Internationally, such policies usually encompass:

- *Support for the application of ICTs.* ICT-related service businesses have received strong support in many countries (for instance for e-trade). Such support sometimes has a human capital dimension: the Danish Ministry of Science, Technology and Innovation has for instance implemented measures to assist ICT staff with a short-cycle higher education (such as multimedia designers) to receive credits towards a university education. Through a number of types of support the Korean government is also promoting ICT-related services such as the use of RFID (radio frequency identification) technology. To promote electronic document and RFID services, the government provides financing to users of the services when they co-operate with service providers and install ICT equipment.
- *Supporting software industries.* Korea has actively promoted the software industry, with software policy being based on the 1987 Software Promotion Law. This law requires MSIP to formulate a mid-term (three-year) plan and an implementation plan (one year) to promote the software industry. The Law also includes provisions for software-related R&D support, the development of human resources in software, policy loans and tax incentives for the software industry, and standards and certification. It also provides a legal basis for software pricing and contract terms with respect to public procurement.
- *Making R&D support more relevant to the service sector.* Across countries, relevant approaches have included: establishing R&D programmes related to the needs of the more R&D-intensive segments of the service sector, such as computing, software and telecommunications services – for instance the US government invests in software-related R&D (the National Science Foundation, for example, funds university research on software engineering and languages); promoting R&D related to the application of ICT to other innovative service industries, such as health-care, financial intermediation, wholesale and retail trade, and education, where much innovation derives from ICT use; and, securing transparent regulation of the transfer of public data (maps, meteorological data, etc.) for private sector commercial use. In Korea, the MSIP provides some KRW 150 billion per year of support for software-related R&D. It also operates an “IT convergence R&D” programme which provides financing support to SMEs for the application of ICT to other manufacturing and service industries, such as automobiles, shipbuilding, health-care and education.
- *Fostering start-ups in services.* New firms effectively serve as a platform for experimentation with service-sector innovations. This is addressed in Chapter 4 of this report.
- *Standards.* The development of standards can affect innovation and other economic outcomes through multiple routes.⁶ Standards are especially important in network industries, such as ICTs, in that they can facilitate a critical mass of users. In this connection, standards ease the emergence of technological platforms - independently supplied yet inter-operable components with shared technical standards. Korea has a legislation-based national standards system. The two overarching laws in Korea are “Framework Act on National Standards of 1999” and “Industrial Standardisation Act of 1961”. The Korean Agency for Technology and Standards (KATS) under MOTIE is the national standards authority of Korea, and is responsible for the two laws. KS (national standards of Korea), managed by KATS, is classified into 21 sectors which includes service sector activities. The KS certification scheme for services, established in 2008, is designed to ensure that the service provider who passes an onsite and service quality audit is allowed to indicate the KS mark on the contract, statement of delivery, warranty and/or promotional materials.

Box 6.1. Forthcoming measures to expand services-related infrastructure and resolve difficulties in the services industry

To expand service industry infrastructure, specific steps include:

Providing support through the tax system

The ‘SME Special Tax Deduction and Exemption’ and the ‘Job Creation Investment Tax Credit,’ which target service industries, will be expanded. R&D-performing service-sector businesses will receive tax credits on research and human capital development outlays, and the ratio of indirect R&D costs will be expanded from 10% to 17% of the sum of labour cost and direct cost. When an SME sells a technology, it will receive a deduction and exemption on the income and corporate taxes resulting from the transfer.

Improving financial support systems

The government will carry out an investigation into the actual conditions of service-sector support given by public financial institutions, and will work to resolve any discriminatory practices with regards to financial support for the service sector. The government will provide export financing for exports of goods and domestic services. The ‘Export Performance Confirmation System’ was implemented in June 2013, and export financing support will be provided beginning in September of this year. Regarding credit guarantees for the service industry, the government will introduce an intellectual property evaluation model which assesses the value of IP with a view to its being used as loan collateral, and will expand credit guarantees for technology related to the culture, information and content industries.

Improving systems and social image

Public utility fee systems for the service industry, which are at a disadvantage when compared to the manufacturing industry, will be made fairer. The government will work to transform the social image of the service industry, including the introduction of the ‘citizen’s star’ for exemplary service companies and offering the APEC Business Travel Card to companies in the service industry. Consumer reports, private sector brand evaluations, Korean Standard Association certificates and corporate certificates will be expanded to the service sector in order to increase the amount of information being offered.

Fostering human capital in the service sector and expanding job training

Among other measures, the government will promote Meister’s designations in the software and ICT sectors, the expansion of new courses in promising service industries at Polytechnic Universities, and college specialisation. Worker education programmes will be strengthened through the establishment of ‘corporate universities,’ and e-learning systems will be introduced to provide start-up consulting support for the unemployed and retirees. Job training groups will be established for the service industry.

Providing support for service sector start-ups and commercialisation

The early commercialisation of ideas will be supported through the establishment of ‘smart venture start-up schools’. Integrated business support centres will be expanded, addressing service-sector start-up support and 1-person start-up issues. Certification systems will be introduced for excellent R&D outcomes in the service sector, and commercialisation support will be provided (funding and tax support as well as support for market expansion).

The government is also adopting measures to resolve specific day-to-day difficulties encountered by service-sector firms. These measures include:

- Improving outsourcing contract systems at professional baseball stadiums.
- Supporting service-sector businesses entering the public procurement system. Twenty new service contracts will be signed for government procurement, including for mobile surveys, big data analyses, and mobile e-publishing. Consulting services will be offered to new venture firms that are trying to access the procurement market.

.../...

Box 6.1 Forthcoming measures to expand services-related infrastructure and resolve difficulties in the services industry (continued)

- Supplying IT solutions to small businesses: For small businesses which do not have access to IT-based management solutions for sales or inventory management, IT solutions will be supplied to service-sector SMEs and other small businesses.
- The ‘High Value Service Project Guarantee System’ will be introduced to provide production funding support even if a distribution contract has not been signed.
- Flexible Fiscal Support for Foreign Education and Research Institutes in Free Economic Zones: Universities receive national funding support regardless of their ranking and research institutions uniformly receive support regardless of their renown or research plans. Flexible support measures will be introduced that reflect ranking and research outcomes in order to provide expanded funding support for excellent foreign institutions.
- The government will collaborate with the related ministries to uncover and alleviate other difficulties and plans to phase-in competitiveness-strengthening measures by sector, in tourism, medical tourism, industry services, culture, art, entertainment and communications.

Source: MOSF (Ministry of Strategy and Finance) (2013), “Service Industry Policy Direction and Measures”, July 2013, Korea.

6.4. Reflections on policy options and the way forward

In most countries the broad category “services” actually consists of a distinct group of subsectors, with varying productivity performance and different mechanisms for enhancing output per employee. Innovation in services is not just about the resources allocated to ICT and intangible investment. Service industries must draw on these investments to reshape the way they conduct business, and to invent entirely new services. To do so, supportive framework conditions must be in place. Indeed, one recent cross-country review concludes that: “the best way to encourage innovation in services is by removing (or at least reducing) identified barriers to service innovation, as well as to the related policy design, rather than introducing direct support measures for companies or other specific programmes for innovation in services (Inno-Grips, 2011).” This insight should be a starting point for Korean policy makers. The many measures of support and enablement described in the immediately preceding section are welcomed. However, *over time, no number of services-specific programmes will offset the drag on service-sector development coming from unsupportive framework policies.*

Key framework conditions that require ongoing policy attention include labour market flexibility (the latter being critical in helping to reduce structural unemployment arising from de-industrialisation), competitive markets for goods and services, and free trade of services across borders. Policies that are plainly discriminatory towards services, in their design or application, need to be identified and removed. Legacy policies that served to underpin manufacturing at the expense of services need to be reconsidered. The description of the causes of weakness in the Korean services sector provided above also points, among other things, to the particular importance of competitive markets in ICT.

Important interactions also exist with social welfare reform. Shifting resources from manufacturing into services and undertaking structural reform in the service sector would both require the social safety net to be strengthened to ease the adjustment costs that individuals face. As previously noted, much financial (credit) support for SMEs is aimed at supporting employment, in a country where social welfare expenditures are low as a share of GDP (for a comprehensive examination of the social welfare system in Korea see OECD [2013f]). This helps to keep resources locked into low productivity firms and entails a bundling of social and economic policy. Better design of social and SME support policy is likely to occur when the two forms of policy are unbundled.

Education and training policies represent another framework condition within which firms operate. Korea has an impressive system for skills development (recent developments and challenges affecting that system, and the system's relationship to the labour market, have been reviewed in the context of the OECD Skills Strategy. Highlights from the ongoing review are summarised in Box 6.2). Vocational education and training has dwindled over time (Korea has the highest rate of university attendance – on 4-year programmes – of any OECD country, but only about 21% of high-school students receive some vocational education, a figure below that in many other OECD countries. The number of high school students which have vocational education is less than that of other countries such as Japan, Germany and the United Kingdom (see Table 6.6). Many parties affirm that there are relatively few technicians, which can hinder development of some service sector activities. Only 21.0% of 25-64 year-olds who have general upper secondary have vocational education and training (OECD, 2012c).

