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Research Report

Diminishing Role of Young Manufacturing Plants as Drivers of Growth

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Diminishing Role of Young Manufacturing Plants as Drivers of Growth

Minho Kim, Fellow at KDI

“Korea’s aggregate productivity growth in the manufacturing industry is on the decline, considerably influenced by the slowing productivity growth of young plants. A particularly sharp decline has been observed in the high-tech industry over the past three years. As such, government support programs need to aim at promoting growth and driving innovation and the numerous targets for support programs should be streamlined towards young innovative firms. The criteria for such firms should involve private sector investment in order to enhance the effectiveness of the programs.”

I . Issues

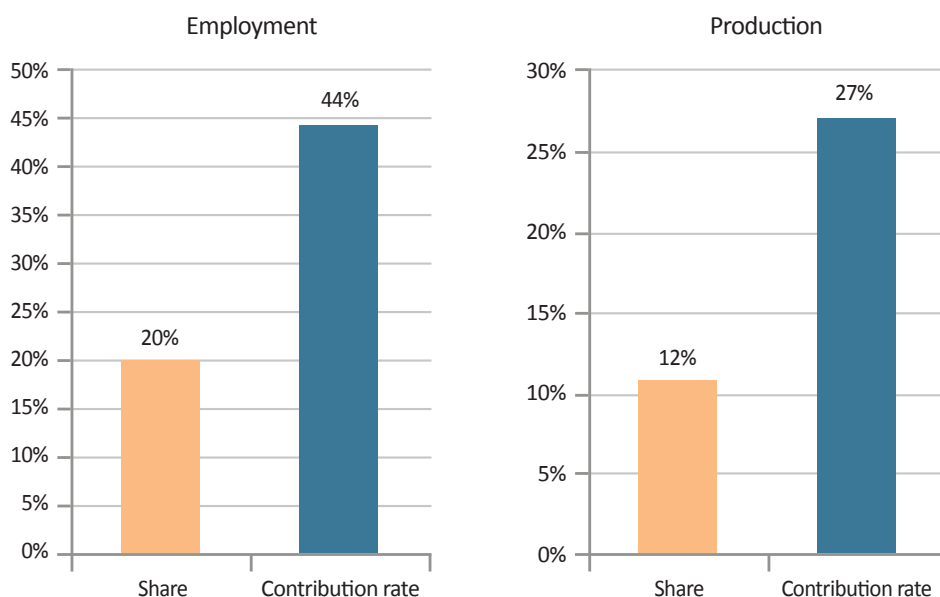
Korea’s manufacturing industry was the impetus behind the nation’s economic growth, and its competitiveness continues to rank high in the global market. The significance of manufacturing in the creation of value added and employment and as a driver of future innovation and growth has already been recognized by advanced countries such as Germany, Japan, the UK and the US who are making concerted efforts to strengthen the industry’s competitiveness and innovativeness. At the same time, the manufacturing environment is undergoing rapid changes as production technologies increasingly integrate with ICT and AI.

However, Korea’s competitiveness in manufacturing has exhibited a decline in recent years, causing growing concern. In terms of the source, stagnating productivity growth may

Advanced countries are making renewed efforts to enhance innovation and competitiveness in manufacturing while concerns are growing in Korea over the industry’s waning competitiveness.

* Based on Kim, Minho, *Productivity Growth in Korean Manufacturing Industries: The Role of Young Plants vs. Small Plants*, Policy Study, 2017-05, Korea Development Institute, 2017 (in Korean); Kim, Minho, “Aggregate Productivity Growth in Korean Manufacturing: The Role of Young Plants,” *KDI Journal of Economic Policy*, 39(4), 2017.

[Figure 1] Share of Young Manufacturing Plants in Employment and Production



Note: The share of young plants (0-5 yrs) in employment and production of all manufacturing plants with 10+ employees on average in 1999-2013. The contribution rate is the annual average share of young plants in terms of newly created jobs and production.
Source: Calculated by author using Statistics Korea's *Mining & Manufacturing Survey* (1999-2013).

This study analyzed the changes in the productivity growth of young manufacturing plants and proposed measures to improve the government's entrepreneurship support policy.

be a fundamental factor as well as external factors such as the prolonged slow growth of the global economy and China's rapid industrialization. Accordingly, an empirical analysis is needed to measure the pace of the productivity slowdown in the Korean manufacturing industry.

