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Reinventing the Government to Nourish Innovation Ecosystem

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Reinventing the Government to Nourish Innovation Ecosystem^a

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Ju-Ho Lee and Changyong Choi

Abstract

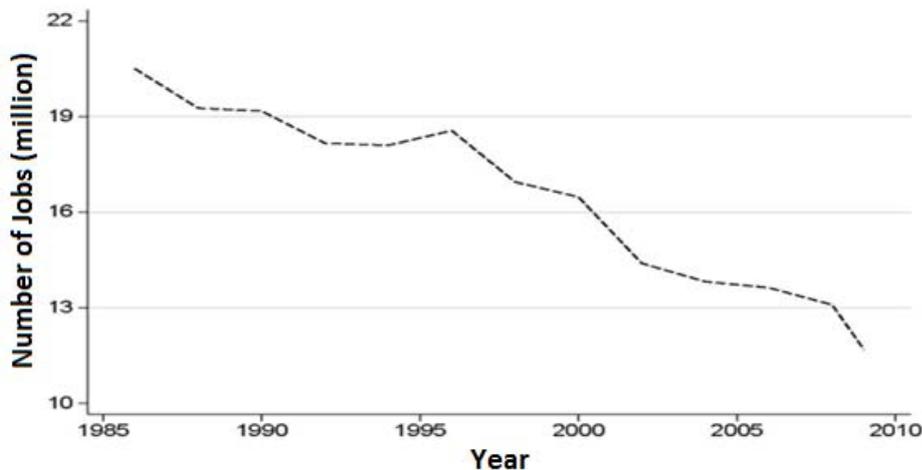
Since the late 1990s, instead of encouraging first-movers to challenge and take risks, innovation related policies of Korean government, such as science and technology policies, industrial policies, and university policies, induced the first-movers to avoid risks. Likewise, these same policies also blocked out active interactions between each level of technology. For these reasons, we criticize here that the Korean government has failed to nourish first-mover innovation ecosystem despite the enormous expansion in the government budget for innovation. Based on such critical assessments, this research suggests that Korean government should focus on reducing its bureaucratic control, which revolves around regulations and interferences, and also on establishing the innovation ecosystem. To these ends, we suggest a government reform transforming Korean government into cooperative government, strategic government, and innovative government.

I. An Innovation Ecosystem that Will Determine the Future of Korea

While the Fourth Industrial Revolution, which will clearly separate the winners from the losers among countries, is expected to reach a tipping point around 2025 (Schwab, 2016), Korea is assessed to be far behind in the readiness for the Fourth Industrial Revolution. According to the report released at the Davos Forum in 2016, as the world's 42nd in readiness for the Fourth Industrial Revolution, Korea has not only been unable to narrow the gap with Japan (15th), but it also has been left far behind countries such as Singapore (5th), Hong Kong (12th), and Taiwan (20th), which, together with Korea, were once called the Four Dragons of the East Asia (UBS, 2016). Furthermore, the report assessed that China (51st) is in close pursuit of Korea.

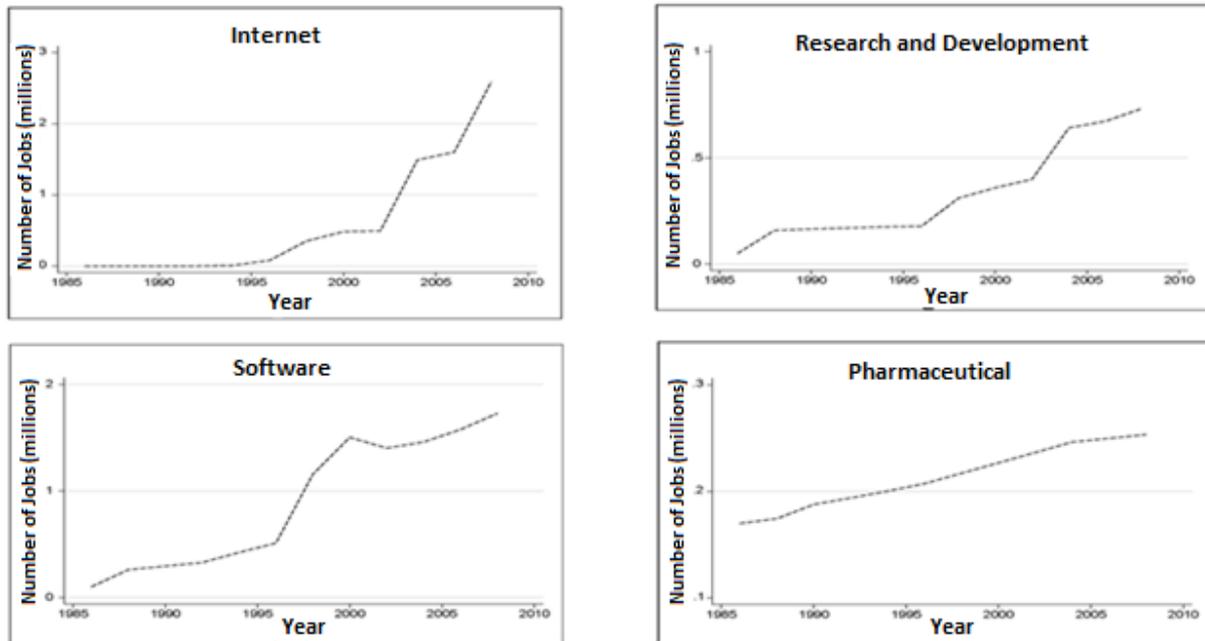
The main reason as to why many countries are devoted to finding responses to the Fourth Industrial Revolution is the job problems that follows rapid technological changes, which could be seen in the forecast that in the next 10 to 20 years, about 47 percent of all jobs in the United States could be in danger by automation (Frey and Osborne, 2013). Certainly, even if many of the jobs we know of today are replaced by machines in the not too distant future, the number of jobs may not disappear altogether. On the contrary, depending on how well a country prepares for and responds to the technological changes nationwide, enhanced productivity due to the technological changes can, in fact, create more jobs in new fields than the number of jobs replaced by machines. In the case of the United States, although employment in the manufacturing sector has almost halved from about 21 million to 12 million in just one generation (35 years) between 1985 and 2010 (Figure 1), during the same period, industries such as internet, software, R&D, and pharmaceuticals, conversely, experienced significant gains in employment (Figure 2; Moretti, 2012). For Korea in the age of the Fourth Industrial Revolution, the changes in jobs will occur much rapidly and more drastically than what the United States has experienced in the past one generation. However, if jobs being displaced by machines only disappear without new jobs being created, much more serious job problems may arise in Korea.