Box 6.2. OECD skills strategy for Korea: Selected findings

Korea is a top performer among OECD countries in terms of 15-year-old student achievement and a high share of young adults has attained tertiary education. However, the skills system is currently being challenged in terms of its relevance, cost and equity implications. The financial burden of skills development on households needs to be reduced, in particular for socio-economically disadvantaged families. And it is important to ensure up-skilling opportunities for older workers, women and employees in small and medium-sized enterprises.

Korea can also boost economic growth by better utilising inactive skills. Target populations here include women, youth and older workers. Korea has one of the lowest female labour participation rates (55.2%) across OECD countries. To boost female participation many inter-connected challenges need to be addressed, ranging from labour market policies, childcare and social values. For example, the lack of affordable high-quality childcare creates disincentives for mothers to work. Compounding this problem, Korea also has one of the highest gender pay gaps across OECD countries (38.9%). And when employed, Korean women are more likely to have work of lower quality (e.g. non-regular jobs) than males. The government aims to increase the female labour participation rate to 61.9% by 2017.

While Korean youth are highly qualified in comparison with their international peers, the share of youth neither in employment nor in education or training (NEET) with a tertiary education qualification is well above the OECD average. Considerable waste of public and private investment in skills development is entailed if the skills of such young people are not utilised. As one of the OECD's most rapidly aging societies, Korea also needs to ensure active labour market participation of older workers, especially given the country's relatively underdeveloped welfare system. The current cohort of older workers has much lower skill levels than the younger generation (and also has the highest relative poverty rate among OECD countries).

President Park's administration aims to create 2.4 million jobs by 2017. It will be important for this process to: (1) use inactive workers; (2) tackle skills mismatch for skilled workers; (3) tap the skills potentials and foster the growth of SMEs and venture enterprises; and, (4) at least maintain employment quality. It is also important to improve the quality of existing jobs and skills. Korea has a large share of low-paid temporary workers (24%) and a problem of decreasing service sector wages relative to manufacturing. Improving the quality of existing jobs would require strategies with different incentives for different workers, e.g. improving employment protection for irregular workers, and flexible employment for regular workers. To improve the quality of existing skills, a fundamental shift in thinking is required: skills must be recognised by assessing competencies rather than qualifications. Furthermore, forecasting skills needs is critical, especially at the local level.

For Korea to more fully develop, activate and use skills, greater policy coherence is required, connecting education, vocational education and training, business and employment, social welfare, tax and financing policies. This will help the government to identify trade-offs between different policies and avoid any duplication. A commitment to a whole-of-government approach is necessary. For example, the sector councils could be better governed and coordinated if the Ministry of Education, Ministry of Employment and Labour, and Ministry of Trade, Industry and Energy could share a common goal and responsibilities in developing an effective skills system. This can be further reinforced through collaboration between national and local authorities.

Source: OECD (2014, forthcoming), "Skills Strategy Diagnostic Report for Korea", OECD Publishing.

Table 6.6. Percentage of students enrolled in vocational programmes during upper secondary education

	2001	2003	2005	2007	2009	2011
Korea	34.1	30.7	28.5	26.8	24.4	21.3
Japan	25.1	24.7	23.9	23.4	22.8	22.3
United Kingdom	66.9	69.2	72.2	41.4	30.5	36.0
Germany	63.3	62.2	60.3	57.4	53.2	48.6

Source: OECD (2011), OECD Education Statistics: Students Enrolled by Type of Institution (accessed on 10 September 2013)

Based on cross-country data, Uppenberg and Strauss (2010) also identify three frequent drivers of service sector productivity expansion. These are:

- *‘Tangible fixed investment.* On average, market services have as much fixed capital per employee as manufacturing, but this capital stock is more skewed towards buildings and information and communications technology. These investments contribute substantially to productivity growth in several key services subsectors. National Accounts data show that gross fixed capital formation in Korea fell from 29.3% of GDP in 2009 to 26.7% in 2012. Nevertheless, its share was the second largest among OECD countries and well above the OECD average of 19.5%.
- *Intangible capital.* Services industries attain higher productivity by combining investment in fixed capital, new computer software and human capital so as to create new organisational structures and business models, and sometimes entirely new service products.⁷ There are big differences across countries in the extent of business investment in such intangible assets – with a wide range of policy considerations being involved – as examined in detail in OECD (2013g). Much of Europe, for example, lags behind the United States with respect to intangible investment, especially in economic competencies, and such cross-country differences are also closely correlated with GDP per capita). The measurement of aggregate business spending on intangible capital is a relatively new and still highly imperfect undertaking (and many data sets are not current). Nevertheless, Chun, Pyo and Rhee (2011) find that the ratio of intangible investment to GDP in Korea has significantly risen from the early 1980s, but by the early 2000s was still about 20-30% lower than in Japan, the United Kingdom and the United States.⁸ This relatively low level of intangible investment is mainly attributed to limited investments in non-scientific R&D and economic competencies, such as advertising, training and business reorganisation. Those authors estimate that the contribution of investments in intangible assets to labour productivity growth in the early 2000s was less than half of that in the United States. In this connection, it is noted that the government is taking steps to raise the relatively low levels of service-sector R&D. Policy must also ensure that conditions exist to facilitate business investment in other forms of intangible asset, such as design, which will be particularly important in the expansion of high-value added services (see Box 6.3).

Box 6.3. Design and innovation

A design is a plan or representation of the look, function or workings of a product or system. Beyond physical appearance, design is often integral to all stages of the business process, from manufacture, brand development and marketing, and after-sales service (in a global context, design can help to differentiate products to meet the requirements of different local markets). The impacts of design are not limited to physical products. Design also plays a major role in innovation in services, such as have occurred with respect to online purchasing or airport check-in. There is substantial quantitative and qualitative evidence that design plays important roles in innovation and firm performance and that overall business spending on design is large. For instance:

- A number of world-beating products owe at least part of their success to different facets of design. For tablet computers and smartphones, some of the most prominent intellectual property conflicts in recent years have focused on design.
- Research published in 2010 indicated that the iPhone had then added around USD 30 billion to the value of the Apple Corporation, only 25% of which was attributable to patentable technology stemming from R&D. Much of the rest was attributable to Apple's innovations in design, marketing and management. Incorporating design into the early stages of new product development has been shown to result in stronger corporate financial performance (Korkeamäki and Takalo, 2013).
- Design can allow firms to pull away from cost-based competition. For example, design enabled Sony to charge a 25% higher price for its Walkman than competitors (Czarnitzki and Thorwarth, 2009).
- Design competencies can also help companies in traditional industries such as textiles, apparel and furniture to succeed. Italy has long had a successful furniture industry largely based on small and medium-sized firms with competitive advantages in design.

Policy makers need to ensure that design education is properly incorporated into curricula (for instance, it is helpful if engineers have familiarity with principles of industrial design, and industrial designers have an understanding of engineering). Also important is a system of design rights that is easy to use, and relatively inexpensive, for small and micro-enterprises, and provides enforcement in the case of design right infringement.

Sources: Korkeamäki, T. and Takalo, T. (2013), "Valuation of Innovation and Intellectual Property: The Case of Iphone", *European Management Review*, (Winter 2013) Volume 10, Issue 4, pp. 197-210, 2013: Available at SSRN: <http://ssrn.com/abstract=2365944> or <http://dx.doi.org/10.1111/emre.12016>. and Czarnitzki, D. and Thorwarth, S. (2009), "The Design Paradox: The Contribution of Inhouse and External Design Activities to Product Market Performance", *ZEW Discussion Papers*, No. 09-068.

- *Services sector innovation, relative to manufacturing, draws less on in-house knowledge creation in the form of R&D.* Service industries tend to innovate in interaction with customers, suppliers and competitors. There is also substantial scope for productivity improvements by adopting best practice, both within and between certain service industries.⁹ *These observations underscore the importance of ensuring competitive and otherwise enabling conditions in markets for services.* A number of additional possible implications for Korea also stem from these observations:
 - The greater reliance on external sourcing of new knowledge suggests that networks and clusters that foster knowledge transfers and spillovers may be particularly important to service sector innovation. Korean policy makers have sought to support cluster and network programmes of different sorts.¹⁰ International experience suggests that important design issues need to be borne in mind when developing cluster/network schemes. Economic logic

suggests that a policy towards clusters should be based on government facilitating existing and emerging clusters rather than trying to create them *ab initio*. A policy aimed at developing entirely new groups of firms in selected sectors could entail high costs, high risks and give rise to deadweight losses should many regions follow policies in pursuit of the same industries. Accordingly, there is a strong case for arguing that an indirect role for government is preferable. By contrast, a more pro-active role for government seems merited as regards the facilitation of business networks. Business networks operate with varied forms and objectives. Some aim at general sharing of information, while others tackle more specific goals. Networks can allow rapid learning (and small companies often favour the peer-based learning that networks permit). Networks can also facilitate the reconfiguration of relationships with suppliers. In some instances networks have led to a new division of labour in a group of firms, allowing individual companies to reap economies of scale and scope. And networks have spurred co-operation on issues as diverse as training, product design, marketing, exporting and distribution.¹¹ An outline of possible policies towards clusters and networks, and their merits, is contained in Annex 1.

