“FOSTERING STARTUPS FOR INNOVATION-DRIVEN ECONOMIC REVIVAL IN JAPAN: CLUSTER-NETWORKS’ CHALLENGES AND STRATEGIES”

Research Paper

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“Abstract”

Innovation is a key driver of economic growth, especially in Japan, where collaboration between industry, academia, and the government has been pivotal in fostering innovation. However, Japan faces a pressing challenge in promoting startup growth. Research conducted from 2004 to 2020 using data from various sources, including the World Development Indicators and International Telecommunication Union's Statistics, examined the impact of startup promotion on GDP per capita growth in 20 OECD economies, including Japan. The panel-data analysis found that fostering startups significantly contributed to economic growth in Japan. The lack of interest in starting businesses among Japanese citizens, coupled with inadequate support and education for entrepreneurship, was identified as a major hindrance. To address this, a strategic framework was proposed, emphasizing the integration of problem-setting, strategy, and tactics. The study recommended policies to facilitate research seed discovery, improve international competitiveness, and enhance collaboration between researchers and business leaders. Moreover, it called for enhanced business education, including startup promotion within school curricula, as a fundamental strategy for fosterting long-term innovation-driven economic revitalization.

Keywords: Startups, Innovation, Cluster-Networks, Economic Growth, Japan, Challenges, Strategies

1 Introduction

Innovation refers to a "new approach" or "novelty," encompassing the integration of fresh mechanisms, technologies, and practices to create innovative value in the market (Christensen, 2019). It is considered a wellspring of economic growth for nations (Schumpeter, 1977). In order to establish the infrastructure for generating innovation, it is crucial to combine "human resources," "financial support," "research and development expertise," and "market expansion" to efficiently foster the capability to generate new products and services (OECD, 2023). In Japan's history, it has played a role as the foundation for economic growth by offering new products and services primarily through collaboration between academia, industry, and government. However, as the world enters the 21st century and global competition intensifies, Japan has lost international competitiveness, causing a stagnation in economic growth through innovation (Larrue, 2021). In this regard, Japan is required to achieve economic revitalization through the promotion of innovation.

Throughout Japan's history, industry-academia-government collaboration has played a pivotal role as the backbone supporting the nation's innovation. Industry-academia-government collaboration refers to a mechanism where research outcomes, technologies, and know-how from universities, private research institutions, etc., are harnessed by private enterprises to drive practical application and industrialization (Ministry of Economy, Trade and Industry, 2023). Key methods of such collaboration include joint research conducted in cooperation among corporations (industry), universities and research institutions (academia), and government entities (administration), as well as cases where the

government facilitates connections between corporations and universities (MEXT, 2023). In Japan, the focus has primarily been on academia-led collaboration between industry, academia, and government. In other words, government funding has facilitated the commercialization of research outcomes from universities and research institutions, leading to the creation of products and services (NEDO, 2022).

Notable instances include the Showa era, during which developments like endoscopes, instant noodles, bullet trains of Shinkansen, and the Toyota Production System were introduced. In the Heisei era, products such as the Walkman, home gaming consoles and software, light-emitting diodes (LEDs), and hybrid cars were brought to market (See Appendix at the end of this paper). Theoretically, three crucial factors for successful industry-academia-government collaboration are "small experiments leading to large experiments," "formation of independent organizations like venture capital," and "optimal alignment of business models and technology" (Kanter, 2011; Utterback, 2006). In essence, the convergence of these three factors fosters successful collaboration.

Taking a global perspective on policies that encourage international collaboration, the United States and Western European countries stand out for their substantial government support for research funding, as well as robust assistance and support for new products and services until they penetrate the market (NEDO, 2020). On the other hand, South Korea and China have actively promoted overseas study and degree acquisition opportunities to cultivate highly skilled individuals with strong research capabilities and business acumen, thereby expanding networks with the West and generating innovative products and services. In India, a prominent IT hub, a trend has emerged since 2015 where local young researchers are spearheading startups that develop apps and offer services. In these countries, including emerging economies, flexible industry-academia-government collaboration strategies are being pursued to adapt to rapidly changing times.

Comparing these international collaboration policies with those of Japan, a significant challenge lies in the relatively low number of startups and ventures utilizing research outcomes and human resources from universities and research institutions compared to Western countries (MEXT, 2022). Startups, in particular, possess the ability to create new value and services, sustaining substantial growth regardless of business size or stage (Forbes, 2023). They exhibit three characteristics: "innovation," "scalability," and "problem-solving." Therefore, promoting startups is viewed as contributing significantly to innovation beyond what traditional venture companies offer (Baldridge and Curry, 2023). Furthermore, startups are deemed highly economically impactful from the perspectives of competitive advantage, innovation, and employment (Kato, 2022). In terms of research outcomes, human resources, and structural establishment, startups are seen as a cross-cutting component of industry-academia-government collaboration. Yet, Japan faces a shortage of talents, including entrepreneurs, mentors, and advisors, especially for startups (MEXT, 2022). Therefore, cultivating and securing startup-oriented talents and developing supportive mechanisms are considered urgent tasks in Japan's innovation infrastructure.

In this paper, within the context of Japan's economic revitalization strategy, the focus is placed on the innovation infrastructure strategy, particularly emphasizing startup initiatives as a central latent growth issue in the realm of industry-academia-government collaboration. The discussion revolves around the role of industry-academia-government collaboration and its existing challenges, within the viewpoint of reviving the Japanese economy through innovation. Subsequently, the attention shifts to the challenges of promoting startups in Japan. The analysis further delves into solutions using examples from overseas, primarily OECD countries. Finally, a strategic proposal for promoting startups as a means of cross-cutting industry-academia-government collaboration is presented, concluding with policy implications to enhance Japan's latent growth prospects.

2 Review of Literature and Identification of Study Gaps

Here summarizes the literature review and the identification of study gaps to be demonstrated, as well.

2.1 Review of literature

Literature review is composed of “Japan’s Global Competitiveness,” “Innovation for Economic Growth,” “Cluster-Networks,” “Comparing Cluster-Networks Policies Overseas vis-à-vis Japan,” and “Startups in Japan” accordingly.

2.1.1 Japan’s global competitiveness

To assess Japan's positioning in the global innovation landscape, let's first examine the "Global Innovation Index (GII)" for international comparison. This index is collaboratively developed by the World Intellectual Property Organization (WIPO), Cornell University, and INSEAD, serving as a prominent indicator widely utilized to evaluate countries' innovation capabilities. The GII assesses seven key dimensions for innovation generation among 129 countries and economic regions worldwide: 1. Institutions, 2. Human Capital and Research, 3.Infrastructure, 4.Market Maturity, 5. Business Sophistication, 6.Knowledge and Technology Outputs, and 7.Creative Outputs. The following table 1 illustrates the trends in the top 20 countries over the past 10 years from 2013 to 2022. Notably, Switzerland and Sweden have frequently secured the first and second positions, while the United States, Netherlands, Germany, and other European countries, along with Singapore in Asia, consistently maintain positions within the top 10. In 2022, Israel's entry into the top 10 and the emergence of economic regions in North Africa and Western Asia are notable. Surprisingly, China, which was ranked below 20th place until 2017, made significant progress by entering the top 20 in 2018, securing the 11th position in 2022.

