

Chapter 4

The Emergence of Innovative Firms in Thailand*

Saowaruj Rattanakhomfu and Supasyn Itthiphattwong[†]

Abstract: The Thai government aims to transform Thailand to be a knowledge-based economy under the concept of “Thailand 4.0” within two decades under the 20-year National Strategy Plan. However, such plan will not be realized unless Thai firms become more innovative. This study aims at measuring the degree of firm innovativeness in Thailand and understanding their firm characteristics, based on the Orbis Intellectual Property patent data. We found that majority-foreign owned firms on average own more patents granted per firm than majority-Thai owned firms. The shares of patents owned by majority-foreign owned firms are also higher than those owned by majority-Thai owned firms. In addition, firm sizes are associated with the number of patents owned. We suggest that Thailand should increase its investment in public and private research and development (R&D), produce more R&D personnel, and more importantly, manage its R&D system more efficiently in order to achieve greater efficiencies.

Key Words: Innovation, Patent, Firm, Thailand

1. Introduction

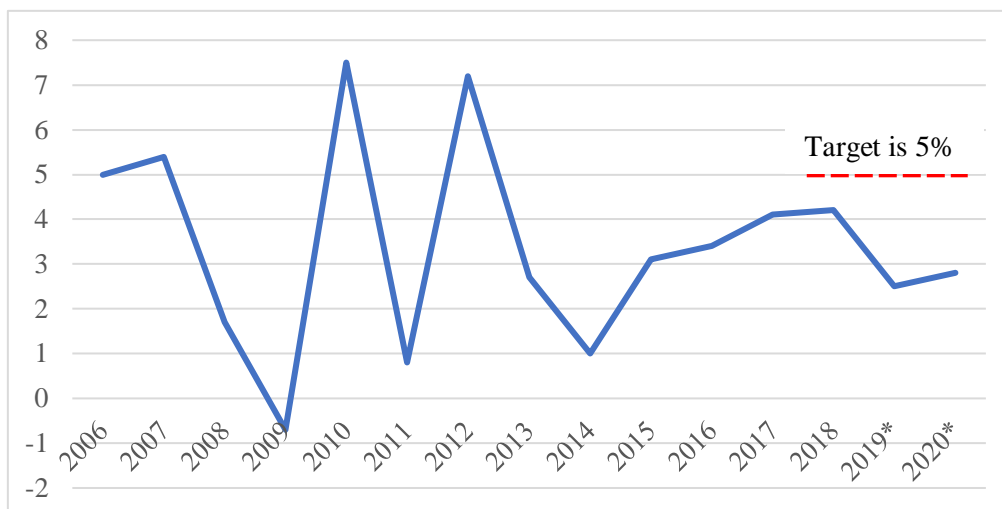
Thailand has long ago become a middle-income country. As a result, it is suspected that the country might be stuck in the so-called “middle-income trap.” The Thai government aims to transform Thailand to be a high-income and knowledge-based economy under the concept of “Thailand 4.0” within two decades under the 20-year National Strategy Plan (2018-2037). To achieve that target, Thailand must have an average GDP growth rate of 5 per cent per year, far higher than the average growth rate achieved in recent

* The authors would like to thank Dr. Somkiat Tangkitvanich for his valuable comments and suggestions and Mr. Warakorn Awutpanyakul for his excellent research assistance.

[†] Thailand Development Research Institute

years. According to the Bank of Thailand, Thailand’s growth rate is projected to be just 2.5 per cent in 2019 and 2.8 per cent in 2020 (Figure 1).¹