- The lack of effective IP protection for non-technological innovation raises the risk of suboptimal levels of knowledge transfer and wasteful duplication of innovative efforts, protected by secrecy.
- Many service industries would gain from learning from best practice in other firms and even in other sectors, yet many are relatively closed to information sharing and co-operation, partly for competitive reasons. *Public support for the dissemination of best practice – say through technical extension programmes – could complement traditional R&D subsidies in fostering more innovation in the services sector.* Korea does operate at least one programme of technical extension, modelled on the United States’ Manufacturing Extension Partnership scheme. A detailed assessment of that and other programmes aimed at enhancing information supply (and its absorption) to SMEs is beyond the scope of this study. However, MOTIE and other Ministries and agencies in Korea are seeking to foster innovations that entail convergence across multiple technologies (as for instance in ‘smart’ cars). These public bodies also wish to bring about a greater contribution to manufacturing from disciplines such as design, the arts, marketing and psychology. This multi-disciplinary orientation is to be welcomed, given an emerging understanding of the importance of intangible assets to innovation generally and advanced manufacturing in particular. In this connection, policy makers in Korea might bear in mind that extension and other information-bridging programmes could be designed to emphasise creativity, going beyond the typical focus on STEM-related information and expertise (see Box 6.4).

Box 6.4. Facilitating access to information and expertise beyond the STEM disciplines

Most OECD governments operate programmes that facilitate business access to research or technology-related advice and information, often from universities and public research organisations. These schemes – such as innovation vouchers, know-how funds and technical extension services – tend to focus on technological information and typically create links to academics in science, technology, engineering and mathematics (STEM) disciplines. Work on knowledge-based capital (KBC) suggests that an exclusive focus on STEM disciplines is too narrow. In fact, businesses require information and advice relating to many forms of KBC and interact with academics for a variety of reasons. In the United Kingdom, for instance, survey data suggest that nearly a third of all academics in the arts and humanities are engaged with business in some way, as are nearly half of academics in the creative arts and media (Hughes *et al*, 2011). As well as knowledge related to STEM disciplines, businesses may want assistance with marketing, sales and support services, as well as human resource management, logistics and procurement.

Source: Hughes, A., Kitson, M. and Probert, J. with Bullock, A. and Milner, I. (2011), “Hidden Connections : Knowledge exchange between the arts and humanities and the private, public and third sectors”, Arts and Humanities Research Council, and the Centre for Business Research, Cambridge, United Kingdom.

6.5. Growth opportunities in specific service activities

The Korean government allocates only 3% of its R&D budget to services. However, in 2012 the government introduced R&D tax credits for 11 knowledge-based service sectors, including health care. Government analysts observe that many service sectors, from retail to knowledge services, have the potential to become more creative and increase value added. McKinsey (2013) describes specific opportunities for growth and productivity increases in health care, social welfare services, financial services and tourism. Again, a discussion of these opportunities is beyond the scope of the present report. However, it is relevant to note emerging good practices as regards policy for the application of ICT in the health sector (which is set to account for a growing share of national income as the Korean population ages rapidly) (see Box 6.5).

Box 6.5. Enhancing the role of ICTs in healthcare: Insights from recent analyses

The application of information and communication technologies (ICT) in the health sector can bring a range of benefits, including: increasing care quality and efficiency; reducing operating costs in clinical services; reducing administrative costs; and enabling entirely new modes of care. Despite their promise, the adoption and use of health ICTs has proven to be a complex undertaking. Around the world, significant public investments have brought not only notable successes, but also costly delays and failures.

Against this background, the OECD has prepared case studies in six OECD countries (Australia, Canada, the Netherlands, Spain, Sweden and the United States) to analyse the conditions under which these technologies are most likely to result in improved efficiency and quality-of-care (OECD, 2010). The OECD has found that successful implementation and widespread adoption are closely linked to the ability to address three main issues:

- *Alignment of incentives with health system priorities:* Governments need to address the fixed costs associated with setting up the health ICT system. In all six case studies, governments are promoting the adoption of ICTs either through direct regulation, financial incentives or persuasive measures such as providing education and training. Public support has generally been aimed at unambiguous public health priorities with clear benefits that would not have been achievable without ICTs.
- *Robust and coherent privacy protection:* Due to the sensitivity of health information, and uncertainty regarding how existing legal frameworks apply to the health ICT system, privacy concerns constitute one of the most difficult barriers to promoting ICT application. The OECD findings emphasise that reliable and coherent privacy and security frameworks must be incorporated into the design of new health ICT systems and policies from the outset in order to establish the public confidence and trust.
- *Achieving commonly defined and consistently implemented standards:* The development and implementation of standards to enable interoperability requires government leadership and the collaboration with the relevant stakeholders. To move the interoperability agenda forward, four of the case study countries established formal health-care ICT product certification processes. Some governments provide financial incentives for the adoption of certified products.

Source: OECD (2010), “OECD Health Policy Studies: Improving Health Sector Efficiency”, OECD Publishing, Paris. DOI: [10.1787/9789264084612-en](https://doi.org/10.1787/9789264084612-en).

Notes

1. “High-end services” include, for instance, computing, engineering, legal, design, financial, accounting, insurance and other business services, as contrasted with low-value-added services such as cleaning and many personal services.
2. The ICT service industry in Korea includes many SMEs. However, large ICT service companies such as SDS (Samsung) and CNS (LG) hold large shares of Korea’s ICT services market. The government judged that unfair pricing practices for SMEs have inhibited the development of the ICT service industry, and decided that it would ban the big ICT service providers, subsidiaries of the *chaebols*, from the public IT service market from 2013, based on the Software Industry Promotion Act (see Fair Trade Commission [2012], Annual Report, July 2012).
3. The Global Entrepreneurship Monitor 2012 Global Report defines ‘necessity-driven’ entrepreneurs as those pushed into starting businesses because they have no other work options and need a source of income. By contrast, ‘opportunity-driven’ entrepreneurs are those entering business to pursue an opportunity and seek to improve their income or independence through entrepreneurship. In Korea, among early-stage entrepreneurs, around 35% are necessity driven, a percentage somewhat higher than in Japan (21%), the United Kingdom (18%), Germany (22%), and the United States (21%).
4. McKinsey (2013) cites data, from various sources, that only 0.07% of SMEs become large companies. Of a total of 2.7 million SMEs in 1997, only 28 had become large firms by 2007 (The Korean Hidden Champions Strategy, Ministry of Strategy and Finance (MOSF), Ministry of Knowledge Economy (MKE), Financial Services Commission (FSC), March 2010).
5. In 2009, for instance, the OECD’s 2008 Economic Survey of Korea reviewed the government’s service sector roadmap, entitled “Service PROGRESS-I”, “Services PROGRESS-II” and Services PROGRESS-III”. These programmes focused on promoting specific service industries such as medical tourism, tourism, animation, etc.
6. Successful standardisation has variously been documented as achieving some or all of the following (Swann, 2000): accelerate enhance innovation because innovation requires competition and competition requires interoperability. Successful standards facilitate that interoperability; increase trade; codify and diffuse information on technology and best practice; reduce risks for producers and consumers (for instance, standardisation of measurement helps producers of innovations demonstrate innovative traits to consumers); reduce transactions costs between producers and between producers and consumers; and, protect against situations in which high-quality producers are driven out of the market by low-quality producers because information is not fully available to consumers on the quality content of their output.

7. For example, Brynjolfsson and Hitt (2000) survey mostly firm-level studies of the role of computers in driving productivity. They conclude that complementary investments in new business process skills and new organisational structures have been keys to enabling the contribution of information technology.
8. The aggregate measure of business investment in intangibles in Korea was subsequently revised down in Chun, Fukao, Shoichi, and Miyagawa (2012).
9. The lower level of in-house knowledge creation partially reflects the smaller average firm size in services industries.
10. Korea's cluster policy has been conducted as part of its regional development policy since 2003. During 2003-2008 the government pushed for "regional strategic industrial development". The government selected strategic industries based on cluster theory for each of the 16 administrative provinces. The government supported infrastructure, R&D, marketing and export activities. Techno parks established in almost all provinces played key roles in planning industrial development, supporting businesses and evaluation. Since 2008, however, Korea set up the 5+2 Economic Regions instead of 16 administrative provinces (5 regions surpass the previous administrative borders and 2 regions [Jeju and Gangwon] are coterminous with previous administrative borders). "Leading industries" were identified in each of these 5+2 Economic regions, with support being focused on these. The Leading Industry Programme has concentrated resources on consortia of firms and universities in the economic region and mainly supports R&D development. The Programme offers support for: developing new products, including new services; supporting the development of local value chains from production, to branding and international collaboration; and provides incentives for collaboration in the regional innovation system. The major lines of action for programme implementation derive from the Economic Region Development Committee, which draws up the development plan for each Economic Region. The Leading Industry Programme started in 2009, with a total of KRW 1.32 trillion to be invested to 2012.
11. In finance, each year, around one million Italian SMEs receive credits mediated by mutual guarantee schemes, a form of network organisation that is mainly local in scope.