Rank	2013	2015	2017	2019	2021	2022
1	Switzerland	Switzerland	Switzerland	Switzerland	Switzerland	Switzerland
2	Sweden	Netherlands	Sweden	Sweden	Sweden	United States of America
3	United Kingdom	Sweden	Netherlands	United States of America	United States of America	Sweden
4	Netherlands	Netherlands	United States of America	Netherlands	United Kingdom	United Kingdom
5	United States of America	United States of America	United Kingdom	United Kingdom	Republic of Korea	Netherlands
6	Finland	Finland	Denmark	Finland	Netherlands	Republic of Korea
7	Hong Kong	Singapore	Singapore	Denmark	Finland	Singapore
8	Singapore	Ireland	Finland	Singapore	Singapore	Germany
9	Denmark	Luxemburg	Germany	Germany	Denmark	Finland
10	Ireland	Denmark	Ireland	Israel	Germany	Denmark
Out of Top 10	Germany (15)	Germany (12)	Japan (14)	Hong Kong (13)	China (12)	China (11)
	Japan (22)	Japan (19)	Israel (17)	China (14)	Japan (13)	Japan (13)
	China (35)	China (29)	China (22)	Japan (15)	Hong Kong (14)	Hong Kong (14)

Table 1. Global Innovation Index Ranking from 2013-2022
Source: Based on the *Global Innovation Index (2023)*, author summarized.

2.1.2 Innovation for economic growth

Regarding the concept of innovation, Christensen (2019) defines it as "novelty" or "innovation," involving the incorporation of new systems, technologies, and practices to create innovative value in

the market. Additionally, economist Schumpeter (1977) introduced the notion of "creative combination," which involves combining existing goods or services to create new value in society. He classified innovation into five types: 1. the production of new commodities, 2. the introduction of new methods of production and handling of new goods, 3. the exploration of new markets, 4. the acquisition of new sources of raw materials or intermediate products, and 5. the realization of new organizational structures (Schumpeter, 1942). Sudo (2018) suggested that these five typologies can be consolidated into two categories: (A) innovation related to the exploration of new products and markets, and (B) innovation related to the enhancement of existing processes in production and distribution. Moreover, the author pointed out that as economic growth rates do not rise significantly, there is a growing emphasis on process innovation, which prioritizes efficiency improvement.

Then, economic growth refers to the expansion of the overall value and production activities of a country or region. Theoretical explanations, from an economic perspective based on Solow's (1956) residual model, suggest that sources of economic growth include qualitative growth factors (technological advancement and human capital) beyond the quantitative production elements of traditional capital (K) and labor (L), represented as the residual term (α) in endogenous growth theory. These residual elements are further enriched by innovation. This theory gained support in subsequent developments, including Romer's (1986) introduction of knowledge and Lucas's (1988) introduction of human capital, forming the first wave of endogenous growth theory through innovation. As an evolved form, Romer (1990) and Grossman and Helpman (1991) formulated the intentional Research and Development (R&D)-driven endogenous innovation model as the second wave. Recent research on innovation and economic growth includes the work of Linton and Warsh (2007), emphasizing that economies grow through "knowledge" and advocating the significance of a knowledge-based economy. Collectively, these studies theoretically underscore the indispensability of innovation for economic growth.

Based on the growth theories mentioned earlier, the process through which innovation drives economic growth can be explained by using several fundamental factors; heightened investment, improved productivity, the accumulation and sharing of knowledge, increased competitiveness, and the development of new markets and value. Namely, when there is growing enthusiasm for new ideas or technologies, companies and investors are more inclined to support related projects. As a result, this increased investment nurtures the emergence of new businesses or initiatives, ultimately enhancing productivity. Innovation gives rise to fresh concepts, technologies, and processes that enhance efficiency, enabling the production of more goods or services using the same resources. Repeated implementation of these technologies and processes leads to the accumulation and exchange of knowledge (Ohashi, 2018). The discovery of new ideas also has a ripple effect, inspiring innovation in other areas. By realizing these investments, production, and knowledge accumulation, improved competitiveness and the creation of new markets and value can be achieved. Then, innovation fuels competition, thereby improving the competitive edge as companies embrace new ideas and technologies. Increased competition allows efficient companies to thrive, resulting in overall enhancements in market quality and efficiency. Furthermore, the introduction of new ideas or products generates new demand, ultimately giving rise to new industries or markets and injecting fresh vitality into the overall economy.

Regarding the mechanisms that generate such innovation, NEDO (2020) outlines a framework with three perspectives: "from Input, Output, to Outcome." To realize this, considering the impact on society and the market is crucial. Specifically, "Input" encompasses all business activities related to innovation generation, such as company development, manufacturing, and fundraising. "Output" refers to the introduction of products or services with new value to the market, as well as the development and provision of processes. Finally, "Outcome" signifies the societal changes and economic growth resulting from business promotion and value provision, influencing society and the market.

From this perspective, innovation enhances economic vitality, generates new opportunities, boosts productivity and competitiveness, and drives sustainable economic growth. Strengthening the infrastructure for innovation creation is essential, with corporate innovation generation activities being particularly important. Through activities like research and development, companies effectively

combine available resources and value to create and offer new value, such as unprecedented products and services, thereby potentially transforming global lifestyles and industrial structures (NEDO, 2020). To enable companies to drive innovation, collaboration with universities, research institutions, and talent acquisition, along with fiscal support like government grants and institutional design, are essential.

2.1.3 Cluster-networks

Industry-academia-government collaboration, more easily called, "Cluster Networks" refers to initiatives in which three distinct sectors—industry (corporations), academia (universities and research institutions), and government—cooperate and share knowledge and resources. This collaboration is said to play a crucial role in the generation and promotion of innovation. Five main roles can be identified within this context as follows.

Firstly, "Sharing and Fusion of Knowledge" from academia is a significant aspect. Kumar (2018) emphasized that Academia possesses the latest research findings and specialized knowledge, generating new ideas and technologies. On the other hand, industry holds insights into practical challenges. Industry-academia-government collaboration facilitates the exchange of these diverse knowledge bases, often leading to the emergence of fresh perspectives and approaches. By applying academic insights to practical problem-solving, innovative ideas can emerge. Indeed, Leick and Gretzinger (2020) proposed that while the relationship between knowledge sharing and the growth of business networks and clusters, along with the prerequisites, mechanisms, and results of knowledge sharing, remains somewhat uncertain, it is undeniable that knowledge sharing holds significant importance. This is particularly true considering the existing saturation of scholarly research in the field of business networks and clusters. In these ways, sharing knowledge is considered the key role in building stronger cluster networks through three parties.

Secondly, "Technology Transfer and Applied Research" involves transferring new technologies and ideas from academic research to industry for practical implementation. Basic research and cutting-edge technologies from academia can be harnessed to improve products and processes in industry, fostering the growth of new markets and industries (Bozeman, 2000). Artyukhov, Omelyanenko, and Prokopenko (2021) proposed ways for extending technology transfer efficiency in Ukraine universities with the complex approach to acclerate scientific research outcomes in comparison with U.S., Japan, and China.