Figure 1. Changes in the Number of Manufacturing Jobs in the United States



Source: Moretti (2012)

Figure 2. Trend for New Jobs in the United States



Source: Moretti (2012)

Among the Korea's main industries, shipbuilding, steel, and petrochemicals are losing their competitiveness in the already saturated market, and even in areas where Korea still maintain competitive edge such as semiconductors, displays, automobiles, machines, mobile phones and home appliances, Korea faces market saturation and the pursuits by rival nations such as China. It would not be easy to create new jobs in these main industries, and the important task in the future is creating new jobs in the new industry areas. In the so-called promising new industries such as energy-new-industries, ICT convergence, biohealth, advanced new materials, and high-end consumer goods, Korean companies are showing signs of potential, but the potential has not yet reached a point where jobs are being actively created. As for the core areas of the Fourth Industrial Revolution such as artificial intelligence, software, big data, and autonomous vehicles, Korea still has not gained any competitiveness at all (Yoo, 2016).

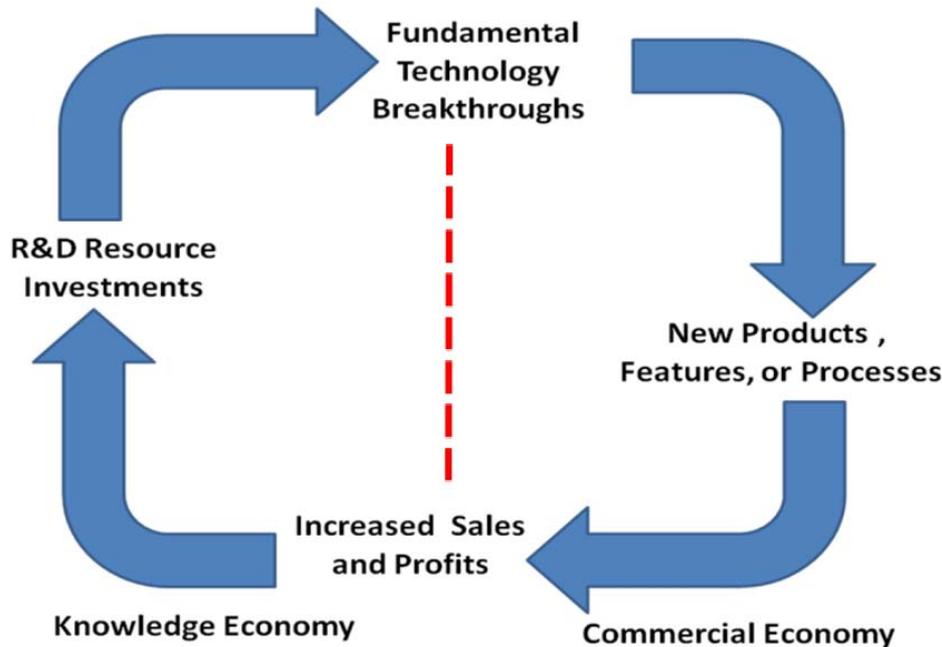
What then should the government do to overcome the threat to jobs during the Fourth Industrial Revolution and achieve both sustainable growth and income equality? Creating a 'first-mover' innovation ecosystem is a very urgent and important task. While Korean companies excel in their abilities to assemble products in imitation of the ones made by other countries, their abilities to create entirely new products, industries, and platforms are inferior in comparison. In other words, 'implementation capabilities' or the abilities to interpret a given blueprint and to physically implement the design by mobilizing resources are considered one of the highest in the world. However, Korean companies still lack 'conceptual design capabilities' such as the capacities to define product and service concepts for the first time or simply the ability to draw pictures on a blank paper (Lee, 2016). Since many Korean companies remain as fast-followers,

