CHAPTER 4

Innovation Policy in Indonesia

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4.1 | Introduction

Schumpeter (1947) defined innovation as simply the doing of new things or the doing of things that are already being done in a new way. To put it more concretely, innovation can take the form of improvements or upgrades in products, processes, technology, methods of production, management, organisational arrangements, or the extent of markets being served. The important role of innovation in achieving better economic performance is well-documented in the economic literature. Among other things, innovation is critical for developing countries, such as Indonesia, to avoid the middle-income trap and achieve much-needed industrial, productivity, and technological upgrading. Attaining sustainable, competitive, and solid economic growth requires accumulating not only more labour and capital but also new technology and innovation – the 'inspiration' as opposed to 'perspiration' approach to development. Hence, the important role of innovation cannot be overstated.

To better understand the Indonesian context for innovation, we first need to provide a brief historical account. Since the 1960s, Indonesia's economy has undergone a significant transition from being dominated by agriculture (before 1970), to relying on oil revenues and import-substitution industries (from 1970 to the mid-1980s), to being led by labour-intensive and export-oriented industries (from the late 1980s), before moving gradually towards a services-led and knowledge-based economy. Foreign direct investment (FDI) was open at the end of 1960s, and then relatively closed during 1970s, before being opened up again during the massive trade and investment reforms of the 1980s. The reforms triggered a significant amount of technology diffusion from foreign firms that started to enter the country.

Evidence has shown that FDI played an important role in increasing productivity in Indonesia, and hence, economic performance, particularly during the boom from the mid-1980s to the early 1990s.

However, Indonesia's economic growth has been driven primarily by natural resources and trade rather than by science and innovation. In other words, Indonesia's growth owes more to the accumulation of labour and capital than to increases in productivity. This is demonstrated by the declining rate of total factor productivity growth since the 1990s to a level far below that of its regional peers. At the same time, constantly rising labour costs have further eroded competitiveness.

Innovation contributes inadequately to Indonesia's economic growth, and the country's innovation performance lags that of its regional peers. Only since the mid–2000s has the government started to give greater emphasis to innovation in the formulation of economic policies, and this is expected to continue in the future. Various development planning documents explicitly and indirectly mention efforts to improve innovation and the target of becoming a more competitive, technology-driven, and knowledge-based economy.[1]

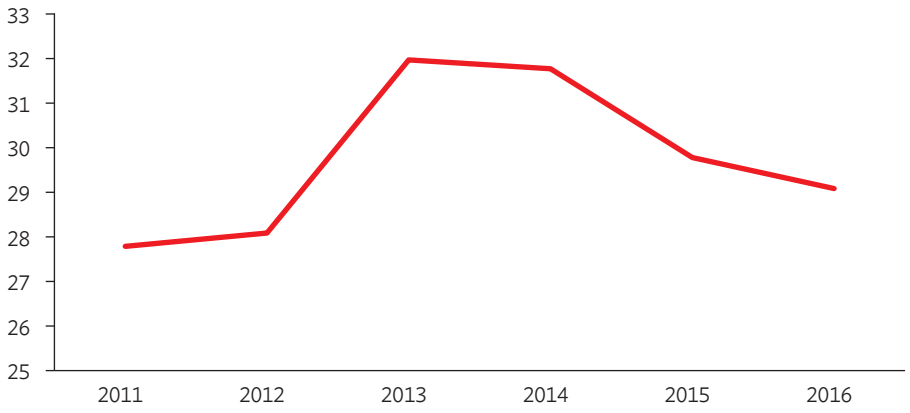
Section 4.2 discusses the indicators of innovation in Indonesia. Section 4.3 describes the institutional governance of innovation, innovation policies implemented in the past and lessons from them, and lessons from cases of innovation policies in past or ongoing projects. Section 4.4 explores considerations for the future national innovation system. Finally, Section 4.5 concludes and provides a summary of suggestions for future innovation policymaking.

4.2 | Current Situation and Indicators of Innovation in Indonesia

Several indicators testify to the poor performance and limited availability of innovation in the Indonesian economy relative to most of its regional peers. For example, Indonesia was ranked 88th out of 128 countries in the Global Innovation Index 2016, and sixth out of 10 countries in Southeast Asia. Its score (100 represents the maximum score) declined consistently from 32 in 2013 to 29 in 2016 (Figure 4.1).