Thirdly, "Human Resource Development and Exchange" is also crucial. Cluster network through industry-academia-government collaboration provides a platform for experts and students from different fields to interact and learn from each other. Professionals with industry experience joining academia can bridge academic knowledge and industrial practices, leading to the birth of novel perspectives and ideas. This, in turn, influences other fields, becoming a driving force for further innovation. Jotabá et al. (2021) classified a number of theoretical perspectives relevant to human resources development through the adoption of innovative practices into four primary approaches of organizational factors of success, strategic human resource management, human behavior, and learning management. Therefore, promoting the human resource is significant.

Fourthly, "Collaborative Research and Projects" is also another key role in activating innovation. Collaboration often involves joint research and project opportunities. Collaborative research topics aligned with industrial needs are identified, enabling researchers and corporate scientists to cooperate in finding solutions (METI, 2023). This can yield practical outcomes while simultaneously advancing academic progress. Indeed, Liyanage (1999) used ‘co-occurrence of words’ method in cluster construction, emphasizing that the iterative process of innovation cluster formation is an effective form of building a national system of innovation. In this way, collaboration is the key in accelrating innovation.

Lastly, "Sharing of Funds and Resources" is another important role. In industry-academia-government collaboration, opportunities to share resources like research funding, facilities, and technical support are common. This enables academic research to be more readily applied to practical applications,

accelerating the development of new technologies and products. Li, Corral de Zubielqui, and O'Connor (2015) examined the entrepreneurial networking capacity of business organizations in leveraging shared resources in clusters to achieve market performance in Australia, resulting that the unique roles of various types of cluster shared resources in enhancing company market performance. In this way, sharing funds and resources is a key tool to strengthen the cluster networks.

From these five roles for crystalizing cluster networks within industry-academia-government collaboration, the infrastructure for innovation generation is established. It begins with "Human Resource Development and Exchange" among these sectors. Through this cycle of development and exchange, "Sharing and Fusion of Knowledge," "Collaborative Research and Projects," and "Sharing of Funds and Resources" can be achieved. Consequently, "Technology Transfer and Applied Research" becomes achievable, with the accumulation of such transfers and research eventually leading to the creation of new products and services. This brings about societal change and economic growth by impacting society and markets. It's certainly not an exaggeration to say that much of Japan's innovation thus far can be attributed to the contributions of industry-academia-government collaboration.

As an example, the Shinkansen (bullet train) was influenced by collaboration between academia, industry, and government. Specifically, in terms of technological development, the Railway Institute at Kyoto University conducted research on high-speed railways and provided a portion of the technological foundation for the Shinkansen. Furthermore, the planning and development of the Shinkansen were led by the government, which not only provided financial support but also established the legal framework. Private companies, including Japan National Railways, the former name of the Japan Railways (JR) Group, responsible for operating, maintaining, and managing the Shinkansen, were involved. These companies collaborated with the government, universities, and research institutions to practically apply and improve the technology, leading to the realization of the Shinkansen implementation.

Innovation cases driven by collaboration between academia, industry, and government, like this, are not only common in Japan but also widely conducted overseas. Particularly in advanced countries such as the United States and Europe, they hold a stronger global competitive edge compared to Japan. This is likely due to significant differences in policies aimed at strengthening the infrastructure for innovation creation. In the following section, we would like to compare and consider strategies for promoting collaboration between academia, industry, and government in Japan and abroad.

2.1.4 Comparing cluster-networks policies overseas vis-à-vis Japan

In the case of Japan, innovation creation activities are driven by individuals, research institutions, and corporations. When individuals engage in innovation, it's referred to as "garage ventures." Corporations typically operate through private research institutes, as previously mentioned. On the other hand, research institutions encompass not only higher education institutions like universities but also technical colleges and national research and development agencies (research organizations).

These research institutions engage in academia-industry-government collaboration, involving joint research with private companies, financial support from the government, and progress reporting on projects. As for corporations leading academia-industry collaboration to achieve success, Canter (2011) and Atterback (2006) highlight three crucial factors: 1. Progressing from small to large experiments, 2. Independent organizations like venture capital firms, and 3. The optimal combination of business models and technology. Indeed, in Japan, small-scale venture capital firms have rapidly increased since the 21st century. They have relatively short histories in applying cutting-edge technologies such as light-emitting diodes and nanotechnology to develop products as businesses. In other words, innovation only reaches society and brings forth new value and transformation when it extends beyond technology development to market deployment.

Now, let us discuss the differences between Japan and overseas in terms of innovation creation policies through academia-industry-government collaboration. Particularly focusing on investment, human resources, and managerial support, in Japan, there are mainly systems supporting research and

development for corporations, the formation of cluster networks (academia-industry-government collaboration) modeled after overseas counterparts, and a wide-ranging research and development support that spans from fundamentals to applications. In fact, Japan has emulated academia-industry-government collaboration from the United States to foster innovation through collaboration among private companies, universities, and the government.

Japan	U.S.	Germany	China
1. Formation of cluster networks (academia-industry-government collaboration) modeled after overseas (U.S.) practices. 2. Support system for research and development to corporations. 3. Comprehensive research and development support covering a wide range from fundamentals to applications.	1. Government-led research and development investments for both private sector and universities. 2. Comprehensive support for startup companies from establishment to market creation. 3. Innovation creation through support for small and medium-sized enterprises.	1. Emphasis on investment and infrastructure development with cluster networks (academia-industry-government collaboration). 2. Support for entrepreneurship among doctoral degree holders. 3. Support for technological improvement through startup promotion.	1. Activating Cluster Networks 2. Come-back High-skilled human resources who obtained Ph.D. Overseas 3. Research Investment and through Business Acceleration Startups Promotion

Table 2. Innovation Policies Comparison with the U.S., Germany and China
Source: Based on the NEDO (2020, p.65) and OECD(2022), author summarized.

Meanwhile, a summary of innovation creation policies in other countries is presented in Table 2. Taking a look the table above, in the United States, government-led investments in R&D for both the private sector and universities are vibrant. A notable characteristic is that they provide support not only for the establishment of startup companies but also financially and technologically for market creation. Additionally, they offer robust assistance for innovation creation in middle-income countries. On the other hand, in Germany, there is a focus on investment and infrastructure development that emphasizes academia-industry-government collaboration. Policy-wise, they also support the improvement of technical capabilities through promoting entrepreneurship among doctoral degree holders and facilitating startup initiatives. Finally, in China, while they also work to enhance academia-industry-government collaboration like many other countries, they place significant emphasis on research investment through startup promotion and driving commercialization. They are also actively encouraging the return of doctoral degree holders from overseas as part of their efforts. The phenomenon of highly skilled individuals obtaining doctoral degrees from universities in the United States and Europe and then staying abroad for employment, leading to a so-called "Brain Drain," has become a serious concern. The same issue is occurring in the Republic of Korea, where individuals with doctoral degrees tend to receive higher wages and better treatment abroad than in their home country's research institutions, creating a lack of incentive to return.

Consequently, the Chinese government is focusing on improving the conditions and research environments for researchers. When comparing innovation creation policies with a focus on academia-industry-government collaboration among advanced countries, it becomes evident that there are significant differences in the level of dedication to startup promotion and variations in investment and support. Therefore, in the following section, startups and the current status in Japan are introduced.

