Progress Status and Analysis of the Policy Effects of the Five New Industries Pioneering Project

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Summary

1. Introduction

❑ This report provides the background and details of the policy on nurturing 5 new industries relevant to the 4IR (4th Industrial Revolution) as well as policy implications drawn by analyzing trends in major countries including the US, Germany, Japan and China; national regulatory trends of the 5 new industries in addition to a comparative analysis of the industry-specific economic spillover effects and export competitiveness vis-à-vis major countries.

2. New Industry Policies and Trends in Major Countries Regarding the 4IR

❑ In order to rapidly respond to the evolving global industry trends such as the 4IR, the Korean government (the Ministry of Trade, Industry and Energy: MOTIE) designated 12 industries as new growth drivers and announced the Life-Changing Innovative Industry Growth Acceleration Initiative in 2018, setting its core action mandate as *five new industry project-led achievements*.

❑ In the US, policies regarding the 4IR are developed towards the objective of facilitating new industry growth through convergence in areas such as cloud services, AI and industry platforms based on advanced

IT technology in the private sector.

- ○ In this respect, the US' strategy towards realizing the 4IR is mostly centered around public-private partnerships, with a focus on the *digital manufacturing revolution* and *advanced industry innovation*.
- ○ In particular, the Advanced Manufacturing Partnership (AMP), which the US is actively pursuing, is aimed at devising collaborative strategies that can draw mutual synergy effects among private sector parties by creating a nationwide association in which diverse private sector economic parties participate.
  - − This partnership is regarded as a system through which changing opportunities in the advanced American manufacturing sector can be explored via increased R&D investments, pre-competitive collaboration and sharing of manufacturing equipment and infrastructure.
- ○ In addition, the Obama administration pursued the BRAIN Initiative (Brain Research through Advancing Innovative Neurotechnologies) which concentrates support for the study of neuroscience and developed the Startup America Initiative as a means to facilitate joint investments by government, corporates, universities and foundations toward the development of innovative technologies. As the Trump administration continues to implement these initiatives, the US is pursuing a long-term research and development strategy.

❑ The INDUSTRY 4.0 of Germany was initiated to develop policies that integrate IT solutions within traditional manufacturing sectors as part of an effort to take full advantage of and amplify the country's unique strengths in manufacturing.

- ○ The initial objective is aimed at achieving evolution by forming networks of production facilities and creating "smart factories" equipped with intelligent production systems.
  - − A new concept of manufacturing and service industries will be in-

troduced by applying ICT technology throughout the overall manufacturing value chain.

- ○ Core initiatives including those related to major technologies of the 4IR such as artificial intelligence (AI), big data, cyber-physical systems (CPS) and the Internet of Things (IoT) are mainly pursued through eight different categories of technology.
- ○ The technologies central to the new German industrial revolution are CPS, intelligent memory and smart factories—which have become the core strategies of the INDUSTRY 4.0 platform upon which the INDUSTRY 4.0 initiative is being implemented.

❑ Japan announced its plan to pursue the 4IR in a full-fledged fashion via the Japan Revitalization Strategy 2015, which is an updated version of the Japan Revitalization Strategy developed in 2013, through which the nation moved away from its previous focus on equipment innovation toward production innovation as its core growth strategy.

- ○ The Strategies to Lead the Fourth Industrial Revolution have been developed to enhance national competitiveness not only regarding technology but also in conjunction with education and labor market reforms, reinforced financial roles, support for the vulnerable classes and the creation of a common understanding associated with industry structure reforms.
  - − As for national government-led policies, the priority mandate has been placed on the institutional improvement for data sharing and utilization.
- ○ In addition, a strategy for drawing up structural reforms across all industries has been developed by utilizing actual data collected by robots and various electronic devices, in which Japan is recognized as a pioneer.
  - − The New Robot Strategy is being actively pursued via the development of a concrete concept "utilizing robot technology" set forth in the Japan Revitalization Strategy in 2014.

- The Investments for the Future Strategy 2017 sets extending healthy life expectancy, realizing the mobility revolution, supply chain advancement, creating pleasant cities with effective infrastructure and financial technology (FinTech) as five new growth strategies through which transformation in all realms of society may be pursued by developing more concrete strategies.

❑ China Manufacturing 2025, which was announced by China in 2015, is a compilation of manufacturing industry policies from the 13th Five-Year Plan for Economic and Social Development of the People's Republic of China, the nation's long-term plan with "innovation-led growth" as its keyword. The plan details China's efforts to transform itself into a manufacturing powerhouse by shifting away from quantitative growth to qualitative growth.