[1] These include the National Long-Term Development Plan, the National Medium-Term Development Plan, the Masterplan for Acceleration and Expansion of Indonesia's Economic Development, and the Masterplan for National Industrial Development.

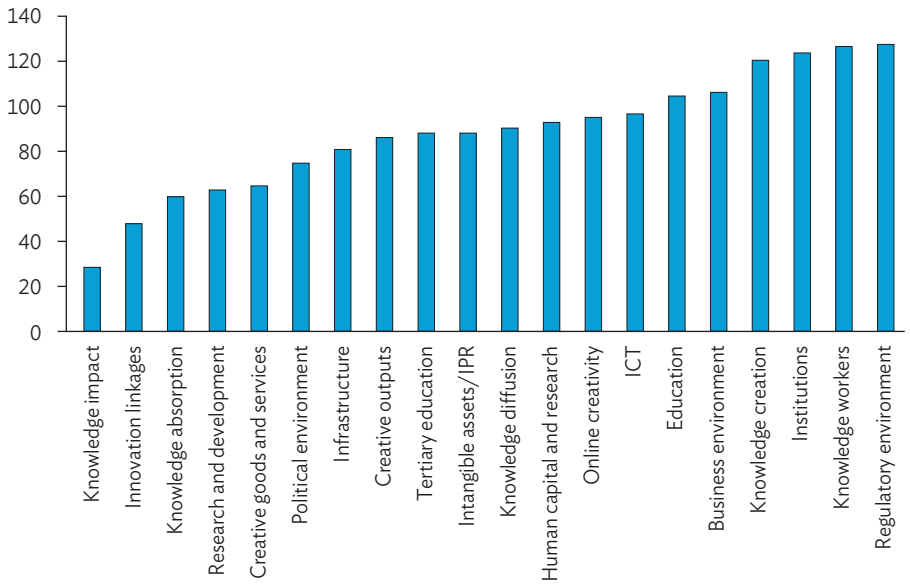
Figure 4.1: Total Global Innovation Index Score for Indonesia, 2011–2016



Source: Global Innovation Index by Cornell University, INSEAD, and WIPO.

Further breakdown shows that institutional and regulatory bottlenecks and a lack of knowledge workers are major factors restricting innovation in Indonesia (Figure 4.2).

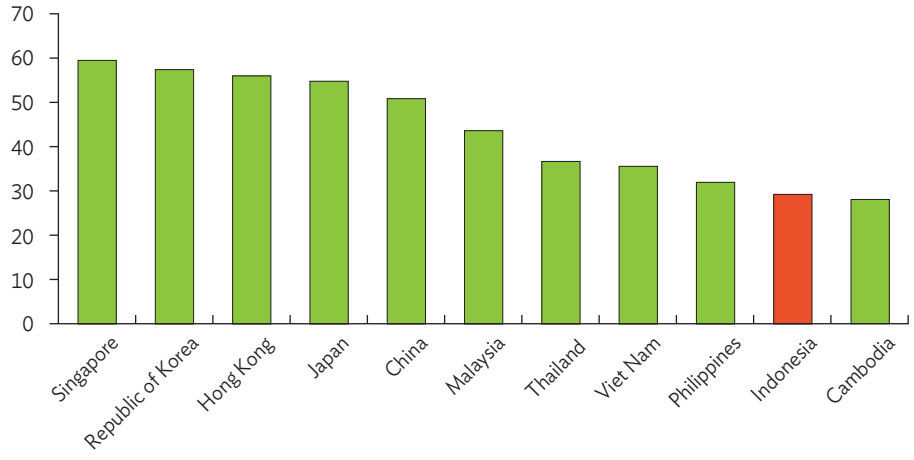
Figure 4.2: Global Innovation Index for Indonesia: Ranking of Selected Innovation Enablers (lower is better)



ICT = information and communication technology, IPR = intellectual property rights.

Source: Global Innovation Index by Cornell University, INSEAD, and WIPO.