References

- Brynjolfsson, E and Hitt, L. (2000), “Beyond Computation: Information Technology, Organisational Transformation and Business Performance”, *Journal of Economic Perspectives* 14, No.4, pp. 23-48.
- Chun, H. Pyo, H.K., Rhee, K.H. (2011), “Intangible Investment and Productivity Growth in Korea”, unpublished paper.
- Chun, H., Fukao, K., Shoichi, H. and Miyagawa, T. (2012), “Measurement of Intangible Investments by Industry and its Role in Productivity Improvement Utilising Comparative Studies between Japan and Korea”, RIETI Discussion Paper Series 12-E-037.
- Czarnitzki, D. and Thorwarth, S. (2009), “The Design Paradox: The Contribution of In-house and External Design Activities to Product Market Performance”, *ZEW Discussion Papers*, No. 09-068.
- Eichengreen, B., Perkins, D., and Shin, K. (2012), “From Miracle to Maturity: The Growth of the Korean Economy”, Cambridge, MA: Harvard University Asia Centre.
- Hughes, A., Kitson, M. and Probert, J. with Bullock, A. and Milner, I. (2011), “Hidden Connections : Knowledge exchange between the arts and humanities and the private, public and third sectors”, Arts and Humanities Research Council, and the Centre for Business Research, Cambridge, United Kingdom.
- Inno-Grips (2011), “Policies in Support of Service Innovation”, INNO-Grips Policy Brief No. 3, available at:
http://ec.europa.eu/enterprise/policies/innovation/files/proinno/inno-grips-policy-brief-3_en.pdf.
- Korea Development Institute (2012), “Competition Policy for the Electricity Industry of Korea“, Study 2408.
- Korkeamäki, T. and Takalo, T. (2013), “Valuation of Innovation and Intellectual Property: The Case of Iphone”, *European Management Review*, (Winter 2013) Volume 10, Issue 4, pp. 197-210, 2013: Available at SSRN:
<http://ssrn.com/abstract=2365944> or <http://dx.doi.org/10.1111/emre.12016>.
- McKinsey (2013), “Beyond Korean Style: Shaping a New Growth Formula”, McKinsey Global Institute, April 2013.
- MOSF (Ministry of Strategy and Finance) (2013), “Service Industry Policy Direction and Measures”, July 2013, Korea.
- OECD (2014, forthcoming), *Skills Strategy Diagnostic Report for Korea*, OECD Publishing, Paris.
- OECD (2013a), “Main Science and Technology Indicators”, Vol. 2013/1, OECD Publishing, Paris. doi: [10.1787/msti-v2013-1-en](https://doi.org/10.1787/msti-v2013-1-en)

- OECD (2013b), "Research and Development Statistics: Business enterprise R-D personnel by industry", *OECD Science, Technology and R&D Statistics* (database). doi: [10.1787/data-00195-en](https://doi.org/10.1787/data-00195-en) (accessed in September 2013).
- OECD (2013c), *Interconnected Economies: Benefiting from Global Value Chains*, OECD Publishing, Paris. doi: [10.1787/9789264189560-en](https://doi.org/10.1787/9789264189560-en)
- OECD (2013d), "Trade : Key Tables from OECD", OECD Factbook Statistics. Doi: [10.1787/20743920](https://doi.org/10.1787/20743920)
- OECD (2013e), "Entrepreneurship at a Glance 2013", OECD Publishing, Paris. doi: [10.1787/entrepreneur_aag-2013-en](https://doi.org/10.1787/entrepreneur_aag-2013-en).
- OECD (2013f), "Strengthening Social Cohesion in Korea", OECD Publishing, Paris. doi: [10.1787/9789264188945-en](https://doi.org/10.1787/9789264188945-en)
- OECD (2013g), "Supporting Investment in Knowledge Capital, Growth and Innovation", OECD publishing., Paris. doi: [10.1787/9789264193307-en](https://doi.org/10.1787/9789264193307-en)
- OECD (2012a), "STAN Database for Structural Analysis ISIC Rev.4", *STAN: OECD Structural Analysis Statistics* (database). Doi: [10.1787/stan-data-en](https://doi.org/10.1787/stan-data-en) (accessed on 10 September 2013)
- OECD (2012b), *OECD Economic Surveys: Korea 2012*, OECD Publishing, Paris. doi: [10.1787/eco_surveys-kor-2012-en](https://doi.org/10.1787/eco_surveys-kor-2012-en).
- OECD (2012c), *Education at a Glance 2012: OECD Indicators*, OECD Publishing, Paris. doi: [10.1787/eag-2012-en](https://doi.org/10.1787/eag-2012-en)
- OECD (2011), "Education Database: Students enrolled by type of institution ", *OECD Education Statistics* (database). doi: [10.1787/data-00211-en](https://doi.org/10.1787/data-00211-en) (accessed on 10 September 2013).
- OECD (2010), *Improving Health Sector Efficiency: The Role of Information and Communication Technologies*, OECD Health Policy Studies, OECD Publishing. doi: [10.1787/9789264084612-en](https://doi.org/10.1787/9789264084612-en)
- OECD (2008), *OECD Product Market Regulation Statistics* (database). Doi: [10.1787/pmr-data-en](https://doi.org/10.1787/pmr-data-en) (accessed in September 2013).
- OECD (2001), *Enhancing SME Competitiveness: The OECD Bologna Ministerial Conference*, OECD Publishing. doi: [10.1787/9789264192560-en](https://doi.org/10.1787/9789264192560-en).
- Park, D. and Shin, K. (2012), "Performance of the Service Sector in the Republic of Korea: An Empirical Investigation", Asian Development bank Working paper Series, No.324, December 2012.
- Sheehan, J., et al. (2005), "Promoting Innovation in Services", in OECD, *Enhancing the Performance of the Services Sector*, OECD Publishing, doi: [10.1787/9789264010307-8-en](https://doi.org/10.1787/9789264010307-8-en).
- Swann, P.G.M. (2000), "The Economics of Standardisation (Final Report for Standards and Technical Regulations Directorate)", Department of Trade and Industry, United Kingdom.
- Uppenberg, K. and Strauss, H. (2010), "Innovation and productivity growth in the EU services sector", European Investment Bank, available at: www.eib.org/attachments/efs/efs_innovation_and_productivity_en.pdf.

Annex 6A.1

Policy rationales and design for enterprise clusters and networks

“Clustering” is the tendency of firms in related lines of business to concentrate geographically. Policy initiatives to foster enterprise clusters are now common throughout OECD member and non-member economies, in wealthy and lagging regions, and in jurisdictions with *laissez-faire* and *dirigiste* approaches to economic development.

It is well documented that the agglomeration of firms and their suppliers can confer competitive advantage to the enterprises involved. For example, agglomeration can create locally concentrated labour markets, bring about specialisation and division of labour between firms (offering scale economies for individual firms), and attract buyers and sellers. The clustering of firms can also reduce the unit costs of technical services provided to members of the cluster. By operating in close proximity firms can also more easily subcontract to competitors those orders that exceed their own capacities, because proximity allows greater knowledge of the capabilities of potential contractors. This may allow firms to retain valued customers during peaks in demand. The clustering of firms can likewise facilitate the flow of ideas and information. Such flows occur formally and informally, for example when employees change employer, through contacts with common suppliers, and through social exchanges. Indeed, it is likely that frequent contacts between users and producers of capital goods have underpinned productivity growth in firms in many industrial districts. And locally overlapping commercial and social institutions can create a social substrate facilitating the reduction of transaction and other business costs. Furthermore, because factor costs are often similar if not identical for the cluster participants, competition may be driven by innovation.

A cluster can contain a small or large number of enterprises, as well as small and large-size firms in different ratios. Some clusters, such as many of Italy’s industrial districts, are comprised principally of SMEs. Different clusters involve varied degrees of interaction between the firms involved, ranging from fairly loose networks of association through to multifaceted forms of co-operation and competition.

It is not the case that benefits automatically arise from clustering – there can be congestion effects for example, especially for firms located in clusters belonging to industries other than their own – but gains are sufficiently common for us to take them as read here. Some clusters also decline: Michael Porter notes – in *On Competition* - how the manufacture of golf equipment in the United States shifted from the State of New England, where clubs were based on steel and wood, to California when the use of advanced materials became a possibility.

Business networks

Intimately linked to the subject of clusters is the theme of business networks. Indeed, many public programmes to encourage inter-firm networks have been inspired by a desire to replicate the success of renowned clusters in such areas as Silicon Valley and Emilia Romagna.

