LOOK OUT TO THE WORLD

THE NATIONAL INNOVATION SYSTEM AND POLICY IMPLICATIONS FOR ENTREPRENEURSHIP IN TAIWAN AND JAPAN

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Abstract:

In a knowledge economy, accelerating the pace of knowledge building and the rapid acquisition of knowledge are keys to innovative development. However, the development of the commercialization of research results and formation of new start-up companies are often not as active as they should be with a lack of motivation and incentive being one of the contributing factors for the failure to take action. In Taiwan and Japan, the reason that widely advocated idea of industry-academia collaboration is to help advance the technological capabilities of research and development as well as produce economic benefit. The assistance rendered by the government during the transformation and the assessment of outcomes from entrepreneurial pursuits are key issues explored in this study. The results indicate that the network system in the national innovation system is important for entrepreneurship development. The domestic market of Taiwan is not as large as Japan and new entrepreneurs have to face global market challenges.

Keywords: *Entrepreneurship; National innovation system; University-industry cooperation.*

1. Introduction

With the globalization trend, knowledge has become an important force and asset for economic growth *(Miner, Eesley, Devaughn, & Rura-Polley, 2001)*. The efficacy of a national innovation system affects its national competitiveness and is a major economic factor *(OECD, 1996)*. As the knowledge economy expands, entrepreneurial activities play an important role in economic growth and the progress of human society. Entrepreneurship is "a series of activities that initiate and manage the rearrangement of economic resources, with the purpose of creating economic values" *(Schumpeter, 1934)*. In contemporary times, entrepreneurship and entrepreneurial activities are considered as leading

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force of economic growth. A study by *Birley & Muzyka (2000)* and *Audretsch & Thurik (2001)* showed that, the frequency of entrepreneurial activities has a positive correlation with the economic growth rate in OECD member countries; therefore, the encouragement of entrepreneurial activities are effective measures to boost the economy.

The OECD (2003) study indicates that 20 - 40% of productivity growth in the OECD member countries is attributable to economic growth from productive startups. As for the content of the entrepreneurship, Shane & Venkataraman believe that entrepreneurship should include "how, who, and what factors that can influence opportunity discovering, evaluating, and utilizing".

In an innovation system, the important outputs of system operations will be in knowledge creation and proliferation; however, the industrialization and entrepreneurship of university research results are also a mechanism of university knowledge transfer, which has also been a policy focus in recent years. The promotion of an innovation system can be influenced by the academic culture and economic environments as well as by the effects of the innovation system *(Braunerhjelm, 2007)*. The government can serve as a role of the integrator when properly intervening in the industry - academy interaction; subsequently, this can help establish innovation development and creating stable response to international competition.

When facing the globalization trend, developed countries utilize the knowledge economy rapidly make best use of global resources, the labor, and the market. However, less developed countries must first deal with local and national economic stagnation and the transformation pressure caused by the internationalization of current major national industries before they can catch up. Therefore, how to quickly and efficiently solve this transformation challenge is a crucial subject for the development of a new economy. The development experiences of developed Western countries show that entrepreneurship is an important factor to maintain industrial activity. *Birley & Muzyka (2000)* and *Audretsch & Thurik (2001)* showed in their study of the OECD member countries, that the frequency of entrepreneurial activity has a positive correlation to the economic growth rate; therefore, the encouragement of entrepreneurship is an effective measure to boost the economy.

After World War II, the Japanese enjoyed the benefits of high economic growth because large Japanese enterprises offered a stable and high income, comfortable work environment, lifetime employment, and retirement protection. However, the "Bubble Economy" of the 1990s motivated the Japanese government to boost the innovation energy from universities and

research institutes. In addition, the government has modified various infrastructure, laws, and regulations that encouraged industry-academy cooperation to create startups that could help improve the economy *(Woolgar, 2007)*.