Figure 4.3: Global Innovation Index 2016 Score for Selected Asian Countries (higher is better)



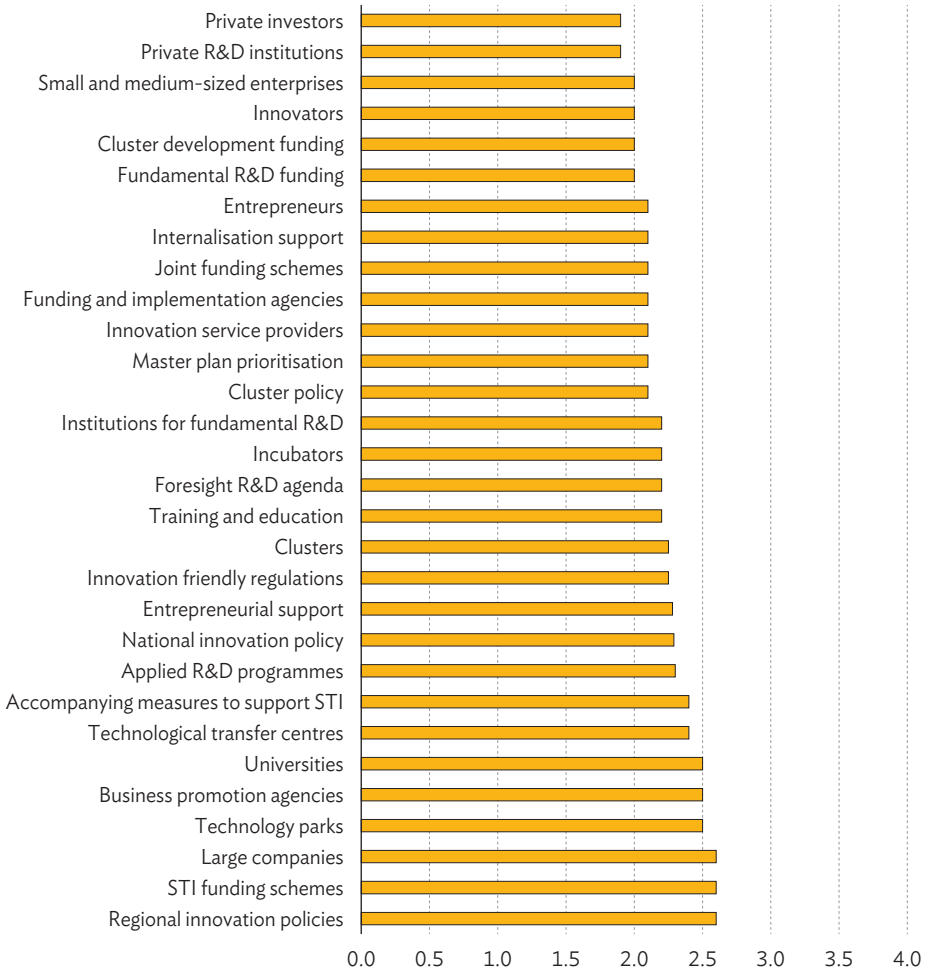
Source: Global Innovation Index by Cornell University, INSEAD, and WIPO.

A collaborative study by the Institute for Innovation and Technology and the Federal Ministry of Education and Research (2012) provides another interesting and detailed analysis, which is summarised in the Innovation Maturity Index (Figure 4.4). In general, Indonesia scored on par with the average of the lower middle-income, transition economies in various innovation indicators at the macro, meso, and micro levels. The subcategories of the index reveal that Indonesia was particularly weak in the area of private sector involvement in research and development (R&D) activities.

At the firm level, the lack of a significant shift toward high-tech industries involved in both exports and imports is shown in Figures 4.5 and 4.6. There has even been a shift away from high-tech exports in recent years. This might indicate, among other things, a lack of noticeable improvement in Indonesian firms' technological capability since 2000.

Indonesia's weak innovation performance corresponds with its extremely limited spending on R&D activities at both the macro and micro levels. Government spending on R&D barely reached 0.1% of gross domestic product in 2013 – far below the middle-income country average of 1.0% (Figure 4.7).