- ○ Policies include objectives designed to propel China into the world's top-tier level in terms of next-generation ICT, automobiles and advanced equipment; improve outdated manufacturing ecosystems and create a future-oriented and service-oriented manufacturing ecosystem.
- ○ The plan aims to help China move beyond low-cost government-led manufacturing (simple processing) and pursue development to become an advanced manufacturing powerhouse armed with innovative competencies and competitiveness.
- ○ A concrete strategy intended to ensure China joins the ranks of global manufacturing powerhouses by 2025 is included, elaborating on investments in the core competencies of big data, cloud computing, IoT and cyber security technology.

❑ Major countries including the US, Germany and Japan have each established unique mid-to-long term new industry growth strategies by taking

advantage of specific national characteristics such as existing technological advantages.

- ○ Through diverse strategies including the facilitation of technological development through cooperation between government entities and the private sector as well as the improvement of business platforms via regulatory reform, these nations have taken the lead as pioneers of the 4IR.

3. Domestic Regulatory Trends for the Five New Industries

A. New Industry Regulatory Mechanism

- ❑ Because new industries based on the 4IR transcend existing and future industries as well as create new technologies and services, the application of a regulatory framework imposed on traditional industries to new industries, in its original form, could inhibit growth of new ideas or business models such as newly emerging convergence or compound products.
  - ○ Regulators must lift 1) regulations that require projects to be initiated and proceed only when approved by the government in advance; 2) positive regulations which prohibit business activities unless they are within the business scope designated by the government; and 3) the "regulatory triangle" that works against new industries such as the lack of regulatory infrastructure that prevents the timely launching of newly developed convergence or compound products because the criteria for safety accreditation and so forth are absent.

B. Regulatory Trends of the Five New Industries

- ❑ Korean research on autonomous vehicles (AVs) is widely lauded for its state-of-the-art competitiveness thanks to Korea's continued technological development. Yet, regulations on driving and the use of in-

formation as well as the lack of operating rules have prevented such development from reaching significant achievements in the commercialization stage.

- ○ Korea must simplify the temporary driving approval application process for AVs, develop rules and regulations for the collection and usage of essential video data as well as confirm WAVE frequency allocation (for V2X standard telecommunications).
  - − The current legislation regarding AVs only contains a simple definition and the basis for temporary driving approval, while legal grounds for the establishment of driving zones and safety standards—which are prerequisites for commercialization—are lacking.
- ○ On the other hand, other countries with advanced AV technology such as the US, Germany and Japan competitively pursue legal and institutional improvements as well as deregulation.
  - − The state of North Carolina in the US has approved the operation of fully autonomous vehicles without a driver's license.
  - − Germany legalized autonomous driving by amending the Road Traffic Act and is the first country to introduce self-driving minibuses as a means of public transportation.
  - − Japan has designated special zones which are exempt from existing regulations (under its "regulatory sandbox") to provide institutional support for AV testing for commercialization.

❑ In terms of IoT, there exists an environment for "regulation-free zones" to be potentially utilized via discussions on the introduction of an "ICT regulatory sandbox". However, the issues related to frequency allocation as well as manufacturing-related certification and approval hinder the realization of concrete benefits and delay the growth of the commercialized market.

- ○ Korea must introduce a negative regulation system which principally approves new technology and services such as information and communication convergence as well as develop reasonable standards for frequency allocation.
  - − Interim approval by default for technology and services including information and communication convergence except for those restricted or prohibited as stipulated by other laws or regulations would help facilitate convergence between IoT and other industries.
- ○ In response to the increased influence of IoT, the US is pursuing policies led by individual federal agencies, whereas the US Federal Trade Commission (FTC) recommended legislation on privacy protections and security regarding IoT.
- ○ The European Commission (EC) investigates minimum safety requirements and standards regarding IoT and is making efforts to apply IoT in various industries.

❑ While Korea has paved the groundwork for its bio-health industry to achieve global growth thanks to concentrated government-led investments, medical service efficiency is falling due to factors such as the 'positive-list' approach toward regulations and restrictions against medical information usage.

- ○ Therefore, there is a rising need to enhance the quality and accessibility of medical services via a sensible level of approval for remote monitoring and remote medical consultations between physicians and patients.
- ○ In order for the Korean bio-health industry to reinforce its global competitiveness, it must pursue a partial transition of some regulations toward a negative-list approach; the introduction of a fast-track deliberation system for the approval of new medical devices and new drugs; as well as review the need and appropriateness of "Korean-style" remote consultations be-

tween physicians and patients.