This study measured the aggregate productivity growth in Korean manufacturing during the past two decades and analyzed the source. The results showed a decline in the productivity growth of young plants for the last ten years implying that existing support policies for technological innovation and entrepreneurship need to be evaluated for effectiveness and redesigned. Based on the findings, this study suggests measures to improve Korea's entrepreneurship support policy.

II. Role and Current Conditions of Young Firms Plants in the Manufacturing Industry

1. Driving Force for Economic Growth and Job Creation¹⁾

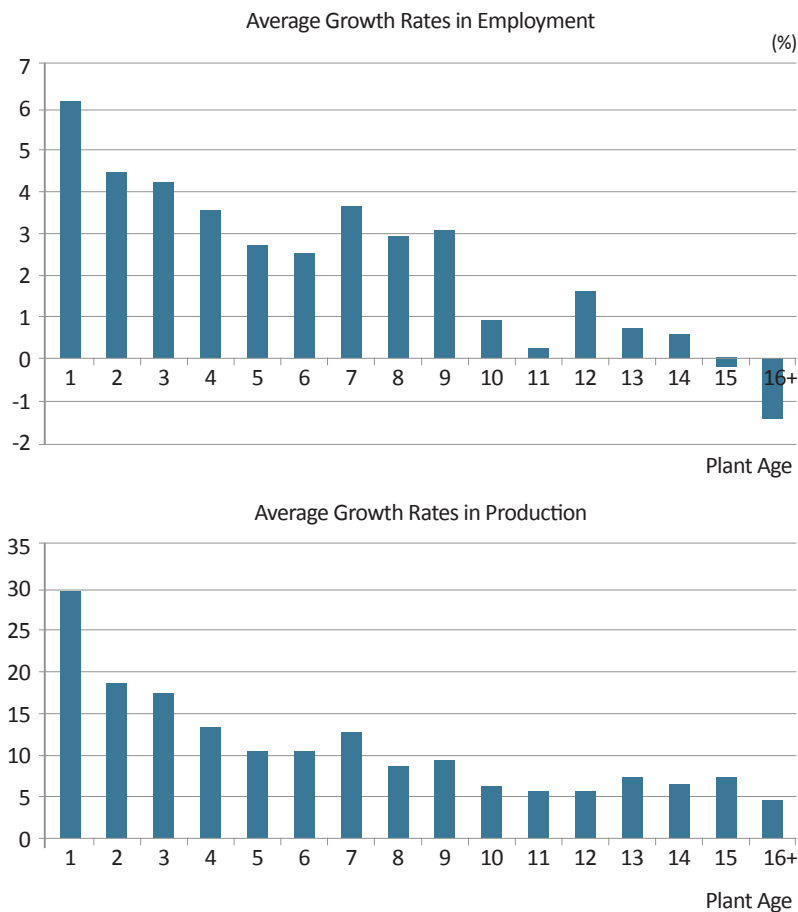
The role of young plants (under 6 years)²⁾ in the economy is considerably significant. They serve as a driving force behind economic growth and job creation and have the potential to accelerate innovation in the market and to stimulate the ecosystem for SMEs.

1) Refer to Kim (2017, forthcoming) for quantitative analysis details.

2) Young plants generally refer to those that are 3-7 years old. In the OECD's (2016), *Entrepreneurship at a Glance*, 5-year-old firms are used as the basis to define young firms for international comparisons on the roles of high-growth young enterprises.

Young firms serve as a driving force for job creation and economic growth.

[Figure 2] Growth Rates in Employment and Production for Continuing Plants



Note: Annual growth-rate averages in employment and production for each age group in 1999-2013.
Source: Calculated by author using Statistics Korea's *Mining & Manufacturing Survey* (1999-2013).