Business networks operate with varied forms and objectives. Some aim at general sharing of information, while others tackle more specific goals. Networks can allow rapid learning - and small companies often favour the peer-based learning that networks permit. Networks can also facilitate the reconfiguration of relationships with suppliers. In some instances networks have led to a new division of labour in a group of firms, allowing individual companies to reap economies of scale and scope. And networks have spurred co-operation on issues as diverse as training, technological development, product design, marketing, exporting and distribution. In finance, each year, around one million Italian SMEs receive credits mediated by mutual guarantee schemes, a form of network organisation that is mainly local in scope. And at the end of June 2001, 10 000 SMEs located around Barcelona, about half that city's total population of small firms, organised through six territorial networks to buy electricity at a rate some 30% below that which they had paid previously (El Pais, 27 June 2001, p. 61).

However, it is important to make a clear conceptual distinction between clusters and networks. In this respect, one can note that:

- Networks allow firms access to specialised services at lower costs, whereas *clusters attract specialised services to a region*.
- Networks have restricted membership, whereas *clusters have open "membership"*.
- Networks are based on contractual agreements, whereas *clusters are based on market dynamics*.
- Networks make it easier for firms to engage in complex production, whereas *clusters generate demand for more firms with similar and related capabilities*.
- Networks are based on co-operation, *clusters require competition*.
- Networks have common business goals, whereas *clusters may have collective visions*.

It is important to make these distinctions because policy towards networks can obviously require resources very different from a range of other policies (say in infrastructure) that might be adopted to foster clusters. And while networks are often easier to form amongst co-located firms, geographic proximity is not a pre-requisite. Policy makers however often mistakenly refer to networks and clusters as if they were one and the same.

Policy recommendations on clusters and networks

Generic observations:

A policy towards clusters should be based on government supporting existing and emerging clusters rather than trying to create them *ab initio*. A policy aimed at developing entirely new groups of firms in selected sectors can entail high costs, high risks, serve as a screen for outmoded forms of industrial targeting, and give rise to

destructive competition should many regions follow the same policies in pursuit of the same industries. Underlying programmes of cluster development is the idea that firms and industries are part of larger inter-linked systems involving market and non-market exchanges. It is difficult therefore for governments to create and manage such complex systems through policy. Accordingly, an indirect role for government is preferable.

There is another economic reason why an enabling role for government is appropriate. Regional and local development agencies sometimes express the view that public spending on cluster development is economically justified because it aims to create positive externalities, that is, it aims to facilitate the agglomeration economies referred to earlier. In fact, such an argument highlights the limits of policy. This is because, while agglomeration economies are clearly significant in many industries, policy makers do not generally have the information with which to judge their magnitude in different industries for agglomerations of different scales. Therefore, policy makers are usually not in a position to assess whether the cost of the support to be given is smaller than the potential benefits. Furthermore, diseconomies of agglomeration – say from congestion or pollution – may occur as clusters increase in size. So, beyond a given scale, a public subsidy of agglomeration may be guaranteed to reduce economic efficiency, although policy makers would not have the data with which to know when this occurs. Such considerations again suggest a non-distortionary and facilitatory role for the public sector, rather than one in which government seeks to plan the creation and development of new agglomerations.

So, essentially, a policy on clusters should provide a framework for dialogue and co-operation between firms, the public sector (particularly at local and regional levels of government) and non-governmental organisations. This dialogue can lead to efficiency-enhancing collaboration amongst firms, such as in joint marketing initiatives, the creation of mutual credit guarantee associations, joint design and sponsorship of training, a more efficient division of labour among enterprises, etc. Such a dialogue can also lead to an improved quality of policy and government action (such as in training, the provision of information, and infrastructure supply). Policy makers can lock-in some of the benefits of existing or embryonic clusters by ensuring suitable institutional conditions. For example, amongst other actions, promoting the establishment of suppliers' associations and learning circles, facilitating contacts among participants in the cluster, facilitating subcontracting arrangements within the cluster, and ensuring effective extension services can all increase the benefits to firms of belonging to a cluster.

Firms should have access to such institutional arrangements whether they belong to a cluster or not. However, it is likely that the benefits of such arrangements will be magnified by cluster membership, and the cost-effectiveness of provision may be greater when supplying to a clustered rather than a dispersed group of firms.

Policy should also obviously be informed by an awareness that programmes need to be tailored to diverse local economic, social and institutional circumstances. Mechanical replication of policy approaches will not produce optimal results.

Policy recommendations on enterprise clusters and business networks were analysed at length in the context of the first OECD Ministerial Conference on SME development,

in Bologna, Italy in 2000.¹ The essential recommendations emerging from that process were that:

On enterprise networks

- **Implement broad campaigns to introduce the networking concept to businesses.** It is important to create informed demand for network services, with networks preferably addressing precise market-driven objectives. The most successful business networks organise around specific goals. Therefore, public authorities and business associations should seek to raise awareness of the benefits and opportunities of networks in order to increase informed demand for network services.
- A degree of financial support, in feasibility work, start-up activities, and the costs of network brokerage, is to be expected.
- **Work with realistic time-frames:** a commitment of 3-4 years is usually required for a significant business network programme.
- **Ensure the presence of experienced network brokers.** As with many schemes to support enterprise, the quality of management is critical. Persons with direct experience of SME development should be employed as network brokers, providing advice and a neutral corner for firms hesitant at the prospect of co-operation.

On enterprise clusters

- **Facilitate local partnerships involving private actors, NGOs and different levels and sectors of government so as to arrive at agreements on individual responsibilities.** For example co-locating complementary public investments with related concentrations of private investment could be beneficial. The building of collective reputation, to take another example, can also be sought through such partnerships. In Oregon, a Wood Products Competitiveness Corporation was initiated by the State legislature and established a common “Made in Oregon” brand for their products. Tourism clusters are another case in which collective promotion can be important.
- **Let the private sector lead in cluster-development initiatives, with the public sector playing a catalytic role.** Policy makers should generally refrain from seeking to build entirely new sector-specific clusters of firms. There should be an element of market-test before significant public resources are committed to a cluster. Adopting this practice may help avoid situations in which sub-national bodies compete in implementing identical cluster development strategies. Similarly, cluster initiatives should not be used to introduce distortionary industrial policy intended to target “national champions”, “sunrise sectors”, etc.

1. OECD (2001), *Enhancing SME Competitiveness: The OECD Bologna Ministerial Conference*, OECD Publishing, doi: [10.1787/9789264192560-en](https://doi.org/10.1787/9789264192560-en)

- **Where possible, match initiatives to the most suitable level of government.** The ideal level of government will correspond to the physical scope of the cluster while having substantial influence over relevant programmes and expenditures.
- **Some prioritisation among clusters is generally necessary due to limited resources** (selection criteria might include the opportunity for the sponsor to add-value, and the existence of organised nuclei of actors in the cluster). There may also be benefits to working with a portfolio of clusters.

The choice of clusters to work with can only draw to a limited extent on economic theory-based prescription. In many localities the selection of clusters will be self-evident, as there may only be one or two clusters present. But in more economically diverse settings, with a number of clusters, the choice is more complicated. The temptation exists to seek sectoral priorities based on inherent technical or economic characteristics of the industry in question: value addition, the breadth of forward or backward linkages; technological complexity, employment intensity, growth prospects, etc. This temptation should be avoided. In ideal circumstances, policy makers could allocate resources between clusters if they had a description of the opportunity set of projects in different clusters ranked in terms of benefit/cost ratios. However, while informed policy makers may have access to technical information in a number of sectors, suggesting where unexploited good projects exist, they often won't have this information, especially when working with larger numbers of clusters. This highlights the importance of an iterative process of dialogue and exchange with the private sector in selecting actions that could be beneficial to firms within clusters. Private actors will generally have better knowledge of potential opportunities for collaborative projects, while public actors can help by outlining the scope for collaborative action amongst private agents unfamiliar with such experiences.

- **Initially adopt a low risk/early return focus.** It is useful to generate small but evident gains through collaborative effort at the outset. As success develops, higher risk and longer term activities can be introduced.
- **Target market failures.** Policy – in which local and regional authorities are critical – should explicitly target market failures. The fact that clusters can afford competitive advantages for member firms does not in itself constitute a justification for public action. Several forms of market failure are relevant to policy on clusters of SMEs. These include under-supply of public goods, and co-ordination failures. By not explicitly identifying market failures a cluster development programme might simply become a source of interest-group support. Indeed, assisting a group of firms to better act in concert can have the unwanted consequence of helping those same firms press for support that is economically unjustified.

Seek to lock-in benefits of existing or embryonic clusters by:

- Facilitating access to accommodation for new and small firms (given the widely reported difficulties faced by small firms, and particularly start-ups, in gaining access to industrial real estate).
- Promoting the establishment of suppliers associations and learning circles, and other forms of collaborative undertaking that are made possible by virtue of physical proximity among firms (such as mutual credit guarantee associations).

- Allowing specialisation and local adaptation in university-industry linkages including experimentation in incentive structures that can encourage local linkages to industry.
- Ensuring access to specialised infrastructure, communications and transport.

If seeking to attract investments then:

- Have local, regional and national authorities disseminate information about the cluster – and the locational advantages it offers – throughout the business community of a region or country.
- Focus investment promotion efforts on linkages within a cluster considered weakest (such as gaps in the chain of local suppliers).
- Consider complementing the national collection and organisation of statistics by adopting a frame of reference that would illustrate the geographic concentration of related groups of firms. Data organised according to the Standard Industrial Classification (SIC) omits the extent of inter-linkages among firms in a given locality belonging to different branches of manufacturing (or services).
- Evaluate the initiative throughout, not just at the end of the process.