Figure 4.4: Innovation Maturity Index for Indonesia (higher is better)

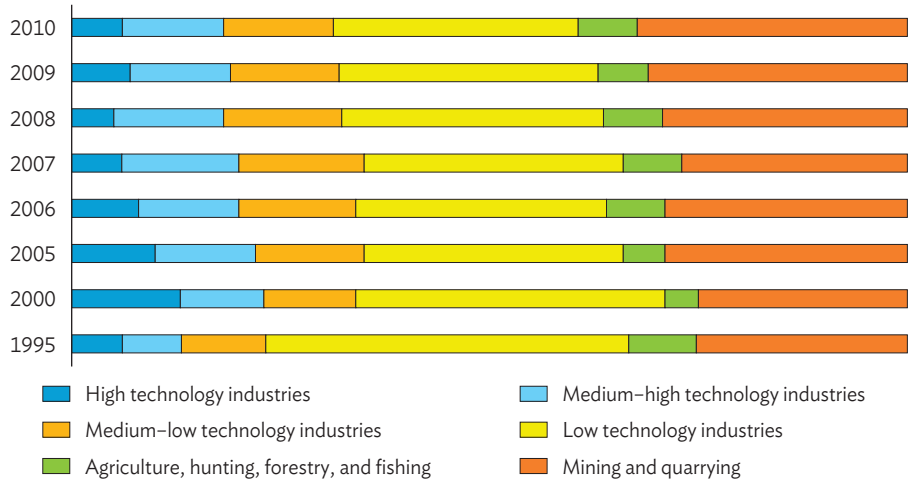


R&D = research and development; STI = science, technology, and innovation.

Source: Institute for Innovation and Technology and the Federal Ministry of Education and Research (2012).

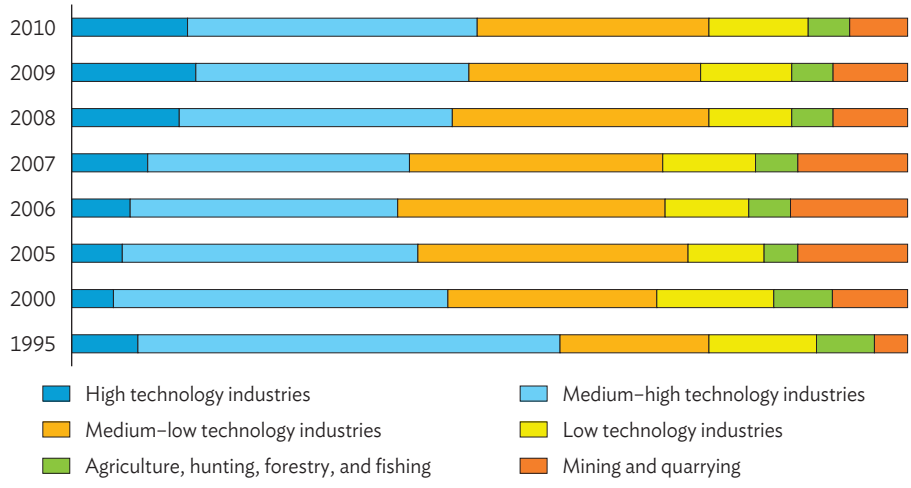
As shown by Aminullah (2015), R&D expenditure in Indonesia has predominantly been government-centric, with government agencies and public universities accounting for 80%. On the other hand, very little private R&D activity has been undertaken in the manufacturing sector, except in large companies, as most firms have a low level of innovation conscientiousness (Hill and Tandon, 2010). Besides, almost no prominent multinational enterprises (MNEs) are willing to set up R&D facilities in Indonesia; instead they favour more developed countries in the region, such as Singapore, Malaysia, Thailand, and Viet Nam.