- Another area for improvement includes the matter of genetic treatment, the scope of which is restricted under the current law, thereby limiting the scope of research which makes it impossible to develop relevant new drugs.

○ For the development of the bio-health industry, major economies around the world such as the US and Europe are clarifying standards for medical devices and wellness projects, improving the approval and certification system and developing guidelines for medical-related privacy protection.

- The US and Europe are preparing to conduct clinical trials on human gene-editing in addition to associated trials on animals and plants. China is conducting clinical trials on intractable disorders.
- Regulatory authorities overseas (i.e., the US FDA, Japanese PMDA, Health Canada) have introduced fast-track deliberation programs, priority deliberation and accelerated approval systems, shortening the deliberation period for new drugs and significantly improving the deliberation criteria.

❑ Regarding new energy industries, a variety of policies and systems are being pursued to enhance green energy production and energy usage efficiency as well as expand the renewable energy industry. However, difficulties exist in encouraging active participation led by the private sector due to factors such as the inefficient approval and certification system as well as unstable renewable energy prices.

○ In this respect, discussions should be conducted on introducing a fast-track approval and certification system as well as on policies to secure price stability for renewable energy.

- Since the reform of the renewable portfolio standard (RPS) initiative in 2018, a trading scheme has been put in place through which

Renewable Energy Certificates (REC) are traded at market prices.

- In order to enhance private sector participation, policies should be devised to take into consideration the introduction of green pricing and the stabilization of REC trading prices.
- Regarding complaints about a high degree of uncertainty due to the inconsistent regulation of the separation distance required for photovoltaic (PV) and wind power generating facilities among local governments, it has been pointed out that collaboration between the central and local governments should be improved.

○ Major countries are implementing structured policies for distributing renewable energy in response to the changing climate system.

- Japan, having introduced the RPS scheme in 2003, shifted to a full-scale Feed-In Tariff (FIT) scheme due to continued opposition.
- The US has various federal and state support schemes including the Renewable Purchase Obligation (RPO), RPS and the Production Tax Credit (PTC).

❑ Regarding the next-generation semiconductor and display industries, Korean companies are global leaders in the semiconductor market as they command top market share with relatively few regulations. Still, Korea must define a reasonable level of regulation so that the "special measures area" designation system under the Framework Act on Environmental Policy regarding land regulation does not pose an excessive entry barrier.

❑ R&D related to future industries require continued investment with a long-term perspective, whereas the legislative system for new industries and technologies calls for a swift transition toward a new regulatory and management system.

- ○ To secure international competitiveness in the new competitive landscape based on the 4IR, entrepreneurship must be highlighted while numerous policies to nurture new industries need to be pursued under the condition that unreasonable regulations are rolled back.
- ○ Furthermore, customized policies need to be reviewed regarding next-generation semiconductor and display industries to support the creation of new markets, mutual cooperation and new jobs.

4. Analysis of the Economic Spillover Effects of the Five New Industries

A. Methodology and Subjects

- ❑ Focusing on the Five New Industries designated by MOTIE as areas of core investment which include electric and autonomous vehicles, IoT appliances, bio-health, new energy industries as well as next-generation semiconductors and displays, input-output analyses were conducted on the industry-specific effects related to the inducement of production, added value and job creation.
  - ○ The subjects of the analyses included the effects on the inducement of production, added value and job creation in areas among the 12 New Industries that are not part of the Five New Industries, as well as in the traditional manufacturing industry.

[New Industries Categories and Subjects of Analysis]

Categories	12 New Industries	9 New Industries	Subjects of Analysis	
			5 New Industries	Areas of Comparison
New Industries	Electric & Autonomous Vehicles	○	○	
	Smart Green Ships			
	IoT Appliances		○	
	Robots	○		○
	Bio-Health	○	○	
	Aircraft & Drones	○		○
	Premium Consumer Goods	○		○
	New Energy Industries	○	○	
	Advanced New Materials	○		○
	AR, VR			
	Next-Gen Displays	○	○	
	Next-Gen Semiconductors	○		
Traditional Manufacturing Industries				○

Note: Among the 12 New Industries, smart green ships and AR/VR have been excluded from the analysis as it was difficult to categorize their field of industry due to their lack of a designated HS code.

❑ First, the input-output table was adjusted to analyze economic spillover effects.