The economy of Taiwan has developed rapidly since 1960; however, it has faced transformation challenges in its economic structure since 1990 due to changes in the internal and external environments. Taiwan has had positive growth in its economy over the last 30 years; however, the growth rates have slowed since 2000 and Taiwan now faces a bottleneck in further development. The Taiwanese government has actively promoted industry-academy connection and development in addition to actively planning industrial transformation. The purpose is to encourage innovation and entrepreneurship.

There are many roadblocks to entrepreneurs and the government should provide consultation as well as create a nourishing entrepreneurial environment. This study analyzes innovation systems and entrepreneurship policy development in Taiwan and Japan as well as provides comparisons and suggestions for governments to create a salient entrepreneurship policy.

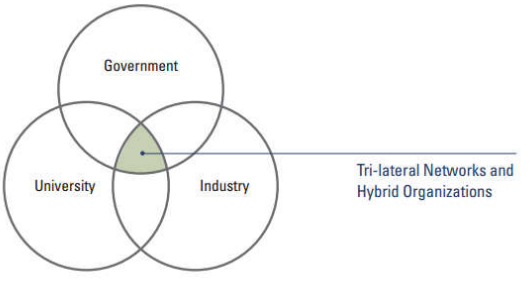
2. Literature review

2.1. National innovation system

The national innovation system is an organization and system network consisting of members in different sectors (such as enterprises, research institutes, colleges and universities, the government, and overseas sectors) that work independently or collaboratively to produce activity in knowledge creation, proliferation, and value-adding *(Metcalfe, 1995)*. They also combine factors to produce results in the process of knowledge production, proliferation, and usage *(Lundvall, 1992; Edquist, 2005)*. The national innovation system includes the production system, market system, fiscal system, and subsystems where learning happens. In a narrow sense, the national innovation system also includes institutes and organizations that conduct research on innovation such as R&D institutes and universities. In this system, enterprises, industries, research institutes, and universities play important roles. The effects of an innovation system include the realization of individual knowledge creation and application as well as interaction in local, domestic, and international areas *(OECD, 1999)*. *Metcafe (1995)* regards the national innovation system as a group of R&D subjects interconnected in emerging science and technology development that conduct knowledge creation, storage, application, and transfer.

Fagerberg, Mowery, and Nelson (2004) believe that the national innovation system includes systems and organizations. The systems include factors such as government policies and regulations, while the organization includes interaction among schools, enterprises, and public sectors responsible for innovation. An investigation of the national innovation system can help show the structure of science and technology development. The connection among each interested party in the current innovation system (including enterprises, universities, research institutes, and operational mechanism) is useful to facilitate the effective development of technology.

The national innovation system is the foundation of the development of the knowledge economy. The OECD (1999) categorizes the system into four major parts: knowledge innovation system, technology innovation system, knowledge proliferation system, and knowledge application system. In the national innovation system, public and private sectors intend to spread knowledge and new technologies to create a systematical relationship that can facilitate interaction among the government, universities, and enterprises. These three relational bodies form the "Triple Helix Model" through innovation interaction *(Etzkowitz & Leydesdorff, 2000)*. The Triple Helix Model proposed by *Etzkowitz (2008)* emphasizes that the development of a knowledge foundation can facilitate close cooperation among universities, industries, and the government and help develop the national economy. These three roles influence each other and will be reinforced over time. Subsequently, this relationship will tend to be equal and make long-term cooperation more stable (Figure 1).



Source: Etzkowitz (2008)

Figure 1. Triple Helix Model

2.2. Impact of Entrepreneurial Activities on Economic Development

As for the relationship between national economic growth and entrepreneurship, Schumpeter (1934) first proposed the idea of

"entrepreneurship" in his "The Theory of the Economic Development". He sees entrepreneurship as the nature of discovering, and promoting a new combination of factors and as an economic development force that is also a source of development. In the book of "Innovation and Entrepreneurship", *Drucker (1985)* argued, "entrepreneurship is a process of innovation in which new products or new services are identified and created and eventually used to develop new capability of creating values". Therefore, entrepreneurship is a way to refresh the economy, maintain the efficiency of an economic society, and create values in the macro-economy.