2.1.5 Startups in Japan

When the research project for Japan's economic revitalization strategy was initiated in the early summer of 2022, the current Kishida administration actually declared it as the "Year of Startups." This could possibly be attributed to a sense of urgency arising from Japan's lag behind Western countries and China, prompting the initiation of startup support efforts.

A startup is defined as a company with the capacity to sustain significant growth, creating new value or services, regardless of its business scale or stage (Baldridge and Curry, 2022). The major characteristics of startups encompass three aspects: "Innovation," "Scalability," and "Problem-solving." In essence, startups are founded primarily for the purpose of innovation creation, rapidly expanding their operations within a short period, and addressing challenges through the penetration of products or services into the market via new ideas or projects (Kato, 2022). Baldridge and Curry (2022) highlight the benefits of startups, including substantial autonomy and authority, flexibility, and speed[1].

Interestingly, startups are positioned to acquire funding at different stages, determined by their development progress. The initial stage is known as "Bootstrapping," followed by "Seed-funding," and then further rounds labeled as Series A, B, C, and D. These stages correspond to different levels of business scale and technological advancement, guiding the fundraising process.

Startups are widely acknowledged for their economic impact in terms of competitive advantage, innovation, and employment. For instance, notable companies like Facebook, Google, Uber, and Twitter in the U.S. started as small entities but quickly evolved into colossal corporations within just a few years (Kato, 2022). Consequently, there has been a rapid global trend since 2017 to promote startups, recognizing their role in fostering economic development through innovation creation. Then, understanding the significance of startups for economic advancement via innovation, the situation in Japan is as follows.

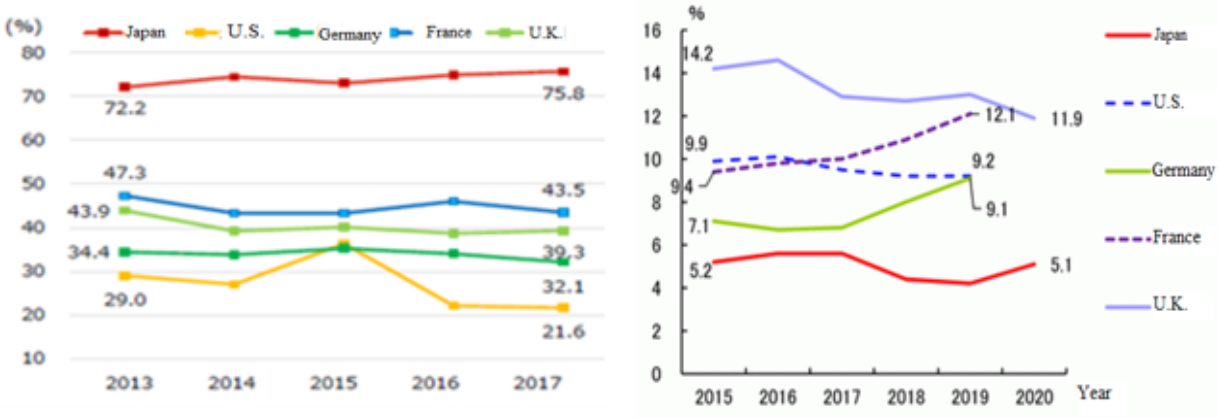

Figure 1. (Left) The Proportion of Individuals Disinterested

Figure 2. (Right) The Proportion of Opening Business (%) in Entrepreneurship (%)

Source: Based on the NISTEP (2019; 2022), author revised the both figures for translation into English.

To begin with, the Ministry of Economy, Trade and Industry (2023) points out fundamental issues including a lack of entrepreneurial mindset and a scarcity of serial entrepreneurs. Figure 1 on the left side illustrates the trend in the proportion of individuals disinterested in entrepreneurship in major Western countries. Although the data is somewhat dated, as of 2017, Japan had the highest proportion

[1] A well-recognized similar term in Japan is "venture companies." Unlike startups, these ventures refer to small businesses that have recently been established and are taking on risks to develop new ventures, emphasizing nuances and connotations associated with small business endeavors.

of individuals disinterested in entrepreneurship at 75.8%, significantly exceeding the figures for the United States (21.6%), Germany (32.1%), and the United Kingdom (39.3%) by more than 40 points. This indicates that Japan's interest in entrepreneurship is notably lower even among advanced countries. Further, Figure 2 on the right side presents the trend in startup rates. Japan's startup rate stood at 5.1% in 2020, almost unchanged from 2015. This level remains low compared to rates of 12.1% in the U.S., 11.9% in the UK, and 9.1% in Germany, reflecting a continuing disparity.

Regarding these figures, the Ministry of Economy, Trade and Industry (METI) in Japan (2023) addresses the issues with entrepreneurship in the country, including the fact that technological advancements and research outcomes often fail to translate into successful business ventures. This is attributed to the limited availability of grants and subsidies for newly established companies, including startups, in Japan, which presents a significant disparity compared to regions like Europe, the United States, and China. Additionally, the lack of substantial opportunities for support until products or services reach the market is another contributing factor. Furthermore, in Japan, known as a high-tax nation, many cases involve struggles with high taxes right from the outset of starting a business. Perhaps due to these reasons, according to the Ease of Doing Business Index published by the World Bank (2023), Japan has fallen behind even Southeast Asian countries like Thailand and Malaysia, ranking 30th. This places Japan notably lower among advanced nations.

2.2 Identification of Study Gaps

Based on the previous research outlined above, the key points and challenges should be organized. First, when categorizing the factors that promote innovation, both theoretically and practically, the main drivers of innovation include technological advancement, entrepreneurial spirit, industrial development, ICT proliferation, research and development (R&D), and human capital. Comparing successful cases of innovation in advanced countries overseas, including the United States, Germany, and China, previous research has shown a strong emphasis on promoting entrepreneurship, particularly startups, fostering high-level talent, and strengthening collaboration between the three parties.

On the other hand, when assessing the current status and challenges of innovation in Japan, it is evident that the country invests heavily in research and development expenditure and has a substantial number of research personnel. Japan also ranks among the top globally in terms of patent applications and research paper output. The track record of corporations developing numerous industrial products is indeed highly regarded worldwide. However, a central issue revolves around the promotion of startups and fostering interest in entrepreneurship, where policy implementation appears to be in a stagnant state. Notably, there is a challenge in enhancing international competitiveness by consistently providing financial and technological support to startups, similar to the academia-industry-government collaboration policies in the United States, until they successfully penetrate the market. In light of this, considering these aspects, I set the research objective and a research question for this paper as follows.

3 Study Objective and Research Question

3.1 Study objective

The objectives of this study is to demonstrate a cross-sectional framework for the establishment of startup promotion measures as part of the academia-industry-government collaboration strategy, which plays a pivotal role in revitalizing the Japanese economy through innovation-driven infrastructure.

3.2 Research question (RQ)

RQ: How can the strategic cluster networks through startups promotion, be structured and proposed as an innovation policy, as part of the effort to foster innovation for the economic revival in Japan?

4 Frameworks

In tackling the aforementioned research objective, two frameworks for analysis was constructed from two perspectives.