Chapter 7

The Korean Creative Economy Strategy as industrial policy

This chapter examines recent experiences with industrial policy in Korea and other OECD countries. The merits and demerits of sector targeting are examined. The chapter considers the possibility of jointly pursuing a sectoral and technology-based approach. Drawing on international experience, suitable characteristics of a sectoral approach are also discussed.

Korea has long been regarded as one of relatively few examples of the successful application of industrial policy to achieve economic catch-up. Since the 1970s, successive Korean governments have used a variety of selective-strategic industrial policies to shape the development of the economy. The current Park government, however, has not yet announced such efforts, even though the Creative Economy Strategy includes some aspects of industrial policy. This chapter analyses recent experiences with industrial policy in other countries, and the merits and demerits of sectoral targeting. It also reviews the possibility of pursuing sectoral targeting together with a technology-based approach, and finally recommends how Korea might develop industrial policy under the Creative Economy Strategy.

7.1. Experience with industrial policy in Korea

As set out in the opening sections of the report, Korea has targeted certain sectors of the economy in a succession of five-year economic development plans. Action to support priority sectors has been taken across several policy areas, including innovation and technology, trade and investment, education and training and infrastructure. As the economy has developed, the sectors targeted by industrial policy have evolved. As was shown in Chapter 2 (Table 2.1), the initial emphasis was on light industry, infrastructure and energy but over time the focus has shifted first to heavy and chemical industries, and subsequently to high tech industries, notably consumer electronics.

From the 1990s, Korean industrial strategy became more technology-focused and the emphasis switched more to the promotion of R&D and innovation. The Roh Government of 2003-2008 adopted the Next Generation Growth Engine Programme in September 2003, under which ten high-technology industrial sectors were identified as priorities in Government R&D programmes, the Lee Government of 2008-12 promoted the Green Economy and classified 17 sectors of the economy as “new growth engines”, namely:

- *Green technology.* New and renewable energy, low-carbon energy, advanced water processing, LEDs, green transportation systems, and high-tech green cities;
- *High-tech convergence.* Broadcasting and communications, IT convergence, intelligent robots, nanotechnology, biopharmaceuticals and medical devices, food industry;
- *Value-added services.* Healthcare, education, green financing, content and software, and conventions and tourism.

The Lee government also introduced the Leading Industries Programme aimed at supporting job creation and regional growth by targeting 12 leading industries in the “5 + 2” economic regions.

The present government has so far put less emphasis on sectoral priorities. The Creative Economy Plan includes some industrial policy initiatives, particularly under the sub-strategy for the creation of growth engines to pioneer new markets and new industries. For example, there are initiatives to strengthen the digital content industry (music, movies, games and animation) and the infrastructure for new web-based businesses. Promising sectors with growth potential are to be supported, especially industries based on biomedical, nano and environmental technology and large-scale national strategic industries such as satellites and nuclear reactors. Traditional sectors are not neglected, as support is to be provided by means of a cross-government project to use science, technology and ICT to improve management and productivity in agriculture,

culture, the environment, food, government, infrastructure and safety. The emphasis seems to be to promote the Creative Economy through strategic technologies, and it is not yet clear what role sectoral targeting will play in the Government's Industrial and Technology Policy.

7.2. Recent experience with industrial policy elsewhere

The reduced emphasis on explicit setting of sectoral priorities in Korea is in line with conventional economic thinking about the practical difficulties of picking winners and the dangers of capture by vested interests. However, it comes at a time when, for a variety of reasons, some OECD countries are experimenting with new approaches to industrial policy. Some countries are concerned that their economic growth trajectory has not been sufficiently balanced, with some sectors declining excessively and other sectors taking too prominent a role (see Westlake, 2013). In some cases there are concerns that manufacturing production has declined too much, and that knowledge and capabilities have been irreversibly lost. In various countries there are calls for industrial policies to strengthen specific sectors, technologies or areas of economic activity, such as advanced manufacturing, knowledge-intensive business services or the 'green' economy, with the aim of fostering new sources of economic growth. Warwick (2013) sets out examples of new industrial policy initiatives in a number of countries, discusses the reasons for the resurgence of interest and traces the evolution of industry policy over time, contrasting its most recent incarnation with earlier versions.

Two countries that illustrate the renaissance of interest in explicit sectoral targeting are the Netherlands and the United Kingdom. The Dutch example is interesting because, until recently, the Dutch experience with industrial policy had been more oriented towards horizontal policies – creating excellent framework conditions in terms of macroeconomic stability, competition, entrepreneurship, infrastructure and skills, and an overall environment in which business can flourish. Similarly, the United Kingdom only recently explicitly embraced a formal industrial strategy. However, first in *New Industry, New Jobs* (BERR, 2009) and then in *The Plan for Growth* (BIS and HM Treasury, 2011), successive governments have set out a vision for the UK economy which includes not only horizontal measures but also the identification of key sectors where work will be undertaken to improve capabilities and address barriers to growth.¹

The Dutch 'Top Sectors' approach brings together enterprise and innovation policy, focusing on nine sectors in which the Netherlands occupies a leading position worldwide.² A 'Top Team' has been put together for each sector, consisting of a sector expert (typically a well-known business figure), an innovative SME entrepreneur, a high-ranking civil servant and a representative from a research institution. Action plans have been prepared detailing their ambitions and recommendations and a plan of approach. Parties collaborating in the top sectors have established 19 Top consortia for Knowledge and Innovation (TKIs), which have started to implement the research agendas set out in Innovation Contracts. These include cross cutting agendas on ICT, nanotechnology and the bio-based economy.

In the United Kingdom, the Government is also building strategic partnerships with key sectors (BIS, 2013) and has given particular focus to developing business competitiveness in the following areas:

- *Advanced manufacturing*: Aerospace, automotive, life sciences and agri-tech;
- *Knowledge-intensive traded services*: Professional/business services, the information economy and internationally traded aspects of education;
- *Enabling industries*: Oil and gas, nuclear energy, offshore wind and construction.

Sector strategies have been published for each of these 11 areas.³

Other countries to have adopted a selective sectoral approach include Japan which in 2010 adopted a new industrial policy plan (METI, 2010) targeting five strategic areas: infrastructure-related and infrastructure system exports; environmental/energy problem-solving industries (including green vehicles); culture (fashion, food & tourism); medical and healthcare; and advanced areas traditional to Japan (robotics, space, aerospace).

In contrast to older, more traditional approaches to industrial policy, the newer approaches typically put more emphasis on instruments based on improving systems and, in particular, interventions designed to build networks, improve co-ordination and secure strategic alignment. At a time of fiscal austerity in many countries, they typically involve a shift away from support for single firms, state aids, tariff protection and product market-focused interventions. Government's role is primarily to act as a facilitator, both to enable closer co-ordination between individual economic agents and to allow for experimentation in the economy. The idea is to move away from one-time attempts to "pick winners" and instead design better processes for search and "self-discovery" of ways to promote growth. In the process, it is accepted that mistakes are inevitable: the policy challenge is to design governance procedures to detect and correct them and to manage the associated vested interests (Rodrik, 2008).

7.3. Merits and demerits of Sector targeting

There is still ongoing debate for and against targeted industrial policy, and the debate is cantered on what advantages there are in following a sectoral approach and what are the risks and limitations of such an approach. Empirically, the evaluative evidence in favour of sectoral targeting is scattered and ambiguous (Box 7.1).

The arguments for a sectoral approach may be divided into four broad categories:

First, externalities and other market failures may differ from one sector to another. They may be particularly prevalent in enabling sectors such as ICT or transport infrastructure or in industries with a tendency to natural monopoly, for example the utilities. External spill over effects may be particularly strong in innovation and technology-intensive sectors such as electronics or aerospace. Taking account of the diversity of the economy can also help inform the design and delivery of the policy and avoid unintended consequences. Knowledge of how economic conditions vary by sector can even help target horizontal policies, for example skills policy or spatial planning policy, more effectively.

Second, because sectors vary in the market conditions and constraints they face, they also vary in terms of what needs to be done to upgrade their capabilities. The strategic concerns of the automotive or electronics sector may be very different from those of the creative industries or renewable energy sector. A sectorally differentiated approach to removing constraints and upgrading capabilities may be required, for instance in areas such as technology policy and skills.

Third, in many areas, government has a direct sectoral interest in the sense that government policy is actually delivered through the specific contribution made by certain sectors of the economy to the policy goal. This is true in areas such as climate change policy where government objectives can only be achieved with the active participation of industries such as construction, transport and renewable energy. More generally, government procurement plays an important and sometimes dominant role in sectors such as defence, education, healthcare, other forms of social provision and some areas of transport.

Fourth, businesses are themselves often organised by sector, as can be seen by the number of sector-specific trade bodies. Trade associations or other sector bodies provide a natural conduit for government in its dealings with business. Working with business within and across sectors, government can play a role as a facilitator and help address the co-ordination and systems failures that hold back economic performance.