As for the impacts of entrepreneurial activities on economic growth, *Schumpeter (1934)* argued that innovation and entrepreneurship are the driving force of economic growth and social development. *Leibenstein (1968)* argued that entrepreneurs with professional human capital, accumulation of knowledge stocks, and entrepreneurship are key factors to promote national economic growth and social development. In a study of 84 countries based on the statistics of the World Bank, Klapper and others (2007) indicated that the self-employment rate has a positive correlation with positive economic growth. The study of the German economy by *Audretsch and Keilbach (2008)* showed that venture capital has a significant impact on regional economic growth and that knowledge input has a positive impact on knowledge-based startups.

However, the establishment of new businesses has a positive correlation with employment growth *(Ashcroft & Love, 1996; van Stel & Diephuis, 2004; Acs & Armingon, 2007). Van Praag and Versloot (2007)* found that entrepreneurship is very important to employment growth as well as a production rate increase; in addition, the employment effect is higher in the production sector than in the service sector. In a study of 36 countries, *Hessels and van Stel (2007)* argued that export- oriented entrepreneurship is more important than regular entrepreneurship; in addition, export-oriented entrepreneurship has higher contribution to GDP growth than regular entrepreneurship in developed countries and transforming countries

2.3. Entrepreneurship Policy and Environment

In a study of 494 economic regions and six industrial sectors in the US, Acs and *Armington (2007)* found that regional entrepreneurship with a geographical advantage and abundant human capital stocks positively impacts employment growth. In all sectors (except for the manufacturing sector), new businesses have a higher effect than small businesses. *Fritsch and Mueller (2008)* showed that regional differences have different effects on new business establishment in regards to employment growth. In these differences, regional environment and product rate are the most significant;

however, the effect can be negative for regions with low production rates. The economic development of Hong Kong and Taiwan is mainly the result of the necessity-push entrepreneurship. Small-and-medium-follower businesses make full use of a copy and follower strategy to implement incremental innovation and specialization, establish their brands, accumulate capabilities, and help upgrade the economic structure *(Bramwell & Wolfe, 2008).*

UNCTAD (2012) proposed an "Entrepreneurship Policy Framework and Implementation Guidance". Many countries do not have an entrepreneurship policy; however, the establishment of an entrepreneurship framework will help emerging countries propose proper policy planning to encourage entrepreneurship while they develop entrepreneurship. This framework emphasizes the entrepreneurship policy and the interaction of the private sector and an economic policy. The "United Nation's High Level Panel on Global Sustainability (2012)" proposed sustainable economic growth and emphasized high value-added, instead of profit. Entrepreneurship policy is a tool to help achieve sustainable development objectives to help improve productivity and solve practical challenges that society and the environment face. Entrepreneurship policy needs to be connected closely with economic policy.

Bryan and Lee (2000) consider the development of a startup (compared to technology licensing) is a more effective way for the commercial transfer of technology that can result in higher profits as well as values. Technology licensing is also viewed as a method only applicable when technology itself cannot form a startup. Universities can increase the probability of a successful transfer if they are continuously involved in the process of transferring research results into a startup. There are three key points in regards of making innovative enterprises help increase economic growth: to increase entrepreneurship, to increase the number of high -growth enterprises, and to increase the R&D of small and medium enterprises (SMEs) to increase their R&D level and quality by building network connection with universities and research institutes *(Dahlstrand & Stevenson, 2007).*

The US has accumulated numerous years of experience in the application of innovative research results and knowledge to market development *(Rosenberg & Nelson, 1994).* This development started in 1980 from the important paradigm of the Bayh-Dole Act *(Shane, 2004; Braunerhjelm, 2007).* The act rapidly increased the number of patents by US universities, licensing become more active, and schools paid more attention to the efficiency of enterprise licensing patents and the establishment of units for

technical transfer that could assist matters in regards to patent technology transfer *(Shane, 2004)*. Research patents were transferred to schools and inventors; subsequently, other countries started to follow this measure as well because of the significant knowledge proliferation and spillover effects.