Statistics confirm the critical role of young plants in the growth of production and employment. An analysis of Statistics Korea's *Mining & Manufacturing Survey* found that in 1999-2013, young plants accounted for a mere annual average of 20% and 12% in manufacturing employment and production, respectively. However, their contribution rate in job creation and growth in gross output marked high at 44% and 27% (Figure 1).³⁾⁴⁾

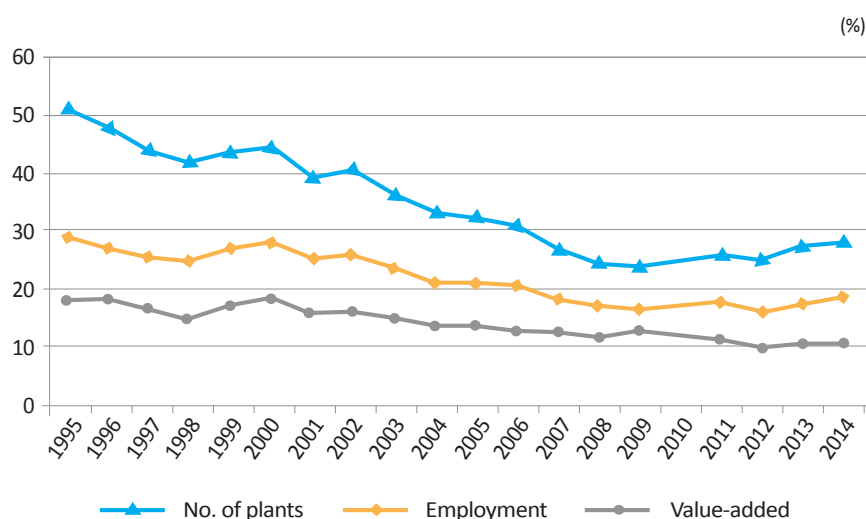
Recent empirical analyses⁵⁾ reveal that young high-growth firms are playing a prominent role in promoting the growth of industry. Indeed, a comparison of continuing plants by age in terms of the changes in employment and production growth showed that the younger the plant, the higher the growth (Figure 2).

3) Because the *Mining & Manufacturing Survey* is conducted on plants with 10+ employees, it is impossible to estimate the impact on those with fewer employees. As such, the analysis was conducted using plant-level and not business group-level data, meaning that new plants founded by existing business groups were classified as a young plant. This method is useful given that the samples are actual workplaces with employees.

4) Choi and Kim (2016), using Statistics Korea's *Census on Establishments*, showed that about half of newly created jobs in workplaces with 2+ employees in 2001-2014 was attributable to young plants.

5) Confirmed in Decker, Haltiwanger, Jarmin and Miranda (2014).

[Figure 3] Share of Young Plants in Terms of Number, Employment and Value-added



Note: Annual share of young plants (0-5 yrs) among manufacturing plants with 10+ employees.
 Source: Calculated by author using Statistics Korea's *Mining & Manufacturing Survey* (1995-2014).

2. Declining Share of Young Plants

The share of young plants in the manufacturing industry has continued to decline, pointing to a weakening of Korea's economic dynamism.

The share of young plants in Korea's manufacturing industry has decreased continuously over the past twenty years. Of plants with 10-plus employees, the number of young plants plunged from 51% in 1995 to 28% in 2014 with similar downward trends seen in the number of employees and value-added (Figure 3). On the other hand, manufacturing SMEs with fewer than 300 employees posted increases in all three indicators. Such a decline in young plants has raised the average age of manufacturing plants, leading to an aging of the industry. The following will analyze the impact of the decline in the share of young plants on the stagnant productivity growth in manufacturing.

III. Slowdown in Young Plants' Productivity Growth

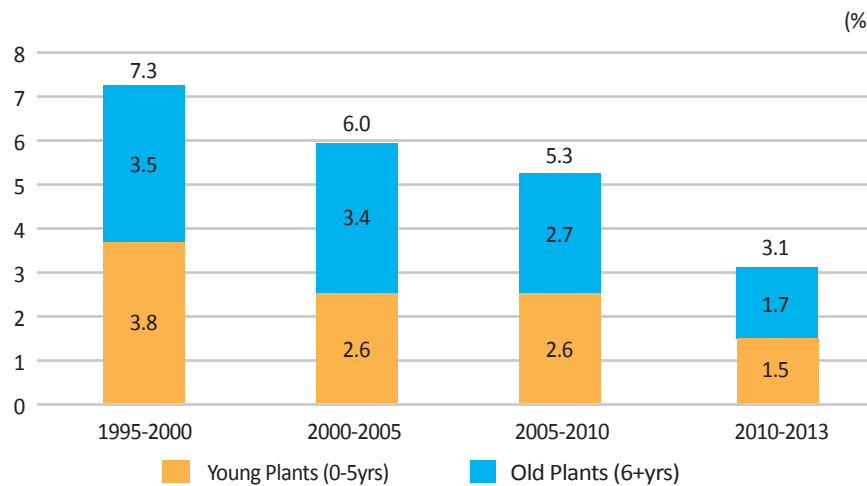
1. Declining Productivity Growth in Manufacturing and the Role of Young Plants