Figure 1: Thailand’s GDP Growth Rate, 2006-2020*



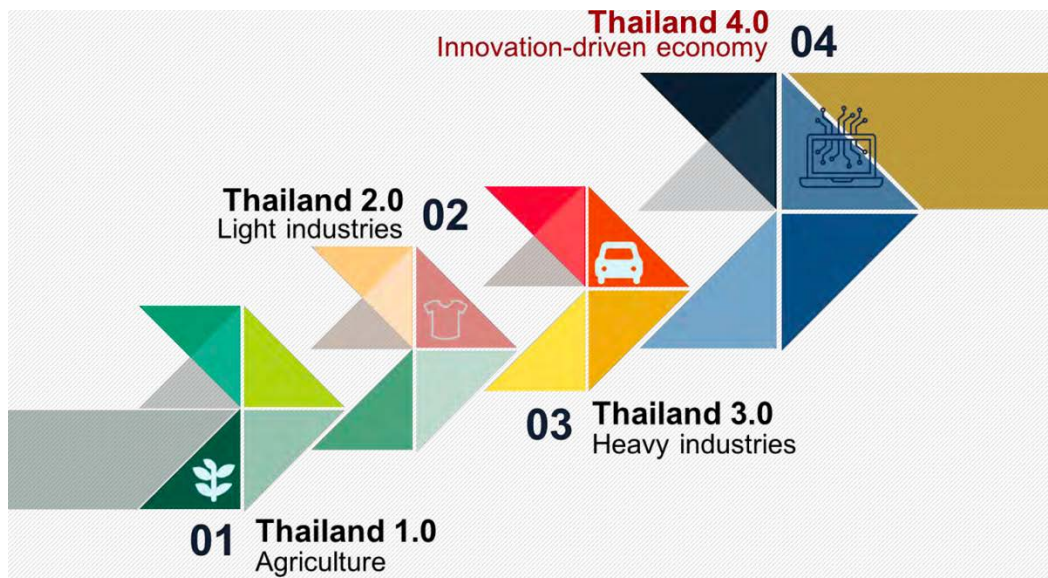
Note: * Forecast

Source: Bank of Thailand

To grow faster, the Thai economy must be knowledge-based and innovative. During the 1960s-1970s, Thailand’s development path shifted from “Thailand 1.0,” an agriculture-based economy to “Thailand 2.0,” a light industry-based economy that produced simple products such as footwear, garments and textiles. With huge investment in infrastructure and active promotion of foreign direct investment (FDI) since the 1980s, the country has been transformed to “Thailand 3.0,” a heavy industry-based economy that produced products such as petrochemicals, automotive products, and electronics. However, to become a developed country, Thailand needs to change structurally towards “Thailand 4.0,” an innovation-based economy (Figure 2). Needless to say, such vision cannot be realized unless the majority of Thai firms become more innovative.

¹ BOT Press Release on Monetary Policy Report, December 2019, accessed on https://www.bot.or.th/English/MonetaryPolicy/MonetPolicyCommittee/MPR/Monetary%20Policy%20Report/PressMPR_December2019_58di84.pdf

Figure 2: Thailand's Structural Change



Source: Board of Investment

2. Literature Review

The relationship between innovation, firm size and market structure has been studied for a long time, at least since 1942 by Joseph Schumpeter. In his book entitled “Capitalism, Socialism and Democracy,” Schumpeter argued that the primary sources of innovation are large firms in a highly concentrated market, such as oligopolistic industries. In contrast, small firms are hampered from innovation due to their high cost structure and the lack of market power.

“The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers’ goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates.”

“The opening up of new markets, foreign or domestic, and the organizational development from the craft shop and factory...that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism...”

“...the competition from the new commodity, the new technology, the new source of supply, the new type of organization...competition which commands a decisive cost or

quality advantage and which strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives.”

Innovation can be defined in many ways. Here we adopt the definition used in the Oslo Manual (OECD/Eurostat, 2005), which defines innovation as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practice, workplace organization or external relations.”

The Oslo Manual also defines four types of innovation: product innovation, process innovation, marketing innovation and organizational innovation. Product innovation is defined as the introduction of goods or services that are new or significantly improved with respect to their characteristics or intended uses. Process innovation is defined as the implementation of a new or significantly improved production or delivery method. Marketing innovation is defined as the implementation of a new marketing method involving significant changes in product design or packaging, product placement, and product promotion or pricing. Organizational innovation is defined as the implementation of a new organizational method in the firm’s business practices, workplace organization or external relations.