2.4. Entrepreneurship Policy Framework

National innovation system consists of stakeholders and innovation policies. They are the actors of entrepreneurship ecosystem. It is very important to create an entrepreneurship framework and environment that inspires and enables individuals to start and successfully grow their businesses to facilitate an effective national system of innovation. Entrepreneurship strategy and policy directly impact entrepreneurial activity. The general entrepreneurship policies are based on a national innovation system related to network building among universities, industry and government. Research and development investment, technology transfer and the regulatory framework are also important for entrepreneurship development.

3. Japan's innovation system

3.1. The Development of Japan's Innovation System

The Japanese innovation system started from the establishment of Tokyo University in the nineteenth century and was a starting point that Japan came from a close door to economic development *(Edgington, 2008)*. The Japanese innovation system is a centralized system in which the roles of regional governments have become more important. The government is a driving force and the major executors are large enterprises such as international enterprises. As for developing advanced areas, Japan has a global leadership position in some technology due to continuous government input in R&D.

Freeman (1987) studied the science and technology policy of Japan as well as its economic benefits and proposed the idea of the national innovation system. The study says that technology development has a close relationship to the national policy, system and organizational innovation; subsequently, the system needs sustained external global interaction to constitute a close interaction link to facilitate the proliferation of innovation knowledge as well as technology.

Since the 1980s, large enterprises have played an important role in innovation and have developed high-technology products that compete

internationally. The R&D input from enterprises accounted for 75% of the total gross production *(Edgington, 2008).* The R&D departments of large enterprises were independent and closed. Enterprises have offered lifetime employment and encouraged interaction between R&D departments and manufacturing departments that help protect information and knowledge. The accumulated tacit knowledge was one of the major reasons for the Japanese success in the manufacturing industry *(Goto, 2000).*

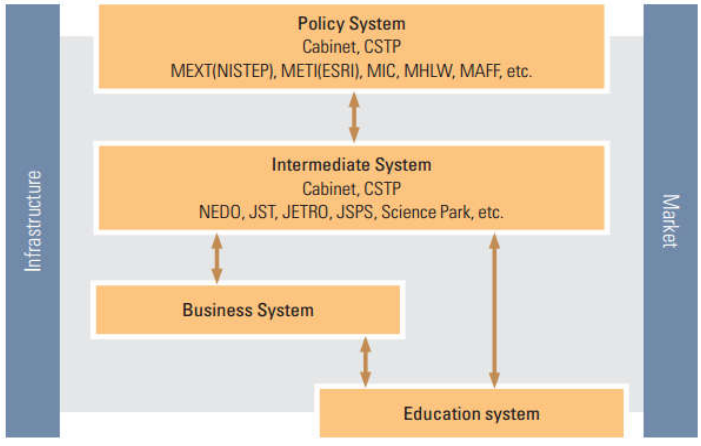
From 1990, industrial relocation became a serious problem due to the increased production cost and made Japan address the issue of de-industrialization. Industrial development based obstacles in addition to the prolonged economic depression and the asset pricing bubble; subsequently, the Japanese started to pay attention to fundamental academic research capacity and technology innovation capacity *(Edgington, 2008).* Traditionally Japanese enterprises have had cooperation problems with universities. For example, universities lacked the motivation to cooperate, and insufficient protection for intellectual property, and for industrialization effects from research results.

In November 1995, the Japanese government announced the "Science and Technology Basic Law". With technology as its national competitive advantage, Japan further proposed the strategy of "technology innovation as the national competitive advantage". The Japanese cabinet established a five-year "Science and Technology Basic Plan" in July 1997 to implement the idea and regulation of the "Science and Technology Basic Law". The Japanese government decided to continuously increase the input in science and technological research and gradually increase the proportion of basic research input to improve the software and hardware environment for R&D and solidly enhance the innovation capability in science and technology. In 2001, the "Second Science and Technology Basic Plan" was proposed and the "Council for Science and Technology Policy (CSTP)" was established. The CSTP should directly report to the cabinet, organize cross-department organizations in regards to the relevant policies or national science and technology, formulate a strategy for basic policies, establish guidelines for resource allocation, and promote large-scale R&D projects.