they have not been able to become first-movers. As such, even in the Korea's main industry, such as the shipbuilding sector, Korea has been pushed behind by companies with conceptual design capabilities in developed countries and is now paying the high cost of restructuring due to market saturation. It is the same reason as to why Korean companies have not been able to even attempt entering new industry sectors such as AI. Of course, after the mid-1990s, as the competitiveness of Korean companies rose sharply in areas of semiconductors, mobile phones, and automobiles, there appeared companies such as Samsung and Hyundai in Korea that went beyond imitating developed countries and entered the same league as companies in the developed countries (Choi, 2003). However, just because Korea has produced few global companies leading the world market, it cannot be said that the first-mover innovation ecosystem has been created in Korea. Innovative ecosystem is a concept that encompasses R&D and industrial innovation and is an evolving system in which entrepreneurs, researchers, and government employees continuously compete and collaborate to constantly generate new products, platforms, and industries based on high-risk and high-value R&Ds going beyond the limits of current scientific knowledge. In order for Korea to overcome the job crisis caused by the Fourth Industrial Revolution and move forward as a leading country in the Fourth Industrial Revolution, it is necessary to create the first-mover innovation ecosystem at all costs.

In the past, it was possible for Korean economy to increase international competitiveness and the number of jobs by relying mostly on expansion of inputs and by rapidly learning technologies from advanced countries with large corporations as the center. However, in the period of the Fourth Industrial Revolution, in which the change and convergence of technologies take place at an unimaginable speed, it would not be easy to create new jobs without the first-mover innovative ecosystem, where there is consistent organic cooperation among government-business-university, and where new products and platforms are created constantly through internal science technology capacities, forming an active virtuous cycle between knowledge and product economies (Figure 3).

It would be no exaggeration to say that Korea's future depends on whether it can create the first-mover innovation ecosystem before 2025, when the Fourth Industrial Revolution will reach its critical point. Many of the problems raised in the Korean society currently, such as low growth rate, social polarization, shrinking job market, and absence of innovation, cannot be solved and are likely to become worse without the creation of a first-mover innovation ecosystem. This implies that Korea should raise its next generation as talents with the capabilities required by the Fourth Industrial Revolution and should create new jobs and form new middle class by enabling these talents, as first-movers and not fast-followers, to grab opportunities offered by the Fourth Industrial Revolution. Ultimately, the future of Korea should be built on the vision and practice of a country leading the Fourth Industrial Revolution.

Figure 3. Virtuous Cycle between Knowledge Economy and Product Economy



Source: Jackson (2011)

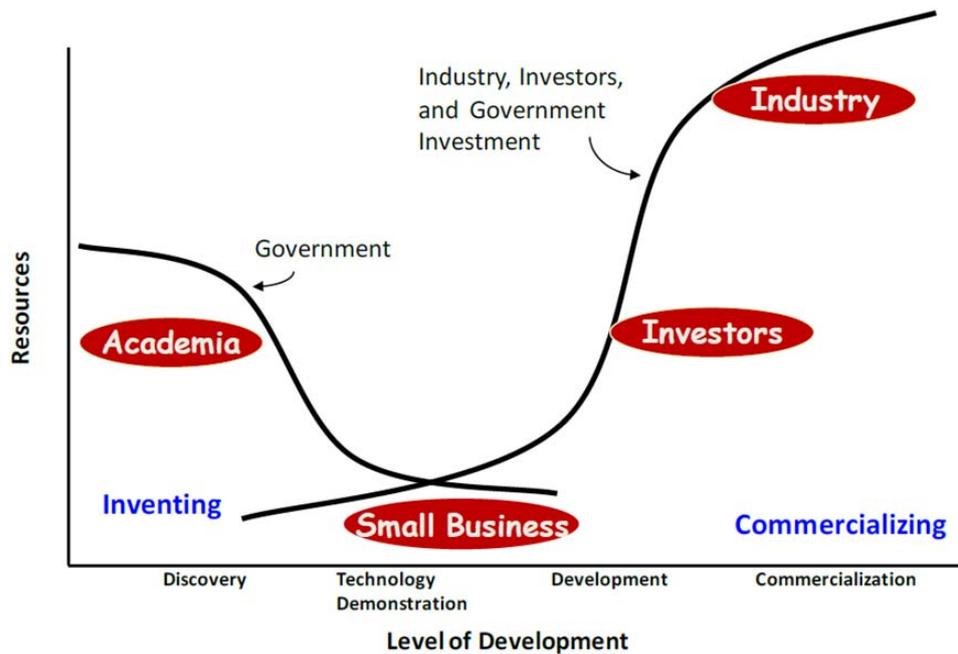
II. Bureaucratic Control that Kills Innovations

In the past, the government was able to support fast-followers effectively by employing industrial policies that directly aided technological advancement of companies and development of industrial structure, while at the same time promoting science and technology policies that helped adoption of technologies from developed countries through government-funded research institutes. Paradoxically, however, such past success makes it difficult for the government to change its role to focus on fostering the first-mover innovation ecosystem that achieves innovations through cooperation and competition between businesses, universities, and research institutes based on high level of autonomy. Indeed, because the government has not been able to move away from the old way of supporting fast-followers, there are increasing side effects of the government actually killing innovations from first-mover companies and researchers everywhere. The bureaucratic control is killing innovations.