In principle, government could pursue a sector strategy for each and every sector of the economy, varying the approach according to the economic conditions and constraints, in line with the considerations above. In practice, however, there is a need to focus, for the simple reason that the resources available, whether for financial support, technology development or the design and delivery of policy, are limited. Setting sectoral priorities is then a way of ensuring that policies are fully aligned across government departments responsible for diverse policy areas including technology, skills, infrastructure, tax and regulation. In the absence of high level strategic priority-setting, departments and agencies will still have to make choices, but there is no guarantee that this will be done consistently or effectively. Attempts to attract foreign direct investment are arguably more likely to be effective if global investors can see that there is a joined-up approach to policy affecting the sector in which they are being asked to invest.

There are of course risks. Even if the need for a sectoral approach can be identified, governments may lack the capacity to intervene or may not be able to do so in a cost-effective way. Governments do not have the information or expertise required to pick future winners and political priorities may take precedence. There is a risk of capture by vested interests and policy may become subject to undue influence from lobby groups and large corporations. The sectoral approach inevitably favours existing players and leaves out potential entrants – support goes to the “incumbents” and not the “insurgents”. This consideration is critical in the Korean context, where large firms play a dominant economic role and where the Creative Economy Strategy is seeking to bring increased dynamism among new firms and SMEs. There is also a danger that a sectoral approach can become overly bureaucratic and slow the decision-making process. Finally, there is the criticism that a sectoral approach is obsolete in a world of rapidly changing technology and global value chains – industrial policy in these circumstances might better focus on tasks and activities (e.g. IT, logistics, and design) rather than sectors. Such considerations lie behind the shift away from explicit industrial targeting in Korea over the last two decades, following the mixed success of the heavy and chemical industries drive in the 1970s. However, the practice of designating certain industries and technologies as ‘strategic’ and providing targeted support has continued, albeit much reduced in scale and scope.

Box 7.1. Sectoral targeting: Evidence of efficacy

The evaluation of sectoral approaches is conceptually and empirically challenging. The evidence is at best scattered and dispersed, and meta evaluation studies are scarce. There are a number of reasons for this. Industrial policy (within which sector targeting is subsumed) often has multiple objectives, and uses multiple instruments, so its impact may be difficult to disentangle from other influences. Data problems and time lags in policy impact also hamper evaluation. That said, and although opinion is divided, it is possible to draw some conclusions about the circumstances in which industrial policy is more likely to be successful and how it should be designed and delivered. Similarly, for clusters policy – which, like sector policy, combines different policy measures – it has proved possible to draw some inferences from the evidence about what works and does not work and the priorities for policy (see for example Potter and Miranda, 2009).

It is rare for evaluations of industrial policy to attempt to identify the value added by sectoral targeting *per se*. Moreover, even if there were clear conclusions about the value added by sectoral targeting, the findings would be more than usually context-dependent. A successful case of sector targeting in the presence of technology targeting and sound framework conditions might not read across to a situation where the institutions were different and the authorities were relying on sector targeting alone.

Another reason why the evidence on sector targeting is incomplete is that sector targeting on its own is not a well-defined policy. If a sector is identified for support, the instruments used need to be specified and the choice can range across the whole spectrum from traditional state aids through factor subsidies to support for public private partnerships or a co-ordination and facilitation role.

Given the patchy evidence and the methodological limits to gauging the efficacy of sectoral targeting, the conclusions that can be drawn about sectoral targeting are not very different from the general conclusions that can be drawn about industrial policy:

There are undoubtedly successful examples of explicit sectoral targeting. The rise to prominence of Korean electronics firms such as Samsung and LG in the 1990s can be traced to support provided in earlier decades. Rodrik (2004) pointed out that there are examples of successful targeting not just in East Asia but Latin America as well and commented that “it is not true that there is a shortage of evidence on the benefits of industrial policy. To the contrary, it is difficult to come up with real winners in the developing world that are not a product of industrial policies of some sort”.

However, it is more difficult to find systematic evidence of a relationship between sectoral support and sectoral performance. Studies by Beason and Weinstein (1996) and Lee (1997) failed to find a clear association between sectoral support and total factor productivity growth in Japan and Korea respectively during the years of rapid catch-up and growth.

New industrial policy puts less emphasis on product market support measures and more emphasis on support for technology and skills, public private partnerships and a government role in facilitation and co-ordination. These approaches are newer and by their very nature harder to evaluate.

Sectors offer a natural conduit for pursuing this form of industrial policy and the targeting of key sectors will help policy makers prioritise their efforts and also help create clarity of vision and an alignment of interests around shared objectives

Combining sector with technology approaches

Another lesson from recent international experience of industrial policy is that countries may focus, as indeed Korea has tended to do, on a strategic choice of technologies rather than sectors. The United Kingdom effectively does both. The United Kingdom Government has identified 11 sectors with which it has developed strategic partnerships and has also identified “eight great technologies”⁴. Sector partnerships and technologies are in fact two strands of the United Kingdom’s overall approach to industrial strategy, which comprises commitments to:

- develop strategic partnerships with industry
- support emerging technologies
- improve access to finance for businesses
- work with business to help develop skills that businesses will need
- publish government contracts to provide confidence to business investment.

In the Netherlands, technology policy is more formally incorporated into a sector framework. The TKIs set up by the top sectors are responsible for drawing up roadmaps for the relevant technologies and part of the Government's research funding is earmarked for top sector projects, alongside fiscal incentives for collaborative research. However, more general technology foresight exercises are also still conducted and only a proportion of the overall research budget is routed automatically to the top sectors.⁵

The present Korean Government has so far put more emphasis on technology targeting than sector targeting. The 30 priority and 120 strategic technologies that have been identified cover energy, environment, ICT and healthcare fields. More specifically, priorities include smart grids, carbon capture and storage, big-data applications and personalised pharmaceuticals. MSIP plans to draw up a strategic roadmap for the 30 priority technologies, together with other ministries.

There are several advantages of adding a sectoral dimension to a technology approach. One is that it can provide a vital channel linking science and technology to the needs of industry. As already argued, a sectoral approach also allows the government to take account of the heterogeneity of the economy. It can give insight into the nature of sector-specific market failure and real world understanding of how policy should be designed and delivered. Businesses sharing common suppliers, markets and market conditions often have a natural conduit for interaction with government and the research community through their sector councils or trade bodies. And setting sector priorities can be useful in focusing scarce policy resources, promoting a more holistic cross-government approach and improving the effectiveness of policies in related areas, for example inward investment promotion, education and training or the design of regulation.

Where both a technology dimension and sector dimension are present in industrial policy making, the risk is that priorities conflict or that policy appears less coherent, with multiple stakeholders and multiple demands on the government. However, as can be seen from the examples of the United Kingdom and the Netherlands, it is not impossible to join up the two approaches. Whether industrial strategy is seen primarily through a sector lens or a technology lens, there can be advantages in being systematic and explicit about the choices being made, as long as policy makers remain aware of the risks.

Considerations affecting the design of a sectoral approach

If a government wants to seek sectoral policy, it will need to think about the governance arrangements and how sectors should be selected. On the first of these, one lesson of the new industrial policy literature is the importance of a partnership approach involving business, government and the research community, through arrangements such as public private partnerships, industry councils and other networks. In the Netherlands, Top Teams play this role and in the United Kingdom each of the sector strategies is guided by a strategic partnership between government and industry. Korea will need to have in place similar institutional arrangements or other governance mechanisms.

As regards the selection of sectors, ideally this should be done in a systematic way according to agreed criteria. In the Netherlands, the sectors identified by the Government were those that (a) occupy a leading position worldwide, (b) are knowledge-intensive, export-oriented and usually subject to sector-specific regulation and (c) have the potential to make an important contribution to societal needs. The establishment of head offices in the Netherlands was seen as helping to sustain the country's strong economic profile, which makes it important for all top sectors.

In the United Kingdom an attempt was made (BIS, 2012) to identify sectors where: societal drivers indicate there is likely to be significant increasing domestic and global demand; United Kingdom business has a comparative advantage and the capabilities to exploit new market opportunities; and, where for theoretical and practical reasons a sector-based approach has a clear role.

Drawing on Dutch and United Kingdom experience, considerations that Korea should take into account in selecting sectors might include:

Future drivers of growth, including: future needs arising from societal challenges such as climate change and sustainability; population aging and other demographic changes; the opportunities afforded by globalisation and the competitive challenge from emerging markets; and, new developments in technology. While the market might be expected to respond to these needs, information asymmetries, uncertainty and externalities may lead to under-investment in the absence of government action.