○ by referring to the "IO goods – HS code Comparison Chart", the 12 New Industries were matched with the 384 basic categories under the input-output table based on the HS code; consolidating and adjusting the other categories to develop an input-output table consisting of a total of 97 categories

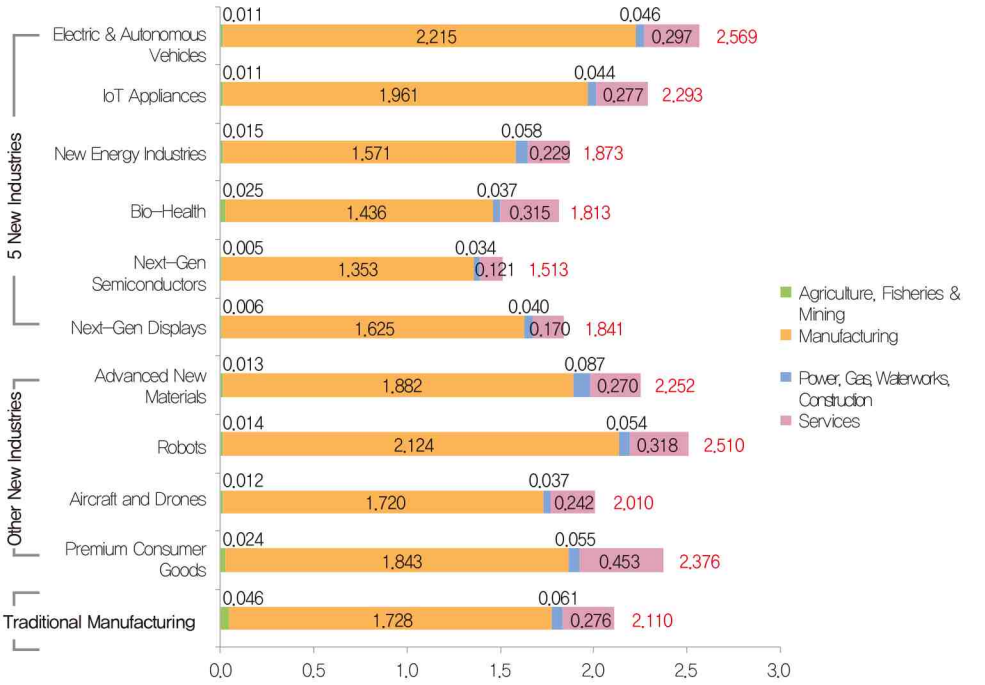
B. Result of the Analysis on Industry-Specific Economic Spillover Effects

❑ The per-unit effects on production inducement were highest in terms of electric & autonomous vehicles, reaching 2.57, with robots (2.51), premium consumer goods (2.38), IoT appliances (2.29) and advanced new materials (2.25) incurring higher effects than traditional manufacturing industries (2.11).

- ○ Conversely, next-generation semiconductors (1.51), bio-health (1.81) and next-generation displays (1.84) had low effects on production inducement.

[Comparison of Effects on Production Inducement per 1 Won Investment by Industry]

(Unit: KRW/KRW)



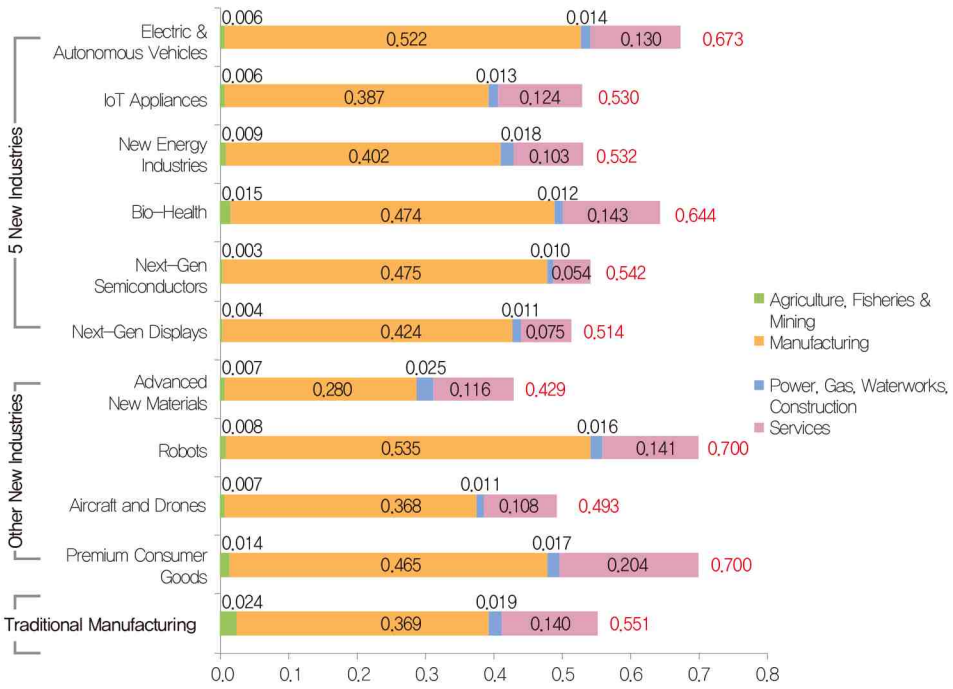
❑ The effects on the inducement of added value was highest in terms of robots, 0.70, with premium consumer goods reporting a similar figure