To form first-mover innovation ecosystem, it is necessary to put in place a system that ensures safe passage across the Valley of Death. In the process of turning new science or knowledge discovered by universities or government-funded research institutes to new products, industry, and platforms by the industrial world, the time period at which the most investment risk is present is the period of passing the Valley of Death. For entrepreneurs who want to commercialize ideas or technologies, it is very difficult to receive enough funding from the financial sector due to a lot of risk involved in the early period of product development when

entrepreneurs conduct technology demonstrations and establish new business models (Figure 4). Therefore, there is a need for a first-mover innovation ecosystem that shares the risk of investment to overcome the Valley of Death or that enables the successful few to continuously generate innovations despite failures of the majority.

Figure 4. Valley of Death



Source: Jackson (2011)

However, the creation of an innovation ecosystem by the government to reduce the risk of entrepreneurs is fundamentally different from the accustomed way of the past in which the government directly supports the fast-followers. In the case of fast-follower, the government chooses and concentrate its support on winners to have them succeed in the world market, but for the first-mover innovation ecosystem, in which there are constant appearances of entrepreneurs attempting to cross the Valley of Death to reach the world market, such excessive and direct interventions, in addition to accompanying government controls, can actually undermine the innovation ecosystem.

In fact, rather than investing in risks, the bureaucratic government ignores or avoids them all together. For instance, it is a well-known problem that when Korean Ministry of Trade, Industry and Energy supports R&D projects, their success rates reach as high as 95%. In effect, only supporting the projects that the ministry already finds confidence in succeeding reflects the fact that the ministry is failing to support real scientific discoveries. In other words, even though science is about discovering the unknown, the high R&D success rate demanded by the Ministry of Trade, Industry and Energy kills innovation by forcing researchers to avoid high-risk high-

return science and cling onto low-risk low-return researches. It is the same with the Small and Medium Business Administration. Rather than have the government share the risk and encourage entrepreneurs to challenge high-risk and high-return businesses, it induces small and medium businesses to avoid risks, killing innovations.

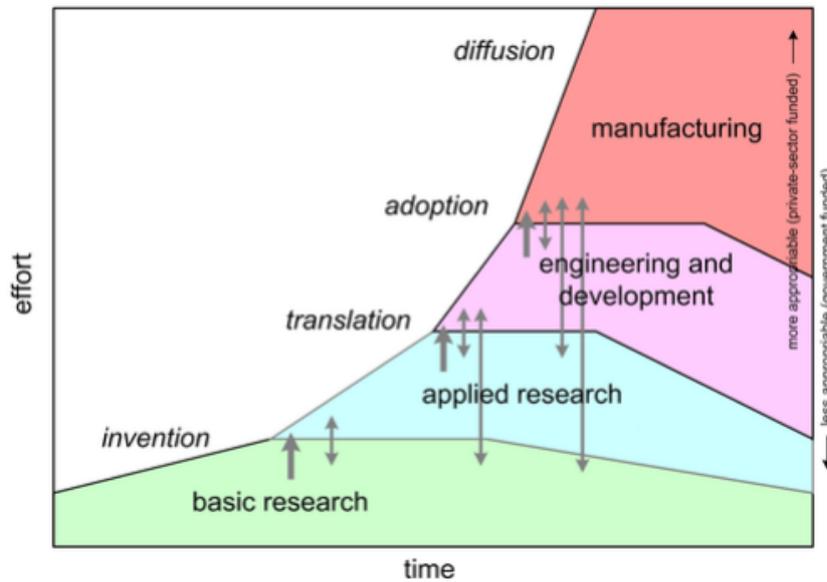
Another important harmful consequence of bureaucratic control in the first-mover innovation ecosystem is that the government blocks the interactions between technology levels. In the past, when Korea was a fast-follower, there was no big problem for the government to take the lead in making the necessary adjustments between the stages of basic research → application research → product development. More specifically, the basic research could be mainly relied on foreign countries, and the government could make adjustments and tightly control the government-funded research institutes to cooperate with research institutes of large corporations to conduct applied researches. As for universities, rather than contributing with R&D, they could be allowed to focus on developing human resources. Based on these strategies, the method of government support given to companies may have been efficient in the past for the product development.

However, through continuous interactions, basic researches in the first-mover innovation ecosystem act the role of platforms in product developments and applied researches (Figure 5). As can be seen from the case of Google, which became a global firm 10 years after its birth in the Stanford graduate school, universities are becoming the center of the innovation ecosystem. However, in a government with high ministry selfishness such as Korea, support for universities from the Ministry of Education is totally independent from industrial support provided by the Ministry of Trade, Industry and Energy, and science and technology support by the Ministry of Science, ICT and Future Planning, suggesting lack of coordination among the ministries. Although the government should create an environment promoting interactions between universities, government-funded research institutes, and businesses, the Korean government is actually taking the charge in creating barriers between the ministries such that the Ministry of Education supports only universities, the Ministry of Science, ICT and Future Planning supports only the government-funded research institute, and the Ministry of Trade, Industry and Energy supports only businesses.