4.1 Theoretical framework: economic growth through innovation

The first perspective is the linkage between economic growth and innovation. Initially, a quantitative analysis was conducted regarding whether innovation contributes to economic growth. This analysis was grounded in conventional models such as the Cobb-Douglas function and Solow's (1956) residual model, as well as the Total Factor Productivity (TFP) framework. Based on these, it was found that economic growth relies not only on capital (K) and labor (L) inputs but also considers the inputs of technology, human capital, and knowledge residuals. Based on the theoretical frameworks, I employed the three models of the pooled ordinary least squares (POLS) model, fixed effect model, and random effect model to investigate the potential linkage of foreign aid on individual income, by referring to the previous study conducted by Nguyen et al. (2022). Further details was explained in the part of 5.2. Methodology below.

4.2 Conceptual framework: strategic management for startups promotion

The second perspective is the innovation strategy. Regarding the startup promotion policies aimed at invigorating the innovation creation infrastructure, attention was directed towards NEDO's (2020) innovation focus, the strategic management framework (SMF) by the WWP (2019), and a macro-environmental analysis of how Japan's innovation contributes to or affects economic growth using the PEST framework (Political, Economic, Social, and Technology). Considering these, it was discerned that crafting an innovation creation strategy through startup promotion necessitates the analysis of the macro-environment, establishment of aligned strategies with goals, and implementation of mechanisms for their management and evaluation. These elements are deemed vital and should be incorporated as strategic proposals.

5 Methodologies

Here summarizes the methodologies to approach the RQ with data-collection, treatment, and methodology as follows.

5.1 Data-collection and treatment

Overall, for arranging the dataset to approach the RQ quantitatively first, I used the secondary data in several variables. The list of the variables of quantitative analysis is summarized in Table 3.
For covering the missing data, I used five items of “Opening Business Rate” “GDP per capita,” and “Capital,” “Labor Market,” “Education,” “ICT_Internet Users,” “ICT_Broadband Subscribers,” and “R&D” this time. The data was primarily gained through the publicly open websites from the World Bank and the International Telecommunication Union (ITU) from 2004 to 2020 with twenty OECD economies of Australia, Canada, China, Denmark, Finland, France, Germany, Hong Kong, Iceland, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Portugal, Singapore, Sweden, the United Kingdom, and the United States. The dataset listed the World Development Indicators of WDI and the ITU *(N* = 340 (17 Years with 20 Economies)).

One weakness to be reported in this paper is that I could not handle the missing data from the specified duration. The other weakness regarding the data-collection to report here is that I could not collect as much “Score-Starting a Business” as possible from the World Bank, primarily because of the massive missing samples. I got only 5 samples from 2015 to 2019 from the World Development Indicators (2023). Instead, I employed “Starting a Business Rate” (WDI, 2023). Since this study focuses on how much the startups affects GDP per capita in the OECD economies, including Japan, it would be justifiable for me to employ the alternative variable to refill the missing data.

Type	Variables	Definition	Expected Direction
DV	GDP per capita	Gross Domestic Product (GDP) per capita (Atlas Method, US$, WDI, 2023).	N/A
IV	Startups	The rate of starting a business (WDI, 2023)	(+)/(-)
CV	Capital	Gross fixed capital formation (% of GDP) (WDI, 2023)	(+)
CV	Labor	Labor force participation rate for ages 15+, total (%) (WDI, 2023)	(+)
CV	Education	The gross enrollment rate of tertiary education, total (%) (WDI, 2023).	(+)
CV	ICT_Internet Users	Individuals using the Internet (%) (ITU, 2023)	(+)
CV	ICT_Broadband Subscribers	Fixed-broadband subscriptions per 100 people (ITU, 2023)	(+)
CV	R&D	Research and development expenditure (% of GDP) (WDI, 2023)	(+)

Table 3. Variables of Panel Data Analysis for the RQ:
Note: DV (Dependent Variable), IV (Independent Variable), and CV (Controlled Variable)
Source: Author

5.2 Methodology

For the RQ, a mixed method was employed, which can combine elements of quantitative research and qualitative research to answer the RQ with the expanded evidence, helping me gain a more complete picture than a standalone quantitative or qualitative analysis in generalizability, contextualization, and credibility (George, 2021). Also, as for the research design, the effectiveness of startups can vary depending on the uncertain elements, including the recipient's diplomatic speculation, allocation methods of the funds, procedure use for policymaking, etc. In these ways, the mixed-method should be justified. Thus, it is appropriate for me to choose an explanatory sequential design; quantitative data collection and analysis occurs first, followed by qualitative analysis.

The following procedure was made below. Firstly, a framework for analysis from the perspective of economic growth and innovation is presented here. This research aims to examine if digitization (ICT) achieved through innovation contributes to manufacturing and service industries in middle-income countries. With a focus on whether it contributes to the growth of manufacturing and service industries, which drive economic development, we decided to utilize growth models. Specifically, we looked into the traditional Cobb-Douglas production function, Solow's (1956) residual model, and the framework of Total Factor Productivity (TFP).

Drawing inspiration from the research by Nguyen et al. (2022), we applied Pooled Ordinary Least Squares (POLS) models, Fixed Effect Models, and Random Effect Models to investigate the impact of ICT on the value added in both manufacturing and service industries over a span of 17 years (from 2004 to 2020). The Cobb-Douglas production function is described as follows:

$$Y_{it} = A_{it}K_{it}^{\alpha 2}L_{it}^{\alpha 3} \quad \text{(1)}$$

Where, "*Y*," representing total production, is the predicted value of the dependent variable, "*K*" signifies the input of "capital," and "*L*" represents "labor." Superscripts denote the output elasticities of capital and labor, respectively. Subscripts "(i)" and "(t)" indicate individual items and time periods, respectively. By transforming Equation (1) into a logarithmic form as a linear regression equation, we rewrote the equation as follows:

$$lnYit = lnAit + \alpha 2 lnKit + \alpha 3 lnLit \quad \text{(2)}$$

Where using the format given in Equation (2) above, we substitute each indicator. That is, "GDP" represents Gross Domestic Product per capita. "*K*" stands for Capital (Gross Capital Formation Rate), "*L*" represents Labor (Labor Force Participation Rate), and the remaining factor "*A*" signifies Total Factor Productivity (TFP), which explains output growth caused by other production factors. Substituting these indicators, we have formulated the following specific equation:

$$GDP_{it} = \alpha 2Capital_{it} + \alpha 3Labor_{it} + A_{it} \quad \ldots\ldots (3)$$

Further, these factors are also referred to as "omitted factors." Two parameters, $\alpha 2$ and $\alpha 3$, contribute to explaining the elasticity of output with respect to "*K*" and "*L*," respectively. Based on this, TFP can be estimated using the following formula:

$$A_{it} = \alpha + \alpha 4ICT_{it} + \alpha 5R\&D_{it} + \alpha 6HED_{it} + \alpha 7STU_{it} + \varepsilon_{it} \quad \ldots\ldots (4)$$