The manufacturing industry's aggregate productivity growth has declined, particularly over the past three years.

This study estimated the productivity growth rate of the manufacturing industry and contribution of young plants. Aggregate productivity growth was defined as the changes in aggregate final demand minus the changes in total expenditure on production factors.⁶⁾ Thereafter, plant-level data from Statistics Korea's *Mining and Manufacturing Survey* was used to estimate the productivity growth during 1995-2013. The above definition can help to measure the contribution of young plants or SMEs to aggregate productivity growth.

6) The author used the definition from Petrin and Levinsohn (2012).

[Figure 4] Aggregate Productivity Growth in Manufacturing and Decomposition into Young and Old Plants



Note: Annual growth-rate averages for the respective periods. The figures were rounded to the nearest hundredth hence aggregate productivity growth may differ with the sum of the growth rate of young and old plants.

Source: Calculated by author using Statistics Korea's Mining & Manufacturing Survey (1995-2013)

[Figure 4] presents the changes in aggregate productivity growth over the past two decades which was divided into the growth rates (contribution) of young (0-5 years) and old plants (6+ years). The figures below show that aggregate productivity growth is declining,⁷⁾ with a particularly sharp drop over the past three years.

From 1995 to 2013, the share of young plants in terms of value added was a mere 13%. However, their productivity growth rate posted 2.8%, accounting for almost half of the aggregate productivity growth rate (5.7%) in manufacturing. On the other hand, the contribution of SMEs, who accounted for 47% of the value-added, was estimated at 2.1%, presenting a lower contribution rate (36%) than their share of value-added. Also, the productivity growth of young plants has been less volatile compared to aggregate productivity growth, helping to enhance productivity growth during times of economic recession. The results imply that young plants play an essential role not only in production and employment growth but also in productivity growth. However, the recent decline in young plants' productivity growth indicates that their role as a growth engine is weakening (Figure 4), which could stifle future economic growth.

As summarized in [Figure 5], young plants' productivity growth can be divided into: the additional increment at the point of market entry (contribution of net entry) and; the contribution from the growth of plants after entry (contribution of continuing plants). The decline in 2010-2013 was due partly to the reduced contribution from net entry but mostly due to the stagnating growth after entry. This suggests that the tepid growth of entrants poses a bigger problem than the weakening dynamism due to fewer market entries.

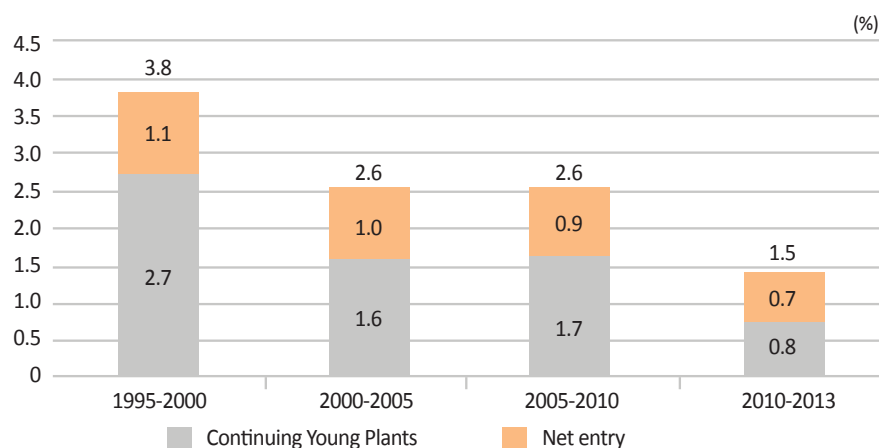
Young plants account for nearly half of the aggregate productivity growth on average in manufacturing while their value-added share is only 13%.