As an example of disputes between ministries that undermine innovation ecosystem, the case of start-up support programs shows redundant roles played by ministries. For instance, although the Ministry of Science, ICT and Future Planning is supposed to be responsible for the Centers for Creative Economy and Innovation the Ministry of Trade, Industry and Energy, depending on the region, operates a Techno Park with a budget 10 or more times larger than that of the Center for Creative Economy and Innovation to play a redundant role of providing support for start-ups in a region. With the way things are going, there are even talks among the Ministry of Trade, Industry and Energy officials in charge of Techno Parks that the Centers for Creative Economy and Innovation, which the current government put a lot of effort in as a project of the Ministry of Science, ICT and Future Planning, may be abolished in the next government. Even the legal support system is fragmented across ministries. For example, because each ministry has its own separate law in the legal system related to technology businesses of research institutes, it is

difficult to make adjustment, creating much confusions. More specifically, each ministry is fragmentally regulating and supporting technology businesses, each with different laws such as the Ministry of Science, ICT and Future Planning with a special law for the Research and Development Special Zone, the Small and Medium Business Administration with a special law related to nurturing venture businesses, the Ministry of Education with a law for promoting collaboration between industry-university-research institute, and the Ministry of Trade, Industry and Energy with a law fostering technology transfer and commercialization (Park, 2016).

Figure 5. Interactions among Technology Stages



Sources: PCAST (2012)

The dispute between the ministries that devastates the innovation ecosystem become even worse when it goes down to the regional-level. First, the Small and Medium Business Administration has 12 provincial offices, the Ministry of Science, ICT and Future Planning manages five Research and Development Special Zones and 10 Science Parks in addition to 17 Centers for Creative Economy and Innovation, and the Ministry of Trade, Industry and Energy administers 18 Techno Parks. Apart from these, even local governments operate Techno-Valleys and new industry complexes. Furthermore, various regional industrial promotion agencies under the local governments also play a duplicate role as well. As the situation is like this, there exists no cooperation at all between regional agencies that are directly overseen by central departments, which have much greater resources than each local government, and agencies organized by local governments themselves, blocking interactions between entrepreneurs, researchers, and government employees within first-mover innovation ecosystem and killing innovations. As a result, regional agglomerations of innovation activities, as in innovation clusters, are not actively established in Korea (Lee, Oh, & Jee, 2016).

Since the late 1990s, the Korean government, through science and technology policies, industrial policies, and university policies, has induced first-movers to avoid risks rather than challenge and take risks. Furthermore, by blocking active interactions between each technology stage, it failed to create innovation ecosystem despite the enormous expansion in the government budget.

First, the science and technology policies of the government failed in creating the first-mover innovation ecosystem. For the 2017 national research and development project, the government drew up a budget of 19.5 trillion won. In comparison to the budget of 1.37 trillion won in 1998, this means that within 20 years, the size of the budget grew more than 14 times. However, in the case of the top 1% citations representing the results of high-risk and high-return researches, the share of Korea in the world only increased from 1.0% in 2002 to 1.2% in 2011. Taiwan, on the other hand, increased from 0.4% to 0.7%, and China increased from 2.4% to 3.9% during the same period. In 2011, the United States still accounts for 41.6% of the total, and the shares for the United Kingdom (7.5%), Germany (6.4), France (4.6) and Canada (4.0%) are also much higher than that of Korea, meaning that Korea has not been able to close the gap with developed countries in the area of highly cited papers. In addition, government-funded research institutes, which take more than 40% of the budget from the national research and development project each year, have not produced any better results than universities, receiving much smaller budget of 24%. This is the consequence of much stricter government control placed on the government-funded research institutes than those on the universities. As for the royalty income, which is a key indicator of technology transfer utilizing research results, the amount for universities has been increasing steadily while the amount for government-funded research institutes has been at a standstill. This means that even though the government budget allocated to the government-funded research institutes has increased considerably, it has not been contributing to the promotion of high-risk and high-return researches (Lee, 2016).

Second, industrial policies of the government also failed to create first-mover innovation ecosystem. The industrial policies in which the Korean government picks winners and provides direct assistances through various subsidies, financial support, and tax support worked well in the past when supporting fast-followers. However, in the first-mover innovation ecosystem, it creates zombie firms, constricting first-movers and impoverishing the first-mover innovation ecosystem. Overly excessive direct support given to firms by the government not only generate the problem of selecting wrong winners but it also creates a more serious problem of zombie firms, which should exit the market, subsisting on the government aid as these losers could not be weeded out. The proportion that policy loan takes in the GDP is close to 4% in Korea. This is much higher than most other countries that have the proportion at less than 1%. Moreover, since the support budget for small and medium enterprises has grown to about 15 trillion won recently, the number of government support projects has been fragmented to as much as 1,287, making government employees to each take finely divided projects to perform tasks bureaucratically (Kim, 2016). Ironically, such direct bureaucratic support from the government squeezes out first-movers from the competition against zombie firms. Likewise, the random support for small and

medium enterprises through bureaucratic finance is also resulting in stagnant venture capital aid to high-risk start-ups.