of 0.70. Electric and autonomous vehicles (0.67) and bio-health (0.64) also exhibited a higher level than traditional manufacturing industries (0.55).

- ○ Meanwhile, advanced new materials (0.43) and aircraft and drones (0.49) had low effects on added value inducement.

[Comparison of Effects on Value-Added Inducement per 1 Won Investment by Industry]

(Unit: KRW/KRW)



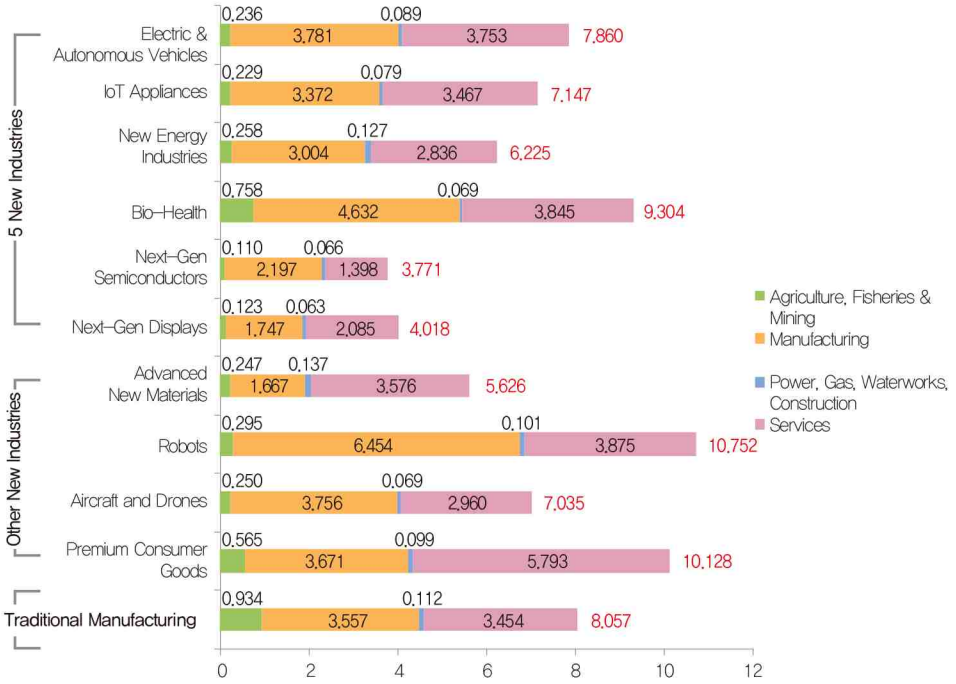
❑ The effects on employment inducement was highest in terms of robots with 10.7 newly employed persons, followed by premium consumer goods with 10.1 persons and bio-health with 9.3 persons—all reporting higher employment inducement effects than in the traditional manufacturing industry (8.06).

- ○ On the other hand, next-generation semiconductors (3.8 persons), next-gen-

eration displays (4.0 persons) and advanced new materials (5.6 persons) had low effects on employment inducement.

[Comparison of Effects on Employment Inducement per 1 Billion Won Investment by Industry]

(Unit: person/KRW 1bn)



❑ A calculation of the weighted average of the economic spillover effects per unit of the areas of concentrated investment by using MOTIE's (planned) budget injection to the Five New Industries as weights, concluded that the per unit effects on the inducement of production and employment are lower than the traditional manufacturing industries, at 2.11 and 8.06, respectively.