Where ICT_{it} represents the ICT access with the components of Internet Users and Broadband Subscribers, $R\&D_{it}$ is research and development expenditure and HED_{it} is the enrollment rate of tertiary education in Japan. Noting that α is a constant, and α4, α5, and α6 are the elasticity of output with respect to ICT_{it} and HED_{it}. Finally STU_{it} stands for the opening business rate which represents Startup fixed as the DV. ε_{it} is the error term. One of the most important assumptions is the growth of ICT, R&D, HED, and STU inflows having the connectedness in terms of the TFP growth, which improves the GDP per capita, based on the Solow's (1956) residual model. Therefore, the extant literature suggests the correction by emphasizing the role of capital goods or technology and is associated with technological transfer (Morrissey, 2001). Further, startups has no association with investment and saving rates. By substituting (4) to (3), I obtained the final regression model as follows.

$$GDP_{it} = \alpha + \alpha 2Capital_{it} + \alpha 3Labor_{it} + \alpha 4ICT_{it} + \alpha 5R\&D_{it} + \alpha 6HED_{it} + \alpha 7STU_{it} + \varepsilon_{it} \quad \ldots\ldots (5)$$

Where *GDPit* represents the GDP per capita. *Laborit* is the country's total labor force. *Capitalit* stands for capital stock measured by domestic savings. The figure of ICT is *ICTit*, R&D expenditure is $R\&D_{it}$, and the gross enrollment rate of tertiary education is HED_{it}. Finally, STU_{it} includes the opening business rate standing for startups. All variables are expressed in a natural logarithm term. In terms of econometric approach, I followed the existing literature with POLS model, Fixed-effect model, and Random effect model to observe the effect of the startups on the GDP growth rate in the OECD economies. Therefore, my study has a new context when using the ICT using rates, R&D expenditure, and the tertiary education rate as the dependent variables, which is apart from the capital as well as labor forces in the model.

Based on the quantaitive results through the panel data analysis, I also conducted the qualitative analysis into practice. From these points of view, I used document/archival analysis with coding process by referencing the papers, journals, articles relevant to the startups not only in Japan, but also in several OECD economies, including the U.S., Germany, and China, in the context of finding the advantageous conditions and causes of the startups directly not impacting the GDP growth in Japan. As a specific methodology for conducting the analysis, a cross-sector strategy for promoting startups, a subset of innovation, is to be formulated to revitalize the Japanese economy. This will be achieved through a comparative examination of policy proposals in Japan and other OECD countries, primarily the United States, China, Germany, and Republic of Korea.

Furthermore, it is crucial to identify the essential components required to build a startups promotion strategy. As an analytical approach, the task of promoting startups was devided into two main categories: 1. Policy Implementation (Red) and 2. Policy Formation (Blue), under which, in the former, "Analysis," "Current Strategies," and "Challenges," were listed, and in the latter, "Execution" and "Management & Evaluation" were established, based on the WWP (2019). Here, each category around the axis of economic revitalization through startups investment in Japan was established. With these settings, I extracted information on the policy status and challenges of startups promotion in Japan

from documents issued by governments and some other scholars' previous studies. Utilizing emphasizing startup promotion, an innovation strategy centered on these aspects were constructed.

6 Study Results

6.1 For the RQ

Table 4 shows the results of the appropriate models executed from Gretl. Because of the missing data with the figure of 89, the total number of observation in all the models was 251. In gaining insight into the varaiable of "Starting a Business" in the fixed-effect model[2], the figure of coefficient was 0.911, which can be interpreted if starting a business, namely startups, can positively contribute to GDP per capita, at least, in all the selected countries when controlling the other varaibles of capital, labor, ICT, education, and R&D. Hence, statistically startups can statistially show the positive effect on the economic growth as a contributing factor. On the other hand, as explained earlier, 20 economies were congregated in the cross-sectional data of the fixed-effect model. Namely, it is still necessary to see how startups can be promoted to boost the Japanese economy in the long run by identifying issues.

	Pooled OLS Model		Fixed Effect Model		Random Effect Model	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
const	−5.11883	1.5801 ***	0.659	1.90745	−0.221760	1.84783
Capital	−0.535128	0.109264 ***	0.341	0.0697357 ***	0.28	0.0714661 ***
Labor	1.86	0.309131 ***	0.875	0.468875 *	1.15	0.448079 **
ICT1_Internet Users	0.07	0.0679167	0.025	0.02661	0.02	0.027674
ICT2_Broadband Users	−0.137258	0.0565593 **	0.041	0.0200672 **	0.04	0.0208686 *
TertiaryEducation	0.69	0.114432 ***	0.213	0.0616033 ***	0.23	0.063437 ***
RDExpenditure	0.02	0.058262	−0.161120	0.0804437 **	−0.130580	0.0755966 *
StartingaBusiness	1.46	0.258275 ***	0.911	0.142882 ***	0.86	0.140758 ***
R2: between	0.476401		0.953204		0.09151	
rho	0.954956		0.670262		0.670262	
No. of Observations	251		251		251	
No. of Cross Sectional Units	20		20		20	
Duration of Observations	17		17		17	

Table 4. Panel Data Analysis Outputs for the RQ
Source: Adapted from the Panel-data Analysis output.

Therefore, based on the quantitative analysis in Table 4 above, one more qualitative analysis was tested. With the two variables of the startups and GDP per capita growth rate, I scrutinized the culprits that can hinder Japan from revitalizing the economic growth through startups, shown in Table 5, with several challenges that can stagnate economic development progress to be identified in comparison with several developed economies of the U.S., Germany, China for reference. Consequently, 12 resultant samples were found as of these entities sampling. In these ways, I obtained sufficient data for qualitative analysis for the RQ. Upon organizing the results, the following five points became evident.

[2] In panel data analysis, it is necessary to select one of three models: the Pooled OLS Model (Pooling Model), the Fixed Effect Model (Fixed Effect Model), or the Random Effect Model (Random Effect Model). The choice between these three models typically involves three tests. First, the F-test is used to choose between the Pooled Model and the Fixed Effect Model. Second, the Breusch-Pagan test is employed to select between the Pooled Model and the Random Effect Model. Finally, the Hausman test is used to decide between the Fixed Effect Model and the Random Effect Model. In this validation, we followed this process to select the appropriate model.

1. In comparison with other countries, Japan exhibits weaker cluster networks among academia, industry, and government, which was pronounced in utilizating doctoral holders' resources.
2. To enhance lateral connections, measures, especially facilitating introductions to entrepreneurs and consultants for promoting entrepreneurship, should be implemented to foster interactions.
3. The Japanese government needs to consider providing financial support for young generations to raise their interests in doing businesses by improving the basic and secondary education.
4. More opportunities to connect researchers with entrepreneurs and consultants to support and stabilize business management, and streamline the process of opening businesses is desired.
5. To heighten interest in entrepreneurship and starting businesses, it is crucial to improve long-term education at the primary and secondary levels, with an emphasis on business curisity.

Also, several benefits of creating such a combined strategy for suggestion can be considered as follows. Firstly, the most significant aspect that can demonstrate the startups in Japan would be that the two platforms of economic growth and innovation policies should be incorporated into one strategy so that the public servants can easily frame the issues and find where Japan is comprehensively. Further, catching up the culprits/obstacles of promoting startups needs to be addressed by taking some measurements should be of importance. Problem-solving needs to be shared with the non-state and citizens, at least, from the government for transparency and accountability.
More importantly, associating the economic and business development strategy with vision, mission, and goals can help the public servants to share the same idea and direction towards national, organizational, and individual development altogether. Simplifying and streamlining the strategy and policies for re-vitalizing the economy in Japan should be the key to success. Making the complicated procedures under the legal administration can demotivate the public servants who wish to work for Japan and local citizens to promote further development, growth, and prosperity. In this way, sharing a simple strategy can help comprehensively put the policies into practice.