Third, even the university policies of the government failed at creating first-mover innovation ecosystem. Although universities in Korea have expanded rapidly in quantitative terms, because it occurred mainly around the lower tier universities, there still is a problem of not being able to improve the overall quality level of universities. Looking at the trend of growth rate for university enrollment by each university from 2000 to 2012, the average enrollment quota of the ten Korean universities included in the top 500 universities in the world has been almost at a standstill whereas the average quota of universities in the top 20% grew by 7% and that of lower-tier universities grew by more than 20%. As such, the government has failed to increase the number of outstanding research universities that can serve as the centers in the first-mover innovation ecosystem. Consequently, education bubble has been forming in which education investments by the government and the private sector cannot make any contribution towards the accumulation of human capital. In other words, the proportion of university graduates who earn less than the average salary of high school graduates increased from about 3% in 1980 to 23% in 2011 (Lee, Jung, & Hong, 2014). For universities to play the role of center in the innovation ecosystem, universities must be able to actively support start-ups, the results of university R&D must continuously be transferred to the private sector, and even the R&D activities themselves must innovate to cross-over traditional majors to match the needs of society and industries. In other words, from education to R&D and even further to innovation, new roles should be continuously added upon universities in the first-mover innovation ecosystem. However, as the bureaucratic control of the Ministry of Education has incited turf wars with the Ministry of Trade, Industry and Energy, and with the Ministry of Science, ICT, and Future Planning, it is actually withholding the change.

In this way, science and technology policies, industrial policies, and university policies thus far all have failed in forming the first-mover innovation ecosystem. The bureaucratic control killed the innovation.

III. Formation of a First-Mover Innovation Ecosystem by Reducing Bureaucratic Control³

Despite the fact that there have been constant suggestions arguing for the need to construct ‘Post-Catchup National Innovation System’ since the beginning of the 21st century (Song et al., 2006) and efforts to create the first-mover innovation ecosystem, the reason for the failure to form the first-mover innovation ecosystem thus far is because the government fell in the success trap. In addition to having too much blind faith in the experiences of past successes, the change is also impeded by the inertia of immobility in which Korea tries to follow the roles and functions of the government hardened by the bureaucratic controls through the vertical planning-execution-evaluation system during the time of fast-follower. However, we need to overcome the resistance against changes by leveraging the sense of crisis that there is no future for us without creating the

³ Policy alternatives presented in this passage was excerpted from Lee (2016).

first-mover innovation ecosystem. As it is imperative to establish the first-mover innovation ecosystem, a strategic approach of first focusing on establishing the innovation ecosystem through the reduction of bureaucratic control and then spreading this movement to other sectors once the innovation ecosystem has been established should be taken. The reduction of bureaucratic control can be achieved through the processes of making cooperative government, strategic government, and innovative government.

First, a cooperative government must be established. As pointed out previously, high walls elected between ministries that devastates the innovation ecosystem must be demolished, and inter-ministerial disputes must be put to an end. To this end, two reforms are necessary for the most part. First of all, an integrated ministry that oversees the innovation ecosystem must be instituted. Similar to the Department for Business, Innovation and Skills (BIS) in the United Kingdom, Korea should also create the Ministry of Innovation Strategy (tentative name). Under the control of extreme ministry selfishness as in Korea, unless supports for universities, science and technologies, and industries are jointly managed by one integrated ministry, it would be impossible to stop the destruction of the innovation ecosystem from the conflicts between ministries, each possessing part of the innovation ecosystem. Of course, there could be concerns regarding the appearance of a mega-department. However, from the perspective of removing elementary and secondary education functions and instead adding industrial support function to the Ministry of Education, Science, and Technology existed in the past during the Lee Myung-bak administration, the Ministry of Innovation Strategy can be viably made around the size of the Ministry of Education, Science, and Technology. In the case of the United Kingdom, when the BIS was being created in 2007, the Department of Trade and Industry continued to exist separately while the Department of Education handed over the tasks related to universities. Then in 2009 when Gordon Brown created the BIS, rest of the tasks regarding the innovation ecosystem were integrated to the BIS (Park, 2016).

Another reform for the cooperative government is building of a National Talent Management System. Even if the Ministry of Innovation Strategy overseeing universities, science and technologies, and industrial support is instituted, it is still not possible to completely integrate R&D activities and innovation related functions in the areas of national defense, health, and energy, which are managed by the Ministry of National Defense, the Ministry of Health and Welfare, and the Ministry of Environment, respectively. Therefore, the Ministry of Innovation Strategy (tentative name) as the center, the inter-ministerial cooperation should be enhanced through reforms in the government employee personnel management system. In the current system of government employees, the employees belong to one ministry for the entire duration of their career. Because of this, there are distorted incentives for the employees to contribute more towards interests and increasing power of their ministries, making it difficult to achieve the inter-ministerial cooperation. To strengthen the horizontal cooperation between ministries, many countries such as Singapore institutionalized inter-ministerial transfer of government employees, and recently, even a country like France, which traditionally has a strong bureaucracy, is promoting the transfer of government employees across ministries.