The productivity growth of young plants has decreased over the past decade, diminishing its role as a growth engine.

The stagnating growth of young plants is a bigger factor to their declining productivity growth than the falling number of new entries.

7) An estimation found that aggregate productivity growth began to slow down before the global economy dipped in the wake of the global financial crisis in 2008, meaning that reduced external demand is not enough to explain the slowdown.

[Figure 5] Young Plants' Productivity Growth and Decomposition into Net Entry and Continuing Plants



Note: Annual growth-rate averages for the respective periods.

Source: Calculated by author using Statistics Korea's Mining & Manufacturing Survey (1995-2013).

2. Diminishing Role of Young Plants in the High-tech Industry

This study intends to identify which sectors of the manufacturing industry are struggling with receding aggregate productivity growth and analyze the productivity growth of the respective young plants. An analysis was conducted to examine whether there were any declines in the growth of the high-tech and medium-high-tech industries, which are both closely linked to the high value-added industries in manufacturing. Based on the understanding that knowledge-based activities create high value-added through innovation and technological progress, the OECD (2011) classified manufacturing firms into the following four groups according to their technology intensity (calculated using the aggregate production and value added to R&D investment ratio): high-technology; medium-high-technology; medium-low-technology and; low-technology.⁸⁾ Using this classification, the aggregate productivity growth of Korea's manufacturing industry was decomposed into the productivity growth rate of the four respective groups and presented in <Table 1>.

For over two decades, 80% of the aggregate productivity growth in Korea's manufacturing industry has been attributable to the growth in the high- and medium-high-technology groups—referred to collectively as the knowledge-based manufacturing industry. However, during the past three years, all four groups have exhibited declines in productivity growth, with the high- and medium-low-technology groups posting particularly steep drops. The high-technology group may have responded more strongly to the economic downturn. However, weakening competitiveness could cause a decline in productivity growth. As for the medium-low-technology group, the reason is most likely due to the falling growth in the steel and shipbuilding industries.

8) Industries with high R&D investment refer to those who have relatively large investments in technology and not those who have high technological capabilities or strong innovation. Refer to <Table 4-3> in Kim (2017) for industrial classification according to technology intensity.

The productivity growth of young plants in the high-tech industry, which has the highest R&D intensity, posted sharp decreases.

<Table 1> Productivity Growth by Level of Technology Intensity (contribution of young firms)

(%)

	Aggregate productivity growth	High-tech	Medium-high-tech	Medium-low-tech	Low-tech
1995-2013	5.7 (2.8)	2.9 (1.0)	1.6 (0.8)	0.8 (0.6)	0.3 (0.4)
1995-2000	7.3 (3.8)	3.4 (1.3)	2.2 (1.2)	1.1 (0.7)	0.7 (0.7)
2000-2005	6.0 (2.6)	2.6 (1.1)	1.6 (0.6)	1.6 (0.5)	0.1 (0.3)
2005-2010	5.3 (2.6)	3.2 (1.2)	1.3 (0.6)	0.4 (0.6)	0.4 (0.2)
2010-2013	3.1 (1.5)	2.0 (0.2)	1.2 (0.6)	-0.2 (0.5)	0.1 (0.2)

Note: Figures in () denote the productivity growth of young plants (5 yrs or less) in respective industries.
Source: Calculated by author using Statistics Korea's Mining & Manufacturing Survey (1995-2013).

Figures in the parentheses in <Table 1> show the productivity growth rates of young plants according to the respective technology groups. Young plants posted a sharp decline in productivity growth from about 2.6% in 2000-2010 to an average 1.5% in 2010-2013, mainly due to the rapid drop in the productivity growth of young plants in the high-technology group. This result indicates that young plants are unable to fully serve as a driving force for economic growth.

Industries with high R&D intensity have been the driving force behind the productivity growth of the manufacturing industry for two decades. But, the last three years have seen a steep decline in the productivity growth of the high-tech industry.