Another important organization is the Science Council of Japan established according to the "Academic Meeting Law" in 1949 that required directly reporting to the Prime Minister. It was created to help the Japan science academy and promote the development of science and technology in Japan. Its major promotions included policy proposals for scientific and technological development, the establishment of scientific researcher networks to facilitate scientific interdisciplinary exchanges, international

scientific information exchanges, and the improvement of a next generation scientific capability.

Since 2000, the Japanese government started institutional changes and adjustments with organizations related to scientific and technological development. These adjustments first included an adjustment of the functions and authority of the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Economy, Trade and Industry, and the Science and Technology Policy Council (CSTP). Second, some intermediary institutes were also adjusted to integrate national key research institutes and enhance the development of a knowledge transfer (Figure 2). Third, the educational system was adjusted that included university incorporation and promoting mechanisms as well as measures such as an industry-academy cooperation. The joining of the Intellectual Property High Court made intellectual property projection an important protection mechanism in the innovation system; subsequently, the input and exercise of intellectual property started to increase at universities.

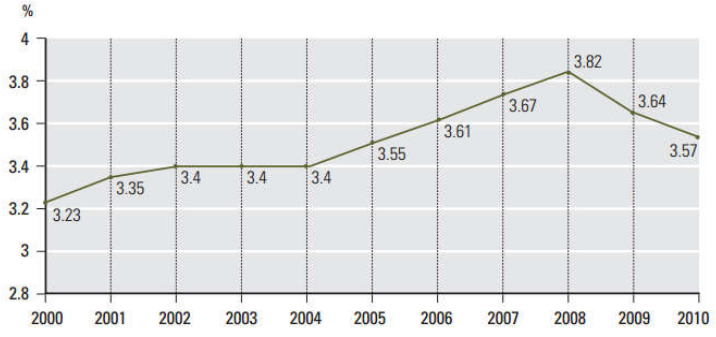


Source: Summary

Figure 2. Japanese Innovation System Structure

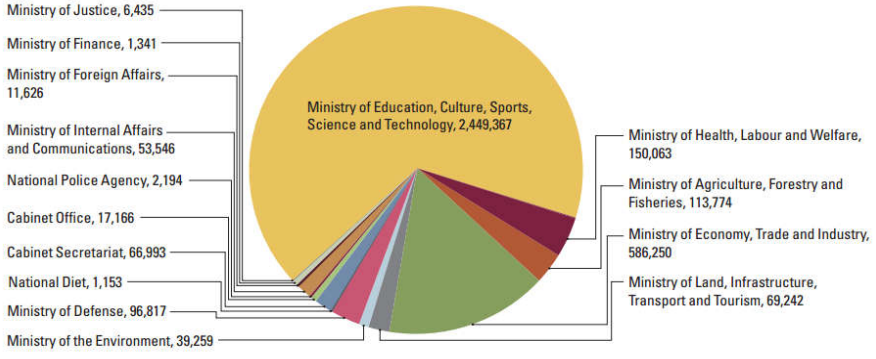
According to recent statistics by the Ministry of Education, Culture, Sports, Science and Technology, Japan has had an increase R&D expenditures in the proportion of GDP by year; 3.23% in 2000 and 3.57% in 2010 (Figure 3). As for the used R&D budget in every ministry, the Ministry of Education, Culture, Sports, Science and Technology had the highest percentage, with 2.445 trillion yen in 2011 or 66.8% of the total budget. The Ministry of Economy, Trade and Industry was second with a budget of 586.2 billion yen or 16% of the total budget. These two ministries used

around 82% of the national R&D budget (Figure 4). As for the source of the budget in 2010, governments and the central governments accounted for 19.3%, enterprise expenditures for 69.8%, private universities for 9.6%, and non-profit organizations for 0.8%.