Figure 4.5: Indonesia's Manufacturing Exports by Technology Intensity, 1995–2010



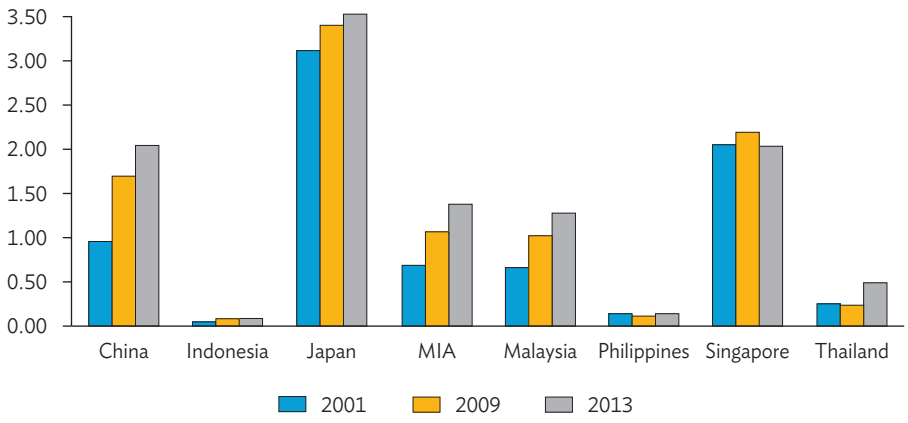
Source: OECD (2013, p. 155).

Figure 4.6: Indonesia's Manufacturing Imports by Technology Intensity, 1995–2010



Source: OECD (2013, p. 156).

Figure 4.7: Research and Development Expenditure for Selected Countries, 2001–2013 (% of gross domestic product)



MIA = middle-income average.

Source: World Bank, World Development Indicators.

Furthermore, Indonesia has also suffered from the poor performance in one of the most critical enablers of innovation in general, and diffusion in particular: intellectual property rights (IPR) protection. Table 4.1 shows that Indonesia's score generally lagged those of some of the more developed countries in the Asia–Pacific region and did not improve significantly during 2010–2015. Breaking this down further, patent protection and copyright protection remain the weakest factors in IPR protection (Table 4.1). Another problem is also displayed by the low score in the enforcement subsection. The lack of proper enforcement or sanctions for IPR violations is evident, particularly in piracy cases, which further discourages innovation and diffusion activities. IPR utilisation has increased in recent years (Table 4.2), although it is still dominated by non-residents (Figure 4.8).

The final story here is Indonesia's weak absorptive capacity for innovation, as evident by the poor performances in education and academic outputs and the lack of availability of knowledge and skilled workers. Figures 4.9 and 4.10 show that despite increases in recent years, Indonesia's academic outputs are still worryingly low compared with its peers, indicating limited innovation. Consistently, poor performance in the Programme for International Student Assessment (PISA), as indicated by the mean science scores, in which Indonesia ranked 62nd out of 72 countries in 2015, shows the limited base of human capital to produce and absorb knowledge. Tertiary education, an important driver of innovation and research, is financially limited (Figure 4.11).

Table 4.1: Intellectual Property Index for Selected Countries, 2010–2015

Country	2010	2011	2012	2013	2014	2015
New Zealand	8.3	8.2	8.2	8.4	8.3	8.2
Singapore	8.2	8.3	8.1	8.1	8.2	8.1
Japan	7.6	7.6	7.7	7.7	7.8	8.0
Canada	8.0	8.0	8.0	8.0	8.0	7.9
Australia	8.2	8.0	7.8	7.9	7.8	7.7
United States	7.9	7.5	7.5	7.6	7.7	7.6
Chile	6.4	6.7	6.7	6.8	6.8	6.6
Malaysia	6.1	6.1	6.5	6.5	6.5	6.6
Indonesia	4.1	5.0	4.8	4.9	5.0	4.9
Mexico	4.7	5.0	5.1	5.2	5.2	4.7
Peru	4.3	4.9	5.0	5.0	5.0	4.6
Viet Nam	4.5	4.9	4.7	4.7	4.8	4.5

Item	Indonesia	Malaysia	Singapore	Thailand	Viet Nam
Rank	28	12	5	31	30
Total score	8.61	14.62	25.38	7.10	7.84
Patent-related rights and limitations	1.50	2.75	6.50	1.50	1.75
Copyright-related rights and limitations	1.77	3.78	5.24	1.53	1.03
Trademark-related rights and limitations	2.75	3.25	4.00	2.75	3.25
Enforcement	1.34	2.43	4.64	1.07	1.31
Membership and ratification of international treaties	1	1	3	0	0