Despite Korea's effort in attempting inter-ministerial transfer of government employees through systems such as the Senior Government Executive Services, it is not easy to free government employees already with a long career in a single ministry from the vested interests in their respective ministries. Thus, it is important to eliminate affiliation to a ministry when government employees are first hired. While the inter-ministerial transfers should be mandated, the minimum term for serving in one particular position should be set at over three years to minimize potential side-effects arising from too much transfers. For the first 15 years of career, government employees should serve in at least three different ministries for more than three years each. Those with positions including and over secretaries and section chiefs may be allowed to stay in a single ministry, but thereafter, transfers of high ranking officials should be encouraged much more to stay true to the initial intentions of the Senior Government Executive Services. In this way, "Mastery-Type Career Development System" that mandates inter-ministerial transfers during the early 15-year periods should be introduced (Moon, 2016).

In order to break ministry selfishness and build cooperative government to harmoniously draw cooperation and competition not only between ministries but also between industries, academics, and governments, Korea should pursue the field-based administration based on networks and communications.

Second, an innovative government must be created. Rather than the two extremes between free-marketism and bureaucratic universalism, it should be noted that the government can be as innovative as any other, escaping from the dichotomic thinking that governments are bureaucratic and markets are innovative (Mazzucato, 2013). The role of government should be focused in establishing the first-mover innovation ecosystem by reducing bureaucratic control that kills innovation, on the one hand, while having the government to invest in high-risk innovations and reducing private sector risks in innovations, on the other.

Organizations in the United States such as the Defense Advanced Research Project Agency (DARPA), National Science Foundation (NSF), and National Institute of Health (NIH) are leading many high-risk innovations or are supporting private sectors pursuing high-risk innovations such that they are called the origin of the Fourth Industrial Revolution. In contrast, in Korea, specialized national R&D management agencies such as research foundations, various regional organizations such as Technoparks, and industrial associations are only regulating the field or are directly supporting on behalf under the strong control of the central ministries, meaning that they cannot lead innovations or provide support like the intermediate agencies in the United States. Therefore, strengthening the independence and expertise of these intermediary agencies are very important part for the government in creating the innovation ecosystem. To this end, first, because 12 specialized national R&D management agencies under nine ministries are scattered around, they must be integrated into three or four organizations for the purpose of planning-evaluation-management of the Nation R&D projects. Then, projects, such as Research and Development Special Zone, Technopark, and Science Park, that were chaotically initiated by the Ministry of Science, ICT, and Future Planning, the Ministry of Trade, Industry, and Energy, and local governments to manage regional innovation ecosystem should also be integrated into

two organizations (Park & Yun, 2016). After the organization has been restructured and the institution of the Ministry of Innovation Strategies has been instituted, all other roles related to the field such as innovation and support duties, except for the strategic and adjustment functions, that were concentrated in the central government should be transferred to the intermediate agencies to raise their independence and expertise.

Government-funded research institutes in Korea should also strive towards becoming innovation organizations that match their respective characteristics by integrating themselves with universities, by commercializing themselves to specialized R&D firm, or by combining with other government-funded research institutes. To this end, first, support should be provided to the research institutes that desire integration with universities. Despite lower research efficiencies for government-funded research institutes under excessive and fine-grained control of the government than universities, the fact that R&D funding is still being focused on places that are easier to manage from the government's point of view is the main reason for advocating the integration of universities and government-funded research institutes. Through the integration with universities, government-funded research institutes can improve its research efficiencies, and universities will be able to raise their research capabilities in a groundbreaking way. Furthermore, in addition to the option of integrating with universities, the government-funded research institutes should also be given the choices and support in turning themselves into specialized R&D firms such as contract research organization (CRO) or integrating with other government-funded research institutes.

To make an innovative government, it is necessary to switch over policies to ones that establish the first-mover innovation ecosystem such as gradually shrinking the direct aid policies used since the past and leading high risk-high return innovations as well as reducing private sector risks. A number of policies employed in the developed countries for the innovation ecosystem such as Innovation Voucher, Small Business Innovation Research (SBIR⁴), non-Disclosure agreement (NDA), and innovation intermediary should be introduced and expanded in accordance with the situation in Korea (Ahn, 2016). It is also very important to change positive regulations to negative regulations. Under the positive regulations, which limit activities to what are 'allowed' by the government, innovations in 'disallowed activities' are fundamentally blocked due to the lack of government interests or knowledge, or due to the oppositions from interest groups.