Source: White Paper on Science and Technology 2012

Figure 3. Japanese Innovation System Structure



Source: Statistics of the Ministry of Education, Culture, Sports, Science and Technology, Heisei 24 Version (2013/01)

Figure 4. Percentage of each Minister's R&D Budget in Japan

3.2. Relevant Policies and Effects of Japanese Industry-Academy Cooperation

In the 1960s, the Japanese educational system relied on strict management and most universities and colleges were managed by the public sector. Industry-academic cooperation tended to be informal. For example, enterprises might send their employees to learn from university professors and serve as visiting scholars, or they might share the research costs of professors to replace the formal cooperation contracts. The patents of research results were often transferred to enterprises by professors and

universities; addition, professors often applied for patents *(Kato & Odagiri, 2012).*

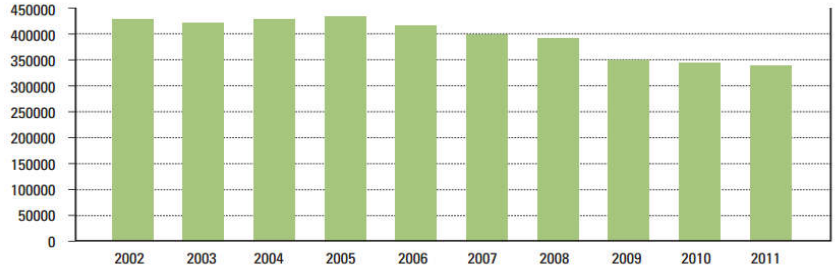
After "Science and Technology Basic Law" was passed in 1996, the regulations on science and technology research cooperation became more flexible in order to encourage industry-academy cooperation. Professors were able serve as directors and supervisors in the private sector; in addition, universities could receive funding through research cooperation with enterprises and officially accept enterprise researchers as university laboratory employees. In addition, universities were able to establish industry-academy cooperation institutes that could specifically promote industry-academy cooperation. These institutes could provide space for startups with cheap rent or provide specific services for startups established by universities. These enterprises could enjoy tax incentives through industry-academy cooperation *(Edgington, 2008).*

Two other important bills influenced the development of Japanese industry-academy cooperation. The first was the 1998 "Industry-Academy Technology Transfer Law" and the second was the "Industry Revitalization Law" (Table 1). The "Industry-Academy Technology Transfer Law" allowed technology transfer centers in universities to assist in technology transfer activities, while the "Industry Revitalization Law" led to a phenomenal increase in the number of patent applications from schools and in the number of transfers *(Kato & Odagiri, 2012).* In 2010, the number of applications exceeded 340,000 (Figure 5).

Table 1. Relevant Laws and Regulations of Japanese Industry-academy Cooperation Development

Years	Related Policies
1995	Science and Technology Basic Law
1996	The 1st Science and Technology Basic Plan
1998	Technology Licensing Organization Act
1999	Act on Special Measures for Industrial Revitalization
2000	Development of the Technology Enhancement Act
2001	The 2nd Science and Technology Basic Plan
2002	Intellectual Property Basic Act
2004	Incorporation of National University
2006	The 3rd Science and Technology Basic Plan
2011	The 4th Science and Technology Basic Plan

Source: Summary by this Study

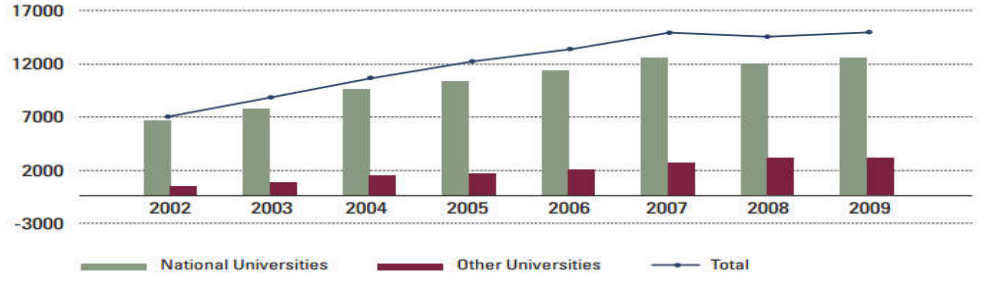


Source: Japan Patent Office Annual Report (2012)