To measure innovation output, patents are commonly used as a proxy measure in empirical studies, such as by Pavitt (1985), Greliches (1990), Archilugi and Planta (1996), and Nagaoka, Motohashi and Goto (2010). This is because, in order to be protected by a patent, the related technology has to be new, useful, and not obvious to someone working in the related field.²

However, the use of patents as a proxy indicator for the innovativeness of firms has some major drawbacks. Firstly, patents are more appropriate for product innovation and process innovation than for marketing innovation and organizational innovation. Secondly, even for an applicable innovation, there are other types of intellectual properties (IPs), such as copyright, design rights, plant varieties, and trade secrets that might be more appropriate for protection. Thirdly, patents are often filed by firms in the manufacturing sectors. This is particularly true in the case of Thailand, as Thai patent law does not recognize some subject-matters, such as plant varieties, modified organisms, software and business models, as patentable inventions.

² https://www.wipo.int/ip-outreach/en/ipday/2017/innovation_and_intellectual_property.html

Nevertheless, we believe that patent data can capture some innovative activities of firms in Thailand owing to several reasons. Firstly, the manufacturing sector constitutes a large portion of the Thai GDP, and is perceived to be more innovative than the agricultural and service sectors. Secondly, patent data provides strong and clear evidence of output innovation which needs to satisfy the criteria specified in the Patent Law. As such, patent data is more objective than survey data, which depends on the survey's respondents, making it difficult to verify the accuracy of the data.

This study aims at measuring the degree of firm innovativeness in Thailand and understanding their firm characteristics, based on the Orbis Intellectual Property (Orbis IP) patent data. Previous empirical studies on the characteristics of innovative firms in Thailand usually use R&D and innovation survey data. For instance, Charoenporn (2005) examined the determinants of successful innovative firms in the Thai manufacturing sector by using Thailand's R&D and Innovation Survey conducted in 2000. Based on the sample of 310 firms³ in the manufacturing sector, he found that in terms of the contextual variables (such as firm age, firm size, exports, and foreign ownership share), innovative firms, defined as firms conducting R&D and/or innovation activities, are older than non-innovative firms. However, there is no evidence that innovative firms are larger, more export-intensive, or foreign capital-dependent, compared to non-innovative firms.

Recently, Suvanvihok (2015) tested the relationship between a firm's characteristics and the level of innovation, using Thailand's R&D and Innovation Survey from the manufacturing sector conducted in 2009.⁴ Based on the logistic regression results, he found that locally-owned firms are more likely to conduct innovation activities, compared to foreign firms. Firms with higher sales or that have more technological activities also tend to implement more innovation activities.

As discussed above, the accuracy of their analyses depends on the reliability of the survey data which is difficult to verify.

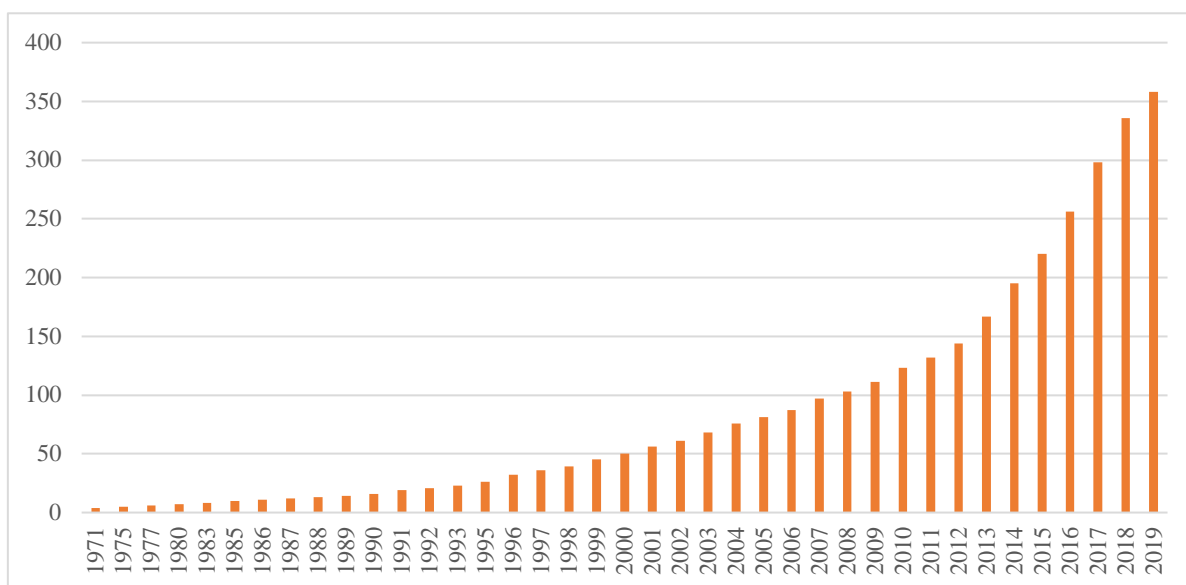
3. Stylized Facts of Innovative Firms in Thailand