- *Sector strengths*, which can be assessed using metrics such as total factor productivity, export performance, revealed comparative advantage and revealed technological advantage. Government intervention is more likely to be effective in sectors where the economy already displays evidence of comparative advantage.
- *Sector linkages of regional or national importance*. Where a sector is highly interconnected with other sectors, through purchases/sales of goods and services, exchange of knowledge and ideas, technology or infrastructure, then spillover and system or network effects are likely to be more important.
- *The prevalence of market failure*. Sectors vary in the extent to which they are affected by market failures such as innovation and knowledge-related externalities, labour market imperfections, natural monopolies, or information failures (e.g. industries with large financing requirements and long investment cycles).
- *The importance of the sector in the provision of public goods or in meeting public procurement needs*. Government already plays a significant role in these sectors and Government or regulatory failure may be more likely in these sectors.
- *The effectiveness of government action*. Without access to the appropriate levers, government intervention is unlikely to be cost-effective and the risk is that government failure might replace market failure.
- *Continuity of policy*. Companies plan for the long term and policy instability can disrupt investment planning and inhibit risk-taking.

According to this framework, the choice of sectors should depend on an assessment of future needs, sector strengths, and the opportunity and capacity to intervene successfully. It is the combination of factors that is important – there is no point in selecting a sector based purely on future needs if there is no evidence of potential com-

parative advantage or of market or systems failure. Again, it is a tenet of the new industrial policy literature that government is not uniquely well placed to make these choices. Decisions need to be made in consultation with industry and the research base, and in the full knowledge that mistakes may be made and adaptation needed.

7.4. The Creative Economy and sectoral priorities

Following a period during which sectoral approaches to industrial policy fell into disrepute in many countries, there is now a resurgence of interest in ways of using industrial policy to support growth and employment, with a particular focus on advanced manufacturing and other high value added sectors of the economy. It is ironic that this comes at a time when Korea is putting increased emphasis on a technology approach which is more horizontal and less sectorally focused than in the past. So what can Korea learn from experience elsewhere? At the outset, it must be recognised that ‘one size does not fit all’. Industrial policy will inevitably be context dependent and it is appropriate to vary the approach according to factors such as the country’s stage of development, institutional features of the business environment and the specific characteristics of the sector being targeted. Given Korea’s stage of economic development and economic structure, an emphasis on services and the creative economy is understandable.

A second lesson from OECD experience is that an approach based on sectors is not the only approach – although the Netherlands and United Kingdom have an important sectoral dimension to their policies, it is not the only dimension, even in these two countries. Increasingly industrial policy around the world may be focused on technologies, activities or tasks, or cross-cutting issues. However the different approaches are not mutually exclusive. It is possible to target technologies, sectors and wider goals at the same time, on the proviso that there must be sufficient instruments available to policy makers and policy must be integrated to ensure consistency and clarity of purpose.

There are various ways that the Korean Government might choose to combine the Creative Economy priority with a sectoral dimension to industrial policy. One way would be to designate the creative industries as one of the priority sectors for industrial policy. The Netherlands has done this explicitly, with the creative industries named as one of the nine top sectors. Progress, however, has not been as fast as in some other sectors, partly because the creative industry sector consists of a large number of relatively small and relatively new SMEs, with no history of organising in this way. The United Kingdom has not made creative industries a priority for a strategic partnership approach, but has set up a Creative Industries Council to promote a sustained dialogue between government and the sector. In Korea, the Lee Government’s New Growth Engines included a number of creative industries, namely broadcasting and communications, digital content and software. This approach could be continued or extended.

An alternative (and possibly complementary) approach to ensuring consistency between the Creative Economy Plan and a sectoral approach to industrial policy would be to add an additional requirement to the criteria set out for identifying priority sectors, namely a sector’s potential contribution to the wider goals of the Creative Economy Plan.

The emerging consensus is that the risks associated with selective-strategic industrial policy can be minimised through a ‘soft’ form of industrial policy, based on a more facilitative, co-ordinating role for government, with the emphasis on systems, networks, institutions and capabilities. Successful implementation of such an approach will require well designed plans for monitoring and evaluation, especially of strategy and policy

programmes. Ideally, such plans should be put in place before the programme begins, so that data gathering and real-time tracking of progress against deliverables and outcomes can take place from the outset.

Korea has considerable experience with the successful application of more traditional forms of industrial policy. For new industrial policy, institutional arrangements may need to evolve to support a more facilitative role for government, drawing on business expertise and existing links with business while maintaining the openness of the system to new entrants and particularly to SMEs. It will also be important to have clarity about the objectives, goals and mechanisms of industrial and technology policy and in particular about the role of sectors within it. Finally, monitoring and evaluation arrangements should be put in place as early as possible to enable an iterative approach to the design of effective interventions.

Notes

1. O'Sullivan et al (2013) say that in the United Kingdom “the evolution of policies towards industries over recent years shows a marked trend from so-called ‘horizontal’ measures and regional focus to a more strategic national approach in partnership with industry to key sectors”. They also note that the approach represents “a significant departure from previous patterns not least by providing a clearer vision and working as important catalysts for new investments and public-private dialogue”.
2. The nine sectors are: agri-food, horticulture and propagation materials, high tech, energy, logistics, creative industries, life sciences, chemicals, water. Head offices were later added as a priority.
3. www.gov.uk/government/organisations/department-for-business-innovation-skills/series/industrial-strategy-government-and-industry-in-partnership
4. Willetts (2013) lists the technologies as: the Big Data revolution and energy-efficient computing; satellites and commercial applications of space; robotics and autonomous systems; life sciences, genomics and synthetic biology; regenerative medicine; agri-science; advanced materials and nano-technology; energy and its storage.
5. For example NWO, the national research council of the Netherlands, expects to devote approximately 40% of its budget to the top sectors. This funding leverages part of the block-funded fundamental research by universities and research institutes. The applied research institutes in the Netherlands tie most of their research to the mission-oriented top sectors approach and other support for specific Top Sectors comes from the relevant ministries and through TKI support (MEA/MECS, 2013).

References

- Bakhshi, H., A. Freeman and P. Higgs (2012), “A Dynamic Mapping of the UK's Creative Industries”, NESTA, December 2012.
- Beason, R. and D. E. Weinstein (1996), “Growth, Economies of Scale, and Targeting in Japan (1955-1990)”, *Review of Economics and Statistics*, 78:2 286-95.
- BERR (2009), “New Industry, New Jobs”, Department of Business, Enterprise and Regulatory Reform, London.
- BIS (2012), “Industrial Strategy: UK Sector Analysis”, BIS Economics Paper No. 18, September 2012.
- BIS (2013), “Industrial Strategy Conference 2013: Securing Jobs and a Stronger Economy”, BIS Analysis Paper No. 1, September 2013.
- BIS and HM Treasury (2011), “The Plan for Growth”, Department for Business, Innovation and Skills and HM Treasury, London.
- DTI (2006), “Creativity, Design and Business Performance”, DTI Economics Paper No. 15, November 2005.
- Florida, R. (2002). “The Rise of the Creative Class”, Basic Books, New York.
- Lee, J. (1997), “Government Interventions and Productivity Growth in Korean Manufacturing Industries”, *Journal of Economic Growth*. 1:3 391-414.
- METI (2010), “The Industrial Structure Vision 2010 (outline)”, Japanese Ministry for Economy, Trade and Industry.
www.meti.go.jp/english/policy/economy/pdf/Vision_Outline.pdf (accessed 12 March 2012).
- Ministry of Economic Affairs, Agriculture and Innovation, Netherlands (2011), “To the Top: Towards a New Enterprise Policy”, 4 February 2011. Available at:
http://english.minlnv.nl/txmpub/files/?p_file_id=2200574/.
- MEA/MECS (2013), “Strength-weakness analysis of the Netherlands’ innovation system at points of interest for the OECD innovation reviews 2013-14”, staff paper assembled by the Netherlands’ Ministry of Economic Affairs and Ministry of Education, Culture and Science, June 2013.
- O’Sullivan, E., A. Andreoni, C. López-Gómez and M. Gregory (2013), “What is New in the New Industrial Policy?” *Oxford Review of Economic Policy*, 29 (2): 432-462. doi: 10.1093/oxrep/grt027.
- Potter, J. and G. Miranda (eds.) (2009), “Clusters, Innovation and Entrepreneurship”, OECD, Paris.
- Rodrik, D. (2004), “Industrial Policy for the Twenty-First Century”, KSG Working Paper No. RWP04-047, Cambridge MA: Harvard University.
- Rodrik, D. (2008), “Normalising Industrial Policy”, *Commission on Growth and Development Working Paper No. 3*, Washington, DC.

- STEPI (2013), “Analysis of the Performance of New Growth Engine of Korean Industry and Policy Implications”, Science Technology.
- Swann, P. and D. Birke (2005), “How do Creativity and Design Enhance Business Performance? A framework for interpreting the evidence”, paper commissioned by DTI Strategy Unit. www.dti.gov.uk/files/file14794.pdf
- Warwick, K. (2013), “Beyond Industrial Policy: Emerging Issues and New Trends”, *OECD Science, Technology and Industry Policy Papers*, No. 2, OECD Publishing, doi: [10.1787/5k4869clw0xp-en](https://doi.org/10.1787/5k4869clw0xp-en).
- Westlake, S. (2013), “Rebalancing act: rationales and policies for sectoral economic rebalancing”, *Oxford Review of Economic Policy*, forthcoming.
- Willets, D. (2013), “Eight Great Technologies”, Policy Exchange, London.

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