IV. Causes for the Decline in the Productivity Growth of Young Plants

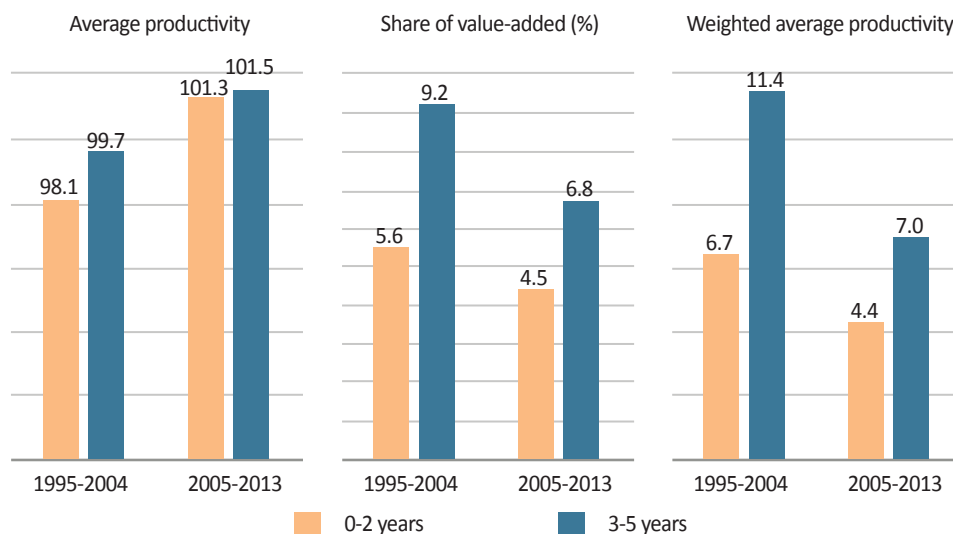
The contribution of young plants to the aggregate productivity growth of the manufacturing industry can decline if their technical efficiency weakens or their share in the industry becomes smaller. To understand the causes, this study examined the changes in average plant-level technical efficiency by age and their weighted average technical efficiency which takes their share into account.

The left panel in [Figure 6] shows the relative average technical efficiency of young plants when the average technical efficiency of old plants (11+ years) is set at 100. In 1995-2004, startups (0-2 years) and infant plants (3-5 years) showed relatively lower productivity than old plants, but their productivity increased in 2005-2013, meaning that the relative productivity of young plants has not weakened.⁹⁾ The increase in the relative productivity of startups reveals a 'selection effect' in which only highly productive firms make it through to the market.

Despite their high average productivity in recent years, the contribution of young plants to aggregate productivity growth has marked a significant decline, mostly due to their shrinking shares (middle panel in [Figure 6]). This is again confirmed by the trends in weighted average productivity, where the ratio of each plant's gross output to total

Although the average productivity of young plants is high, their contribution to aggregate productivity growth has declined due to their shrinking share of the industry.

9) The productivity gap was not large between plants of different ages. But, in terms of size (based on number of employees), average productivity differs significantly and the larger the size, the higher the average productivity. Moreover, the relative productivity of SMEs has declined further in recent years (Kim, 2017).

[Figure 6] Changes in Young Plants' Productivity and Share of Value-added

Note 1: Young manufacturing plants with 10+ employees were divided into startups (0-2yrs) and infant plants.

Note 2: As for productivity, the graph shows the mean of plant-level technical efficiency for each age group relative to old plants (11+ yrs) of which the level was set at 100.

Source: Calculated by author using Statistics Korea's *Mining & Manufacturing Survey* (1999-2013).

value-added was used as the weight (right panel in [Figure 6]). Compared to average productivity, weighted average productivity varies significantly among plants of different ages due to the small share of young plants. The average productivity of young plants has not weakened while their relative weighted average productivity has continued to decline. For infant plants, their share in value-added slipped from an average 9.2% in 1995-2004 to 6.8% in 2005-2013, and their weighted average productivity relative to that of old plants declined from 11.4 to 7 during the same period.

Productivity can be enhanced by reallocating resources from low productive firms to highly productive firms. A receding proportion of highly productive young plants implies that there will also be a deterioration in the efficiency of resource allocation. A decline in the share of young manufacturing plants indicates that it has become increasingly difficult to establish and grow in manufacturing in Korea's economic environment. As such, conditions must be monitored to check whether firms are facing obstacles in entering and expanding.