Figure 5. Changes in Patent Application Number

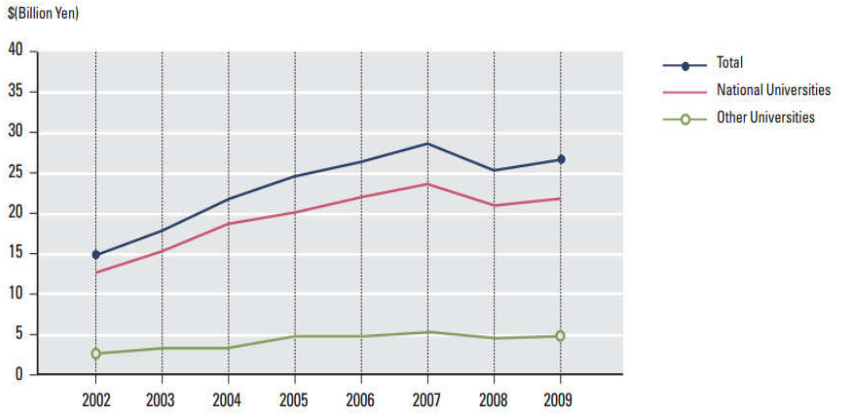
In 2004, Japan started an institutional reform of national university incorporation; subsequently, universities became an organizational form of a corporation no longer regulated by the Civil Servant Law. Universities could own patents and actively promote technology transfers. The passing of the law also provided incentives for universities to participate and execute industry-academy cooperation. This helped promote industry-academy cooperation as well as increased the output of industry-academy cooperation research.

According to the survey results of Japan's Ministry of Education, Culture, Sports, Science and Technology (in regards to industry-academy-government connection development) the project number of cooperative research by universities and civil institutes increased from 7,248 in 2002 to 12,544 in 2009. Major cooperative parties of enterprises were national universities and there were 12,361 projects in 2009 (Figure 6). The income from research expenditures increased from 15.2 billion yen in 2002 to 31.4 billion yen in 2009. The income for research expenditures at national universities was 25.5 billion yen (Figure 7).



Source: White Paper on Science and Technology 2012

Figure 6. Number of Cooperative Research Projects by Civil Enterprises and Universities



Source: White Paper on Science and Technology 2012

Figure 7. Income for Research Expenditures for Cooperative Research Projects by Universities and Enterprises

3.3. Development of Japanese startups

According to the entrepreneurship survey of GEM *(Global Entrepreneurial Monitor, 2012)*, the administrative procedure to establish a startup in Japan required eight procedural steps versus Canada that required only one-step to register a startup. As for the administrative time after the application (in regards of the development experiences of several major countries), Japan takes 22 days to complete the process versus seven days in Canada, six days in the US, and seven days in Korea. Japan is a country with substantially longer application days and administrative commitments.

In regards to becoming a startup entrepreneur, the GEM surveyed Japanese citizens 15-64 years old on their entrepreneurship attitudes. The results showed that the Japanese perceive the fewest opportunities for startups among citizens in all surveyed countries. The percentage of Japanese that believed that they have the ability to establish a startup is lower; in addition, they have the highest risk perception for startup failure. The Japanese show a lower willingness to bear the uncertainty of the startup compared to statistics from other countries. GEM also surveyed citizens not yet involved with entrepreneurial activities to investigate their entrepreneurial intent in the following three years. The Japanese result was 2.9% and the Total Entrepreneurial Activity Index (TEA Index) was 3.3%.

The Japanese government has engaged the issue with an expansion of the policy focus for small and medium enterprises (SMEs) that includes support for startup companies. The Organization for Small & Medium Enterprises and Regional Innovation JAPAN (SMRJ) supports a network

for startup companies. Financing business ventures is an important issue for Japan because the supply of risk money is minimal in Japan. A major reason is that Japanese national universities are not allowed by law to invest endowment money in risk assets that include VC funds; however, this regulation may be liberalized *(METI, 2012)*.

(continue)

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