7 Conclusion

This part has study results interpretations, suggested frameowork, limitations, and recommendations.

7.1 Interpretations of study results and sugggestion of a SMF for startups

As of the RQ, I attempted to the effects of the startups on the GDP per capita by using the fixed-effect model, resulting in the identification of the statistically significant contribution to the variable. Based on the quantitative analysis, I also employed qualitative analysis to formulate the strategic frameowork of how to promote startups in Japan as a horizontal way of cluster network to ravitalize the economic growth. Based on the mixed-method, I made the hypotherical SMF with three axes of academics, provate corporations, and government shown in Figure 3 as follows. The emphasis in this figure lies in addressing the challenge of invigorating innovation creation infrastructure by harnessing the respective roles of academia, industry, and government (financial, human resource, technological). Universities and research institutions, aside from their traditional research, have been engaging in university-affiliated ventures, making it desirable to continue providing financial support. The private sector plays a vital role in discovering research seeds and their commercialization, laying the foundation for bringing new products and services to the market, even though this journey is lengthy.

Furthermore, enhancing international competitiveness in the global market will increasingly hinge upon collaborative efforts involving entrepreneurs, students, consultants, and foreign talent to foster more opportunities for exchange. Lastly, from a medium- to long-term perspective, governmental focus should extend beyond improving the ease of doing business to encompass reforms in school education that can enhance interest in entrepreneurship. Specifically, enhancing education at the primary and secondary levels is imperative. Even dedicating a small amount of time to nurturing an environment where young individuals are inclined towards entrepreneurship, financial literacy, and IT through entrepreneur-focused classes, symposiums, or seminars in collaboration with entrepreneurs, universities, and research institutions is deemed necessary.

■Vision: Innovation Strategy for the Revitalization of the Japanese Economy				
■Mission: Development of an Innovation Strategy Aimed at Revitalizing the Japanese Economy				
■Objective: Analysis of Innovation Creation Challenges through Entrepreneurship Promotion and Development of Strategic Proposals				
【Formulation】 Identification of Challenges for Activating Innovation towards Economic Revitalization			【Execution】 Efforts towards Enhancing Innovation Activation Challenges	
【Analysis】 Analyzing Japanese Society and Economy	【Strategic Study】 Directing Japanese Innovation Strategy	【Goals】 Identifying Innovation Issues	【Structures】 Problem-solving Action Items	【Management and Evaluation】 Outcomes and Improvement-oriented
■External Environments	1. Implementation of strategic collaborations (differentiating between closed and open approaches)	1. Improvement in National Citizens' Interest in Opening Business	1. Conducting seminars on starting a business and sharing information on social media. 2. Introducing entrepreneurship classes or extracurricular activities in elementary, middle, and high schools.	1. (Government) Monitoring the cultivation of young entrepreneurs and their level of interest. 2. (Industry) Organizing entrepreneurship schools and seminars for elementary, middle, and high school students as well as university students, and creating opportunities for interaction.
1. Japan's population is declining. 2. There is a tendency towards a high aging population ratio. 3. The GDP is the third largest in the world in terms of scale.	2. Deployment of products and services with global scalability in mind	2. Increase in the time volume of doing Research and Development (R&D)	1. Establishing independent organizations to increase researchers' engagement in research and development activities.	1. (Government) Initiatives to improve the ease of starting businesses (tax incentives, support for market expansion, etc.). 2. (Academia and Industry) Publication of outcomes and status of fund acquisition.
■Industrial Situation	3. Acceleration of decision-making, acceptance of risk-taking and challenges	3. Improvement in Entrepreneurship and Rate of Oening Businesses	1. Creating an environment conducive to starting businesses and ventures (increasing startup companies and university-originated ventures).	1. (Government) Efforts to improve the ease of starting businesses through system enhancements (tax incentives, etc.) aimed at enhancing the "ease of starting." 2. (Government and Industry) Support for expansion into new markets.
1. Corporate profitability tends to be lower. 2. There is low labor mobility and employment rigidity in the workforce. 3. The startup ecosystem is underdeveloped.	4. Moving away from over-compliance and analytics	4. Improvement in the Rate of Accelerating Open-Innovation	1. Enhancing investment capabilities into universities and research institutions and externalizing functions (spin-offs).	1. (Academia, Industry, and Government) Application of research in the industrial sector. 2. (Industry and Government) Implementation of large-scale collaborative research and management based on corporate needs.

Table 5. Results of the Qualitative Analysis
Source: Author

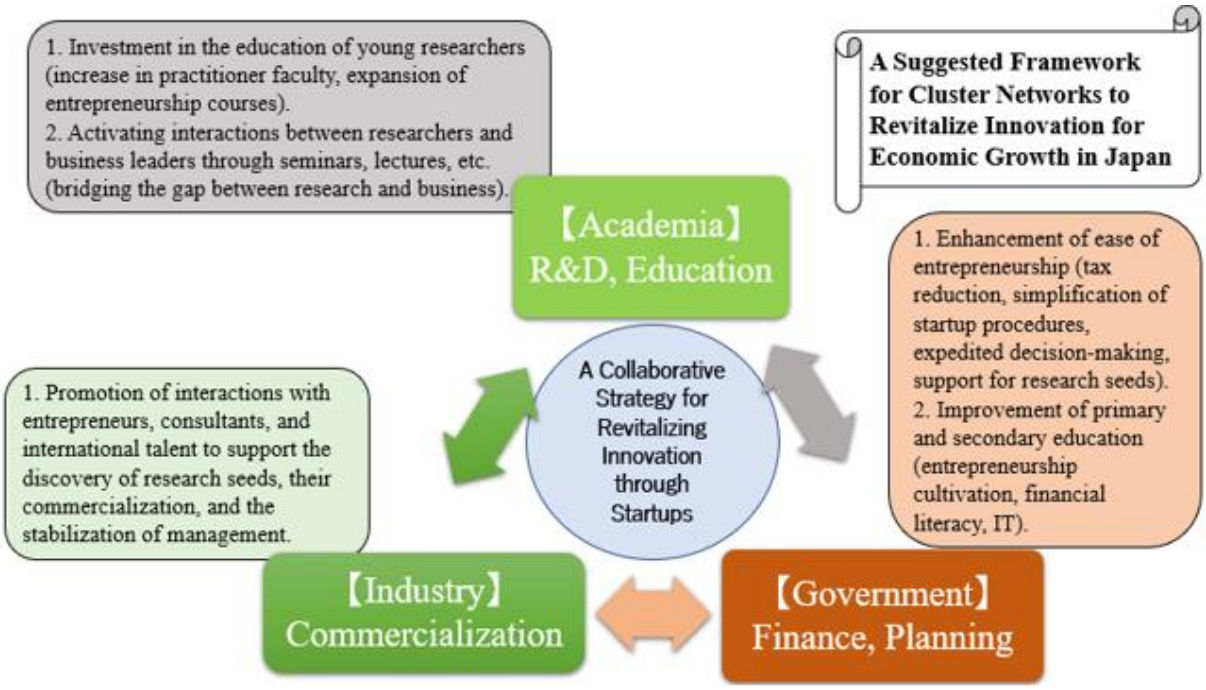

Figure 3. A Hypothetical Strategic Framework of Revitalizing Innovation through startups in Japan
Source: Author