It is also important to fundamentally improve the system, such as by abolishing the policy audits of the Board of Audit and Inspection, which reduces the will of the government employees

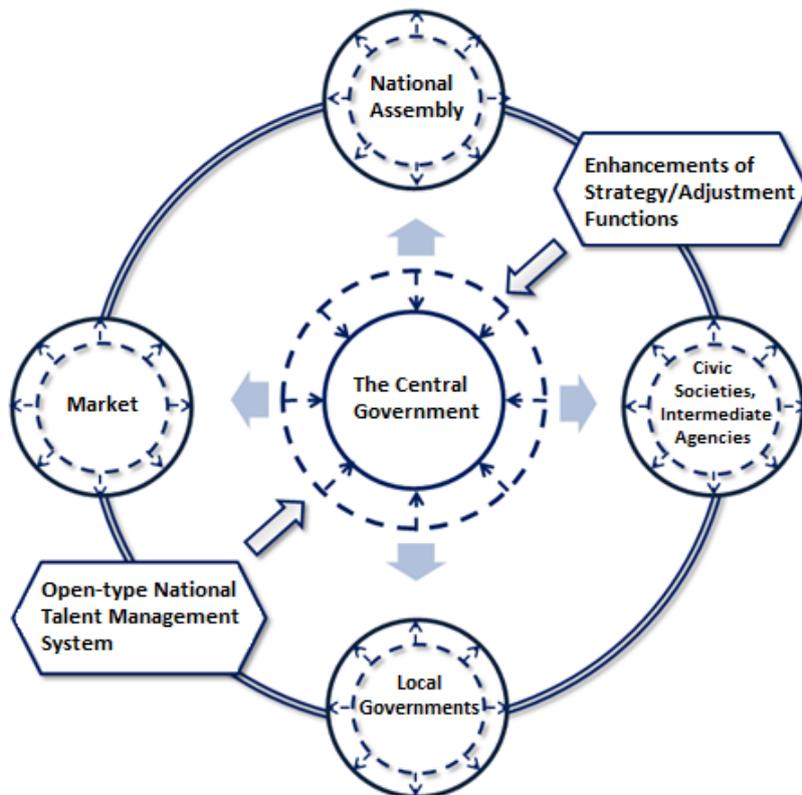
⁴ Innovation Voucher is a system in which each government in Europe provides small and medium sized enterprises (SMEs) with the purchasing right of innovation services so that SMEs take the lead in making partnerships with universities and research institutes and receive technology innovation aid that they need. Small Business Innovation Research aid program is a system in which federal agencies with extramural R&D budget over 100 million dollars are providing 3% of their extramural R&D budget to SMEs in stages in line with the three steps of innovation, which are feasibility study, technology development, and commercialization (Ahn & Moon, 2016). The attempts to introduce innovation policies of developed countries have failed frequently. In fact, KOSBIR, which is a Korean version of the SBIR in the United States, has been in place, but it is hardly living up to its initial purpose (Hong, 2016), and the story is the same for the Innovation Voucher that has begun recently.

to innovate policies, and by transferring the Board of Audit and Inspection to the National Assembly while transforming the National Assembly's inspection of State Administration into a regular audit system. In this way, the time has come to completely redesign government policies under the new framework of creating an innovative ecosystem.

Third, a strategic government must be established. The Ministry of Innovation Strategies (tentative name) should transfer or slim down many regulatory and control centered duties to intermediate agencies, and in their places, the ministry should focus on policy development and strategies for establishing the innovation ecosystem. As we are at the crucial moment in which the future of nation is hanging on the fact that whether Korea can make colossal shift towards a country leading the Fourth Industrial Revolution, there needs to be constant contemplations on the role of the government and on anticipative strategies responding to rapidly changing demands of policies.

As the roles and functions of the central government have been continuously focused and strengthened, the problem of bureaucratic control has reached a serious level in all parts of Korean society. If the bureaucratic control is left to kill innovations and left to stop the formation of the first-mover innovation ecosystem, it is highly likely that in the near future, Korea will be left behind in the Fourth Industrial Revolution, stunting economic growth, intensifying inequalities, and worsening job problems. Reduction of bureaucratic control should redistribute the functions of the central government to intermediary agencies or other organizations such as civic societies, local governments, the market, and the National Assembly. At the same time, it should also introduce the Open Nation Talent Management System and reinforce the strategic and adjustment functions of the central government (Figure 6).

Figure 6. A Government Reform to Reduce the Bureaucratic Control



There are still many major problems related to weakening bureaucratic control that are left untouched in this paper, including which functions of the central government, in relation to innovations, should be transferred to local governments, how to have the National Assembly share or intervene on rights regarding budgets and human resource affairs of innovation related intermediary agencies, which are excessively focused on the administration, and how to solve bureaucratic financing to promote investments related to innovations. Changing Korea from a fast-follower to a first-mover through the reduction of bureaucratic control cannot occur overnight. There must be constant self-transformation by the government on its own, and within the government, there should be continuous strategic pursuit of solutions that are unafraid of trial and error.

As suggested above, the plan to nourish the innovation ecosystem through cooperative government, strategic government, and innovative government is not about having the government abandoning itself from the private sector innovation all together because the bureaucratic control is killing innovation. Rather it is about focusing on establishing innovation ecosystem and weakening the bureaucratic control. Although the plan may seem somewhat aggressive, without such high intensity government reform, it would impossible for Korea to achieve the transformation into a country leading the Fourth Industrial Revolution. Nevertheless, as there may be a number of side effects from suggested measures in this paper, more detailed reform design is required to overcome these potential problems. In this regard, we expect active follow-up researches in the future.

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