V. Conclusion and Policy Suggestions

This study shows that the productivity growth of young plants has been declining, particularly in the high-tech industry in the last three years. The Korean government has already implemented start-up support policies and greatly increased the budget size over the past decade. It is time to review the effectiveness of the government support programs for entrepreneurship. Based on the findings from the above analyses, this study

proposes the following three reform measures to improve current government policies for innovation and entrepreneurship.

Innovative and high-growth firms play a leading role in economic growth. As such, support programs should be focused on promoting their growth and innovation. Above all, the government must streamline the many targets of the support program to one, i.e. innovative firms,¹⁰⁾ which could be achieved by formulating an exit plan to scale down and integrate existing programs. Additionally, to increase the effectiveness of the support, the government should refrain from selecting and supporting firms directly but rather, make efforts to reform regulations that hinder the entrepreneurship and growth of innovative firms.

Also, the selection process of innovative firms should shift away from being government-certified. Instead, the criteria for young innovative firms should involve private sector investment. According to the Ministry of SMEs and Startups' (MSS) 2016 *Survey of Korea Venture Firms*, 93% of all certified venture firms were recipients of the technology evaluation-based government guarantee and loan and 73% were already at the high-growth or mature stage. This has raised concerns over the effectiveness of the certification system for venture firms.¹¹⁾ Innovative firms should be under a certain age and include recipients of venture capital or those whose R&D investment ratio exceeds a certain level (R&D firms).¹²⁾ The EU approves member countries' schemes to support SMEs and R&D under EU state aid rules. For example, Belgium implemented a tax exemption scheme for young innovative firms who are defined as a SME that is not over a certain age and spends at least 15% of its total costs on R&D.¹³⁾

Finally, programs should undergo rigorous and objective evaluations. The evaluations can be used to manage, improve and restructure the programs. Evaluations that are focused on short-term performance indicators such as the number of recipient firms or new startups should be avoided. And, the effectiveness of support must be evaluated using statistical methodology. Indeed, rewards and liabilities can only be properly determined when evaluations are done objectively via a third party with no conflicts of interest.

While streamlining the targets for the support programs towards innovative firms, the government should refrain from selecting and supporting firms directly and reform regulations that hinder entrepreneurship and the growth of innovative firms.

The government's verification process should be abolished and innovative firms should be defined as young venture capital firms or R&D firms.

Restructuring government programs should be based on objective project evaluations.

10) Most programs provide direct support to various target groups with their focus on entrepreneurship e.g. 'Generation-Convergence Entrepreneurship Support Program,' a policy agenda designed to encourage the rise of businesses related to the fourth industrial revolution. However, to be eligible, there must be a youth-senior match, which means firms with more commercially viable innovations may not be a priority.

11) Lee (2016) examined and analyzed the management performance of the certification system for venture firms and discussed measures to correct and improve. Kim (2011) shows that the increase in sales and employment is contingent on how young the firm is at the time of selection. His empirical analysis of firms' performance by certification type suggests that venture firms selected in the market exhibited higher probability for IPO and faster growth in sales and employment compared to those guaranteed or financed through the government's technology evaluation system.

12) The government is planning a private sector-driven reform of the current certification system. But, as long as it serves as the certifier, fundamental reforms will not be possible. Furthermore, the policy package released in 2017, 'Measures to Create the Ecosystem for Innovation Entrepreneurship,' contains several suggestions for expanding the types of venture investment and R&D and adding a type for new technology growth. A similar evaluation system for new technology venture firms existed at the incipient phase of the certification system but it was removed from the policy reform in 2006 due to inconsistent evaluations, inadequate selection ability and low performance of newly certified firms.

13) By using *The Korean Innovation Survey* and applying a much looser definition—those whose share of R&D cost is over 10% or 6%—Mun (2016) shows that new innovative firms could exhibit distinctively stronger innovation performance.

In response to the changing industrial landscape, the entry and expansion of young firms is vital to Korea's competitiveness in the manufacturing industry. Furthermore, policy makers designing and implementing innovation and entrepreneurship programs must change their point of view from being a program supplier to being an entrepreneur who can recognize the underlying risks in investment, invest in (support) innovative projects and take responsibility for the outcomes.

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