7.2 Policy implications

In line with Figure 4, it is imperative to emphasize the enhancement of lateral connections with well-defined roles for academia, industry, and government, all while having clear objectives and goals. In this context, the crux of invigorating the innovation creation infrastructure lies in fostering a stronger connection between "research" and "business." Addressing the establishment of a cross-sector infrastructure for startup promotion, the discussion can be framed around two facets: the "human resource" and "environmental" aspects. First, in the "human resource" domain, over a short- to medium-term perspective, the government should focus on the items for policy implications below:

Increasing investment opportunities for young researchers within universities and research institutions. Measures like augmenting practitioner faculty members and mandating entrepreneurship and management courses as core or elective courses in various universities should be considered. Facilitating interaction between young researchers and entrepreneurs through workshops, seminars, and lectures. NEDO's (July 2023) implementation of support for securing management personnel in university-affiliated startups indicates the potential of such initiatives to provide real-world opportunities for bridging the gap between "research" and "business," potentially expediting startup promotion. Encouraging collaboration between universities, private entities, and entrepreneurs to facilitate the discovery of research seeds, their commercialization, and the stabilization of management. The growing presence of entrepreneurs and consultants in Japan presents an opportunity to leverage their resources, connect with university students and foreign talent, and increase awareness and interest in entrepreneurship. Meanwhile, focusing on the "environmental" aspect over a more medium- to long-term horizon (within a decade), the government should prioritize the following:

Firstly, as previously mentioned, striving for improved "ease of doing business" as part of the strategic framework is essential. This is crucial to enhance international competitiveness. Addressing challenges such as high taxes, inadequate startup support, slow decision-making processes, and delayed research seed discovery in Japan is time-consuming but necessary for gradual resolution.

Secondly, enhancing education at the primary and secondary levels. As stated earlier, sustained efforts to nurture entrepreneurship, financial literacy, and IT skills are necessary. This not only boosts interest

in entrepreneurship but also lays the foundation for contemplating entrepreneurship and sustainable revenue generation.

Finally, exploring measures to mitigate bankruptcy risks. Given the inherent uncertainties within a capitalist economic system, bankruptcies are inevitable. Maintaining a business for 30 years is a remarkable feat, with a global average of about 0.02%, underscoring its challenges (KS, 2010). Consequently, while startups inherently carry bankruptcy risks, it remains a pivotal managerial concern. Thus, seeking avenues to mitigate these risks is crucial, and government support is also warranted.

7.3 Study limitations

In relation to future strategies for promoting startups in Japan, the following remaining challenges are identified to be addressed in future research:

The first point entails conducting a more detailed investigation from an educational perspective into the reasons behind the comparatively low interest in entrepreneurship, even among advanced nations. Japan faces a wide array of educational challenges, with business education notably lagging behind even in comparison to other advanced countries. It has been considered to approach this issue comprehensively, utilizing not only economic analysis but also insights from related fields such as management and sociology, to comprehensively analyze the realities of business education in Japan and factors contributing to low interest. Concurrently, researching educational policies to enhance entrepreneurship interest should also be pursued.

The second point involves the necessity of delving into research on strategies for preventing corporate bankruptcy. While efforts to promote startups are underway, addressing the persistent issue of cases where startups face bankruptcy due to cash flow uncertainty remains crucial. Sustainable business operations are integral to achieving economic growth; thus, conducting research on the prerequisites and strategies for sustaining profitability and business continuity, notably for startups, is essential.

7.4 Recommendations

Two recommendations can be demonstrated as follows.

To begin with, it is crucial to integrate cultural and social dimensions when investigating matters related to innovation. The socio-cultural context has the capacity to either transcend or deviate from established theories and frameworks. Delving into innovation management studies from cultural, historical, and societal standpoints can indeed pose significant challenges, but the potential for valuable insights and practical theory formulation is equally substantial.

Lastly, when undertaking studies in the realm of innovation management, which encompass topics like cluster networks through collaboration between academia, industry, and government, it is advisable to engage in research collaboration, particularly with specialists in innovation, entrepreneurs, and other professionals. This is primarily due to the increased likelihood of enriching research through activities like data collection, tracking research trends, and engaging in discussions for the exchange of opinions. In this regard, it becomes even more advantageous to tap into the expertise of other professionals to ensure the creation of a comprehensive and valuable research outcome concerning global matters.

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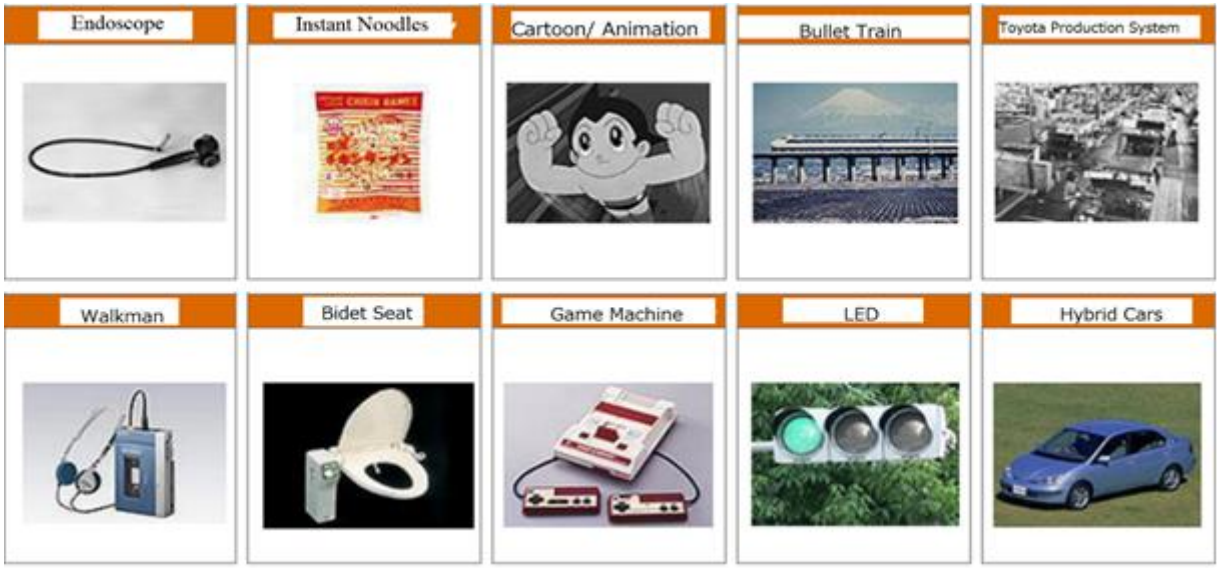
Appendix:



Appendix: Representative Examples of Innovation in Japan since World War II
Source: Based on the NEDO (2020, p.22), author revised it for translation into English.