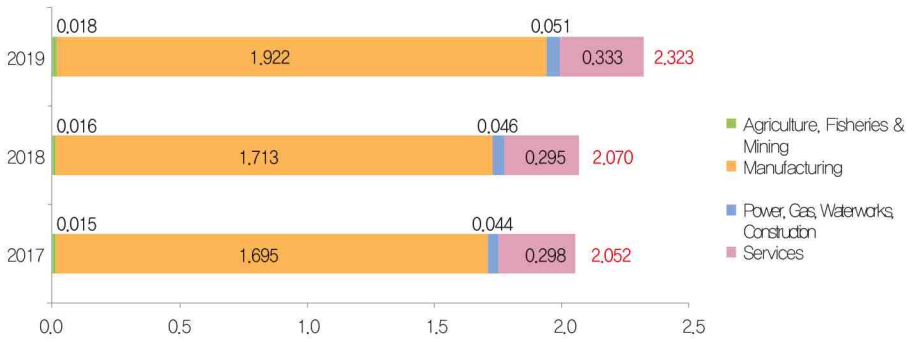
[Economic Spillover Effects in Areas of Concentrated Investment (weighted average)]

	Production Inducement Coefficient (KRW/KRW)	Value-added Inducement Coefficient (KRW/KRW)	Employment Inducement Coefficient (person /1bn won)
Concentrated Investment Areas' Weighted Average (based on 2018 budget)	2.034	0.584	7.113
Concentrated Investment Areas' Weighted Average (based on 2019 budget)	2.043	0.585	7.072
Change	0.009	0.001	-0.041

❑ A calculation of the per unit weighted average of new industries by using the government's (planned) budget injection to industry-specific R&D programs as weights resulted in insignificant changes in 2017 and 2018. In 2019, however, the average spillover effects were higher than traditional manufacturing industries as higher budgets were allocated to industries with strong economic spillover effects such as robots, under the annual budget plan.

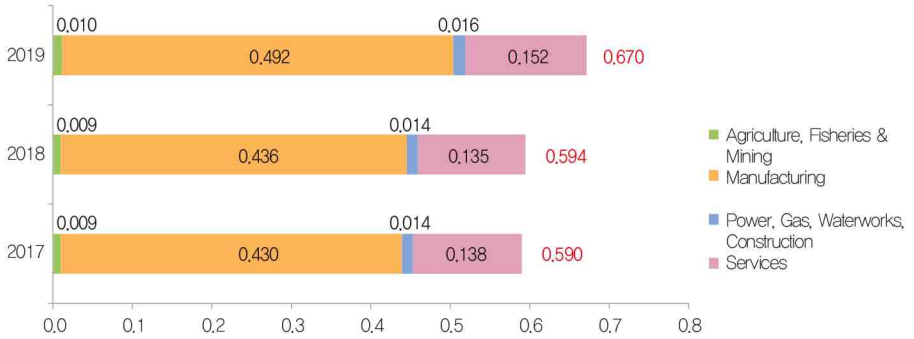
[Comparison of Effects on Production Inducement per 1 Won Annual Investment in New Industries]

(Unit: KRW/KRW)



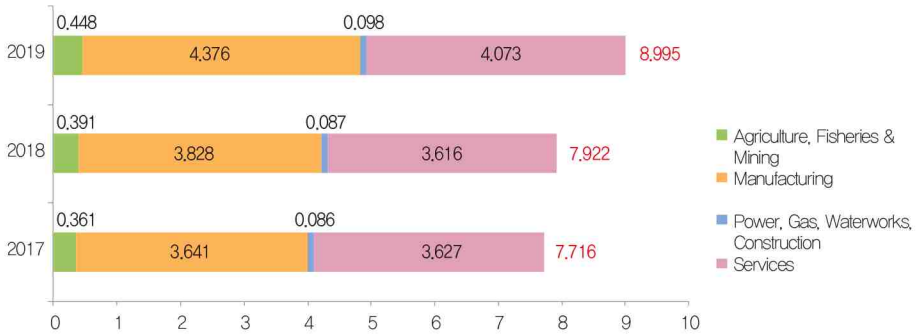
[Comparison of Effects on Value-Added Inducement per 1 Won Annual Investment in New Industries]

(Unit: KRW/KRW)



[Comparison of Effects on Employment Inducement per 1 Billion Won Annual Investment in New Industries]

(Unit: person/1bn won)



❑ The industries designated by MOTIE as the Five New Industries (areas of concentrated investment) are mostly ranked medium or low in terms of per unit economic spillover effects.

○ The effect of electric and autonomous vehicles on production inducement was the only industry that ranked highest, having a relatively strong spill-over effect by ranking 3rd and 4th in terms of the inducement of added value and employment. On the other hand, next-generation semiconductors and displays as well as new energy industries have especially low effects on

employment inducement.