³ The sample size included 310 firms conducting R&D and/or innovation activities. Classified by innovative activities, there are 164 innovative firms and 147 non-innovative firms. Classified by the firm's nationality, there are 164 domestically-owned firms and 146 foreign-owned firms.

⁴ There were 3,239 samples. Of the total sample size 707 firms conducted R&D or innovation activities in 2008.

Despite Thailand’s aim to escape the middle-income trap by promoting Thailand 4.0, an innovation-based economy, the number of innovative firms is still limited in Thailand. By using the number of patents granted as the proxy indicator of firms’ innovative activities, we found that the number of innovative firms increased from 50 in 2000 to 123 in 2010 and 358 in 2019, achieving the compound annual growth rate (CAGR) of 9.3 and 12.6 per cent during 2000-2009 and 2010-2019 respectively (Figure 3).

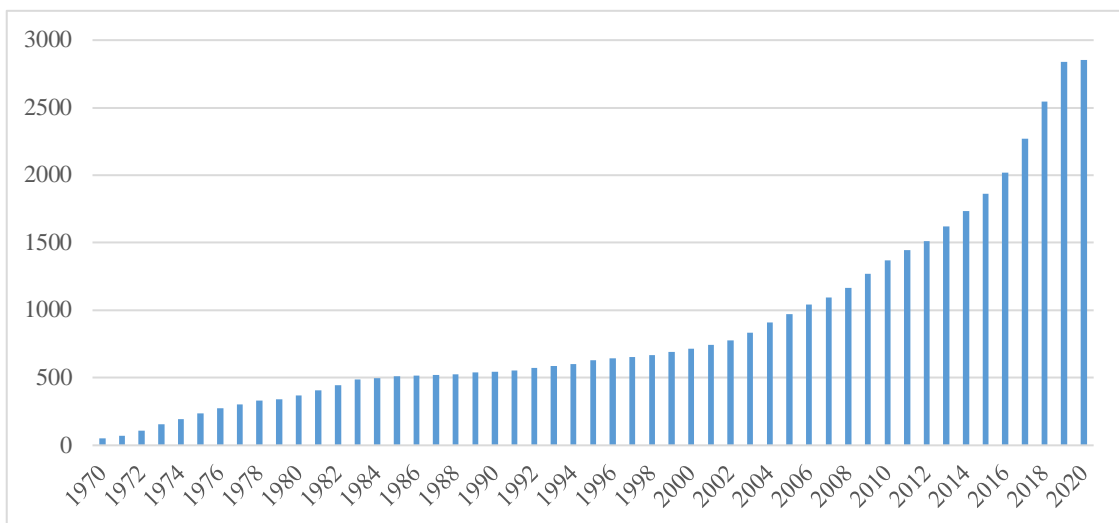
Figure 3: Cumulative Number of Innovative Firms in Thailand
(As of February 14, 2020)



Source: The Authors, calculated from the Orbis IP database

Among these innovative firms, the total number of patents granted was 2,854 patents in February 2020 (Figure 4). Over the past 30 years, the technological development in Thailand has improved, but at not a very fast pace. The number of patents granted was 543 in 1990, and this increased to 717 and 1,368 in 2000 and 2010, respectively. The CAGRs are 2.7, 6.6, and 7.6 per cent during the 1990-1999, 2000-2010 and 2011-2020 periods, respectively.