- Similarly, according to the calculation of the weighted average of the economic spillover effects by using MOTIE's (planned) budget injection to the Five New Industries over 2018-2019 as weights, the effects on the inducement of production and employment were lower than that of traditional manufacturing industries.

- The average economic spillover effects of the government's R&D program for new industries have been significantly improved under the 2019 budget plan, compared to 2017 and 2018.
  - This is due to the significant increase in the R&D budget for robots, bio-health as well as electric and autonomous vehicles - which have relatively strong economic spillover effects - in 2019.
  - This has specifically proven that increased investments in industries with high effects on employment inducement per unit such as robots and bio-health could result in higher employment inducement compared to the traditional manufacturing industries.

- Regarding information services such as AI and big data, even though the per-unit effect on employment inducement is very high due to the convergence of manufacturing and services sectors, they lack government attention and investments.
  - This area is not characterized as an independent field in terms of government R&D programs and has not been designated HS codes which serve as the standard for trade and industry statistics.
  - The budget allocated to this area is merely around 2.5% of the total R&D budget for new industry areas in 2019 (as proposed by the government), which amounts to 2 trillion 122.4 billion won.

❑ The result of the comparative analyses of the effects on the inducement of direct and indirect employment, value-added (income) and production according to the government's budget injection (or investment) in each new industry area may serve as a crucial reference in prioritizing investment destinations.

○ The five new industries (projects) are expected to be intensively nurtured by the government with an aim to create jobs and incomes in 2018, as well as by MOTIE with an aim to reinforce its strategic power and efficiency of budget injection.

5. Analysis of Trade Trends and Export Competitiveness of the Five New Industries

❑ The Five New Industries are regarded as newly growing industries due to their strong growth.

○ The trade volume of these industries has increased annually by 7.98% on average over the past five years, exhibiting strong growth that surpasses that of the trade volume increase rate of all Korean industries (0.18%) as well as the increase rate of global trade volume (-0.50%).

− The proportion of the trade volume represented by the Five New Industries among all Korean industries has also increased by 2.57%p from 6.81% (in 2013) to 9.38% (in 2017).

[World Trade and Five New Industries' Trade Trends]

(Unit: trillion or 100 million dollars, %)

		2013	2014	2015	2016	2017	Avg increase rate per year
World	Trade Volume ($tn)	75.8	76.1	66.5	64.5	71.4	
	Increase Rate (%)	2.0	0.3	-12.6	-2.9	10.7	-0.50
Korea	All Industries Trade Volume ($100mn)	10,752	10,986	9,632	9,016	10,521	
	Increase Rate (%)	0.7	2.2	-12.3	-6.4	16.7	0.18
	New Industries Trade Volume ($100mn)	732	748	803	838	987	
	Increase Rate (%)	8.3	2.2	7.2	4.5	17.7	7.98
	New/All Industries Percentage (%)	6.81	6.82	8.33	9.30	9.38	

Note: "Photovoltaic" performance is omitted from the 2017 trade increase rate calculation. (PV-related HS codes were newly developed in 2017)

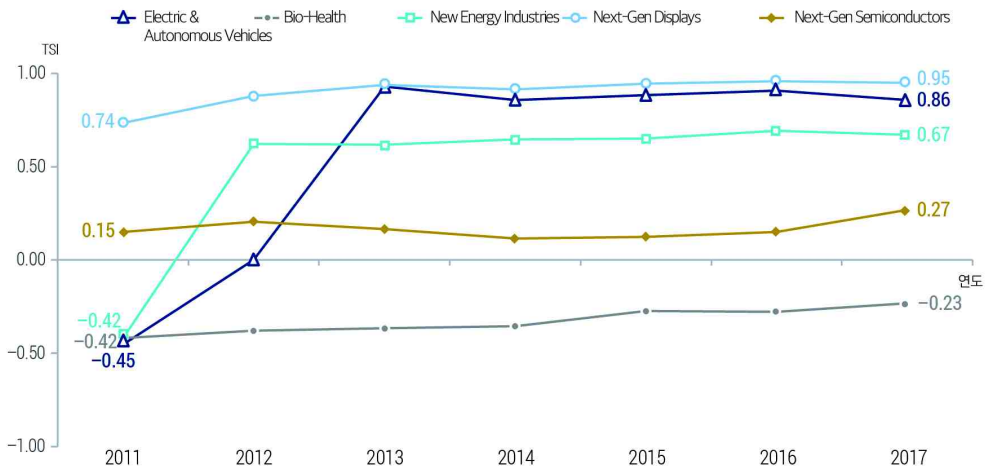
Source: Calculated by NABO based on references from the Korea International Trade Association (KITA).

❑ An analysis of the export competitiveness of the Five New Industries against the international market by using the Trade Specification Index (TSI) exhibited an increasing trend of export competitiveness from 2011 for electric and autonomous vehicles, next-generation displays and new energy industries; while the export volume significantly exceeded the import volume as of 2017.

○ Conversely, next-generation semiconductors continue to be weighted toward exports but with no significant change in terms of export competitiveness, whereas bio-health has witnessed a relative improvement but appears to be skewed toward imports as its import volume continue to exceed its export volume.

※ The Trade Specification Index (TSI) indicates a product's comparative advantage based on its total export and import volume as well as total trade volume. A value of at least 0 and below 1 is interpreted as a trade surplus, indicating strong export competitiveness, whereas a value closer to -1 is interpreted as a trade deficit, indicating weak export competitiveness.

[Comparison of TSI Trends of the 5 New Industries against the Global Market]

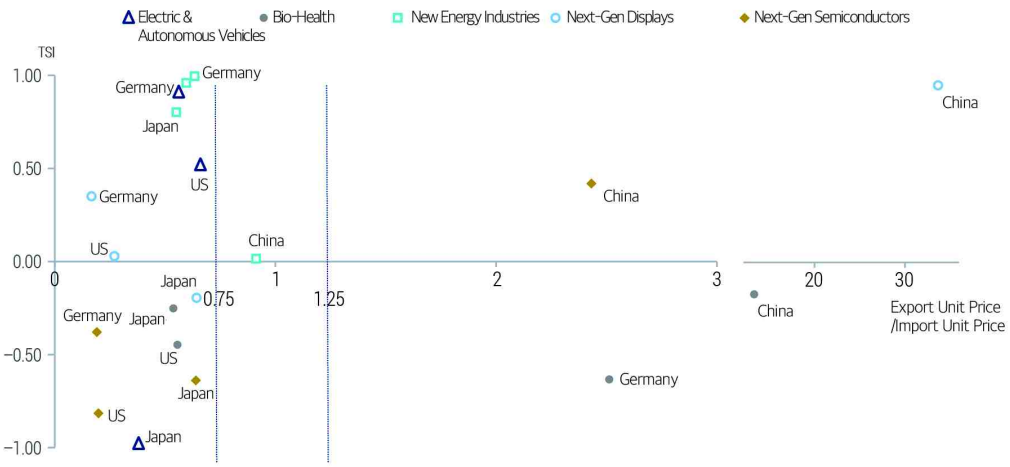


Source: Created by NABO based on references from KITA.

❑ An analysis was conducted on the export competitiveness and technology gap against major countries by simultaneously comparing TSI and export-import unit price ratios (export unit price/import unit price) as of 2017. As a result, export unit prices were higher than import unit prices in almost all areas of the Five New Industries against advanced economies such as the US, Germany and Japan (indicating a technological disadvantage).

○ While export volume is higher than import volume in the fields of new energy industries (Germany, US, Japan), electric and autonomous vehicles (Germany, US) as well as next-generation displays (Germany); the only industry in which export unit prices are higher than import unit prices is in bio-health against Germany.

[Comparison of TSI and Export/Import Unit Prices by Industry and Region (2017)]



Source: Created by NABO based on references from KITA.

※ If the export-import unit price ratio (export unit price/import unit price) is within the 0.75-1.25 range, the export and import unit prices are not considered to have any meaningful difference (**trade within a horizontal industry** incurred by product differentiation). This is considered a qualitative advantage if the ratio is higher than 1.25 and a **qualitative disadvantage** if the ratio is lower than 0.75 (the qualitative advantage or disadvantage is considered **trade within a vertical industry** incurred by a technological gap.)

❑ In order to enhance the national competitiveness of the Five New Industries, Korea must establish unique R&D strategies in each field by reflecting their respective export and import trends as well as export competitiveness derived from technological advantages.

○ Regarding countries with technological advantages such as the US, Germany and Japan, an environment should be created in which Korean companies may benefit from technology transfers via technological partnerships and cooperation with leading global businesses based in such countries, while securing new technologies through mergers and acquisitions should be actively pursued.

○ Regarding China, Korea appears to have a technological (qualitative) advantage in terms of next-generation semiconductors and displays as well as bio-health. Therefore, in order to maintain Korea's current edge, the government needs to provide support to encourage continued R&D investments by Korean companies with advanced technology, while reinforcing security measures against technology leakage.