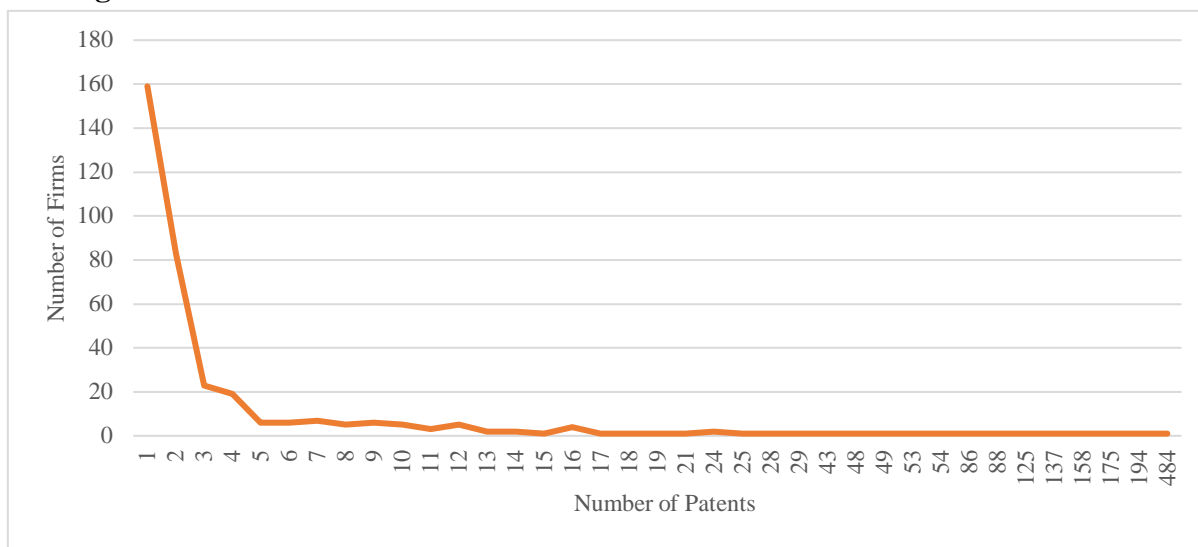
**Figure 4: Cumulative Number of Patents Granted in Thailand
(As of February 14, 2020)**



Source: The Authors, calculated from the Orbis IP database

Moreover, a large number of the patents granted are concentrated in a small number of firms. Most innovative firms still own very few patents. Figure 5 shows that the patent distribution is positive-skewed. In particular, there are very few firms owning a high number of patents. The mean of the patents granted is 8, and the median is 2.

Figure 5: Distribution of Patents Granted to Innovative Firms in Thailand



Source: The Authors, calculated from the Orbis IP database

4. Characteristics of Innovative Firms in Thailand

4.1. Nationality of Innovative Firms

It is interesting that more than half of the innovative firms (54.5 per cent) are fully-Thai owned, contributing 31.5 per cent of the total number of patents granted, while 12.6 per cent of innovative firms are fully-foreign owned, accounting for 21.6 per cent of the total number of patents granted during 1920-2020 (Table 1).

Considering the number of patents granted per firm, majority-foreign owned firms own a number of patents per firm higher than majority-Thai owned firms. For instance, fully-foreign firms own 14 patents per firm, whereas fully-Thai firms own approximately 5 patents per firm. Furthermore, the shares of the patents owned by majority-foreign owned firms (53.8 per cent) are higher than those owned by majority-Thai owned firms (46.2 per cent).

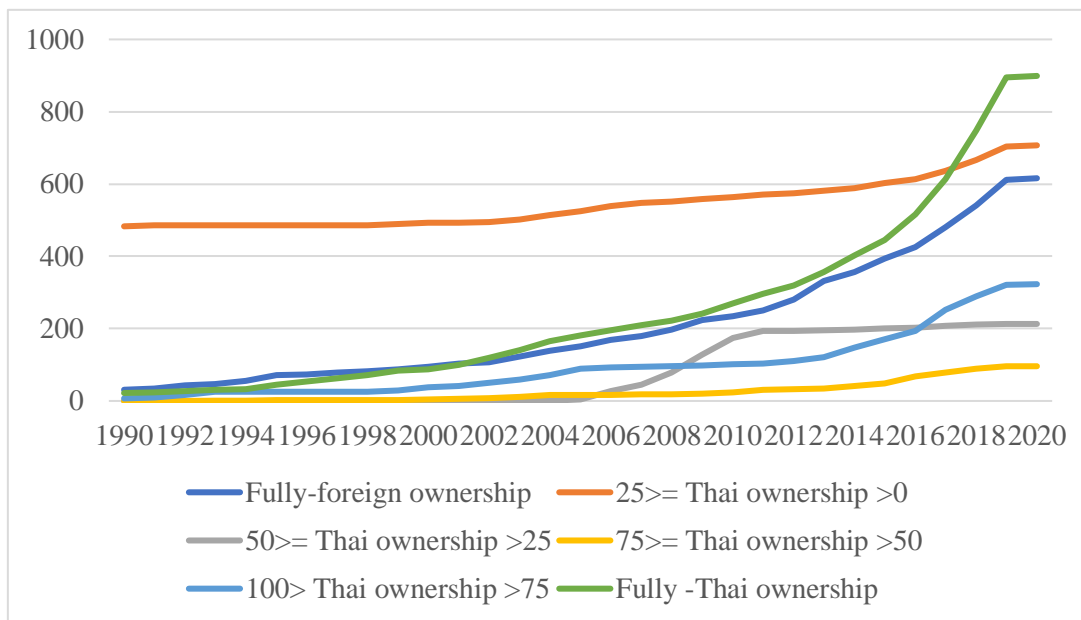
Table 1: Innovative Firms Classified by Shared Ownership (1920-2020)
(As of February 14, 2020)

Thai-shared ownership (per cent)	Innovative firms		Patents granted		Number of patents per firm
	Number of innovative firms	Share (per cent)	Number of patents granted	Share (per cent)	
0	45	12.6	616	21.6	13.7
25 \geq x > 0	25	7.0	707	24.8	28.3
50 \geq x > 25	7	2.0	213	7.5	30.4
75 \geq x > 50	52	14.5	96	3.4	1.8
100 > x > 75	34	9.5	323	11.3	9.5
100	195	54.5	899	31.5	4.6
Total	358	100.0	2,854	100.0	8.0

Source: The Authors, calculated from the Orbis IP database, Orbis Asia-Pacific database and the Department of Business Development database

In the past, most innovative firms were foreign-owned firms. However, since the early 2000s, Thai firms have started to invest more on R&D activities and owned more patents granted. Figure 6 shows that the number of patents held by fully-Thai owned firms surpassed those owned by fully-foreign owned firms in 2002. During 2010-2019, the CAGR of the patents owned by fully-Thai owned firms is 11 per cent.

**Figure 6: Number of Patents Granted Classified by Firm Nationality
(As of February 14, 2020)**



Source: The Authors, calculated from the Orbis IP, Orbis Asia-Pacific and the Department of Business Development databases

4.2. Size of Innovative Firms

Firm sizes are associated with the number of patents owned. Particularly, very large and large firms own 74 per cent of the total number of patents granted, while medium-sized and small firms hold 26 per cent of the total number of patents granted during 1920-2020 (Table 2). Consistently, on average, very large firms own 24.2 patents granted per firm, but small firms own only 2.9 patents granted per firm.

Table 2: Innovative Firms Classified by Size (1920-2020)
(As of February 14, 2020)

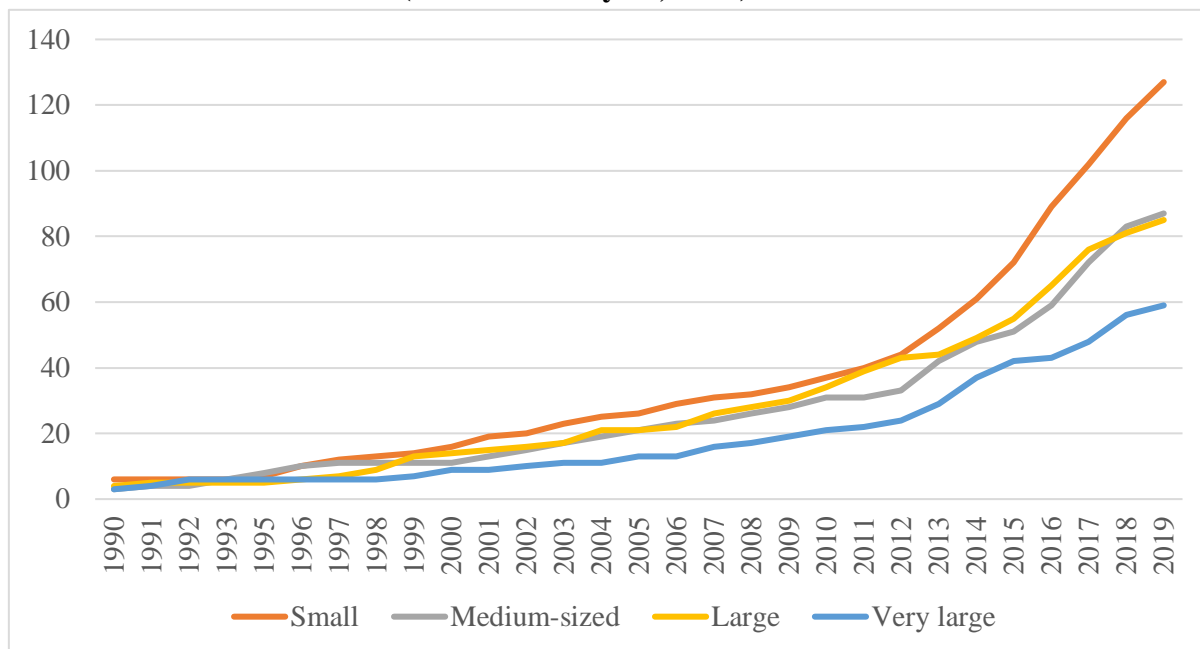
Size	Firms		Patents granted		Number of patents granted per firm
	Total	Share (per cent)	Total	Share (per cent)	
Small	127	35.5	369	12.9	2.9
Medium sized	87	24.3	371	13.0	4.3
Large	85	23.7	686	24.0	8.1
Very large	59	16.5	1,428	50.0	24.2
Total	358	100.0	2,854	100.0	8.0

Note: Followed size classification by Orbis Asia Pacific, very large companies match at least one of the following conditions: operating revenue \geq 100 million EUR (130 million USD), total assets \geq 200 million EUR (260 million USD), employees \geq 1,000, and listed. Large companies match at least one of the following conditions: operating revenue \geq 10 million EUR (13 million USD), total assets \geq 20 million EUR (26 million USD), employees \geq 150, and not very large. Medium-sized companies match at least one of the following conditions: operating revenue \geq 1 million EUR (1.3 million USD), total assets \geq 2 million EUR (2.6 million USD), employees \geq 15, and not very large or large. Small companies are not included in any category above.

Source: The Authors, calculated from the Orbis IP and Orbis Asia-Pacific databases

Since the last decade, firms of any size have become more innovative (Figure 7). Particularly, the number of small firms holding the patents granted has increased significantly, accounting for a CAGR of 14.7 per cent during 2010-2019.

**Figure 7: Number of Patents Granted Classified by Firm Size
(As of February 14, 2020)**



Source: The Authors, calculated from the Orbis IP and Orbis Asia-Pacific databases

5. Conclusion and Policy Implications

Based on the Orbis Intellectual Property patent data, we found that majority-foreign owned firms on average own more patents granted per firm than majority-Thai owned firms. The shares of patents owned by majority-foreign owned firms are also higher than those owned by majority-Thai owned firms. In addition, firm sizes are associated with the number of patents owned.

For Thailand to become a high-income knowledge-based economy, firms in Thailand must invest significantly more in creating innovation through R&D. However, private firms will tend to underinvest in R&D activities as they would not be able to capture all the benefits from their R&D outputs, even with a secure intellectual property protection regime. As a result, public subsidy to support private R&D is needed. The subsidy can be in the form of tax breaks to encourage private R&D investment, providing complementary public R&D, and providing qualified R&D personnel.

The Thai government has granted tax incentives for many years in order to encourage private R&D investment. Previously, it allowed a 200 per cent tax deduction

for private R&D investment expenditure. The rate was adjusted to 300 per cent after the corporate income tax rate was reduced from 30 per cent to 20 per cent in 2015, in order to keep the government's subsidy constant at 60 per cent. However, R&D tax incentives appear to have a limited effect in promoting private R&D investment, especially among small-and-medium sized enterprises (SMEs) that have little before-tax profit. As a result, we will focus on the two potentially more effective policies.

5.1. Providing complementary public R&D

The government should invest more in R&D to complement private efforts. However, simply increasing public R&D investment will not guarantee greater innovation capability. Thailand must also invest wisely by allocating its limited public funds more efficiently and using them to encourage private investment with the aim of creating a more demand-driven system. To achieve this, the country will need to take the following actions.

- Allocate most of the R&D budget through research-granting agencies that have a good management record, rather than through agencies run by the line ministries that do not have research management capabilities. The aim is to increase the efficiency of public investment in R&D.
- Direct granting agencies to allocate funding for applied R&D on the basis of matching funds invested by the private sector. For example, one baht of public money can be matched with one baht funding by the private sector. The aim is to make universities and research institutes more responsive to the needs of the private sector, and encourage the private sector to invest more in R&D activities.

In addition, without an appropriate accountability mechanism, publicly funded research would not generate sufficient economic return. We suggest that the government holds publicly funded research accountability by setting clear targets:

- Set clear targets for research-granting agencies commensurate with the size of their funding. These agencies should be regularly evaluated by independent assessors to measure their impact based on cost and benefit analyses. The results should be reported to Cabinet, Parliament, and the public.

- Set clear targets for government research institutes that receive direct funding from the government commensurate with the size of their funding. They should also be evaluated similarly to the research-granting agencies mentioned above.

We also suggest that the government creates a specialized government research institute with the sole mission of conducting R&D for commercialization. The institute can be modeled after the Industrial Technology Research Institute (ITRI) of Taiwan, A*Star of Singapore, the Fraunhofer Society of Germany, or other institutions with a solid record of achievement. To ensure that the institute responds to market demands, its board of directors should be composed mainly of representatives from the private sector. In addition, it should be financed by matching the funds received from the public and private sectors in the manner mentioned above.

5.2. Providing qualified R&D personnel

A shortage of R&D human resources is a major bottleneck inhibiting the private sector from undertaking more R&D and innovation activities. To solve this problem, we suggest that the government improves its R&D human resources policies by:

- Reforming the current government scholarship system to be more demand driven by allowing private companies to contribute to scholarships in exchange for the right to hire scholarship recipients after graduation;
- Allowing and encouraging R&D professionals in public universities and government research institutes to work in the private sector by expanding the current “Talent Mobility” program; and
- Allowing foreign R&D personnel and highly skilled professionals to work in Thailand by abolishing the foreign national employment quotas and expediting the relevant immigration procedures.

References

- Archibugi, D., and Planta, M. (1996) “Measuring technological change through patents and innovation surveys,” *Technovation* 16(9): pp 451–519.
- Griliches, Z. (1990) “Patent statistics as economic indicators: A survey,” *Journal of Economic Literature* 28: pp. 161–1707.
- Nagaoka, S., Motohashi, K., and Goto, A. (2010) “Patent Statistics as an Innovation Indicator”. In B. Hall and N. Rosenberg (Ed), *Handbook of the Economics of Innovation*. Oxford, United Kingdom: North-Holland. doi:10.1016/s0169-7218(10)02009-5
- Charoenporn, P. (2005) “On the Determinants of Successful Innovative Firms in Thai Manufacturing Sector,” *Journal of International Development and Cooperation* 12(1): pp. 15–34.
- Plehn-Dujowich, J. M. (2009) “Firm size and types of innovation,” *Economics of Innovation and New Technology* 18(3): pp. 205–223.
- Schumpeter, Joseph A. (1942) *Capitalism, Socialism, and Democracy*. London, United Kindom: Routledge.
- Suvanvihok, V. (2015) “Technological Investment of Thai Industries and Government Supports,” *NIDA Economic Review* 9(1): pp. 72-98.