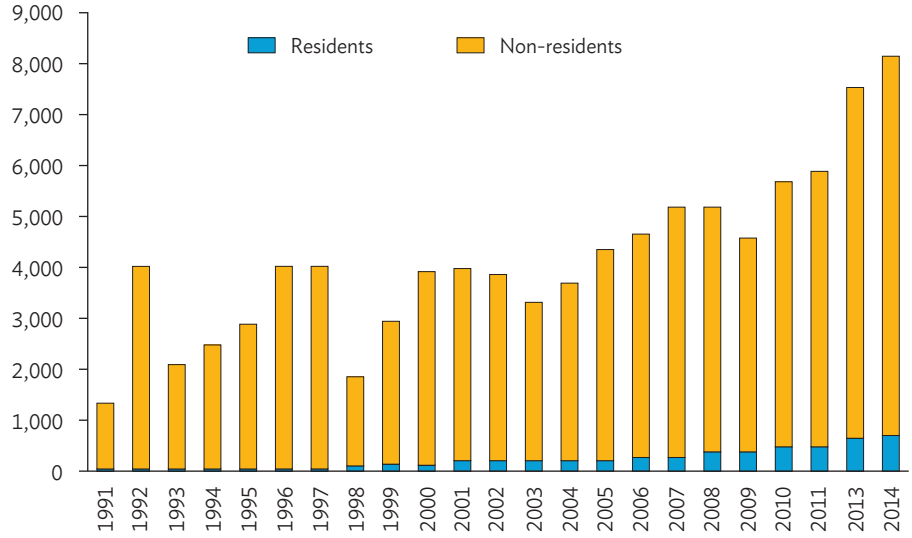
Source: 2015 Global Intellectual Property Center Index.

Table 4.2: Number of Intellectual Property Rights Registrations in Indonesia, 2010–2015

Year	Patent	Copyright	Trademark	Industrial Design	Total
2010	5,821	4,882	47,794	4,047	**62,544**
2011	6,123	5,541	53,196	4,196	**69,056**
2012	7,027	6,382	62,445	4,612	**80,466**
2013	7,800	6,190	62,813	4,258	**81,061**
2014	8,348	5,142	60,894	3,376	**77,760**
2015	8,874	5,467	61,787	2,770	**78,898**

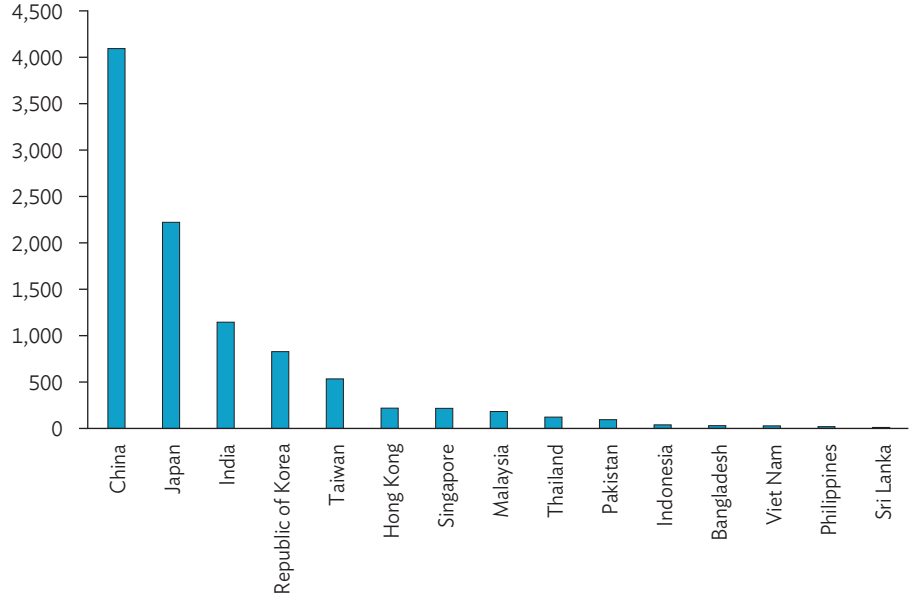
Source: Directorate General of IPR, Ministry of Law and Human Rights.

Figure 4.8: Number of Patent Applicants in Indonesia, 1991–2014



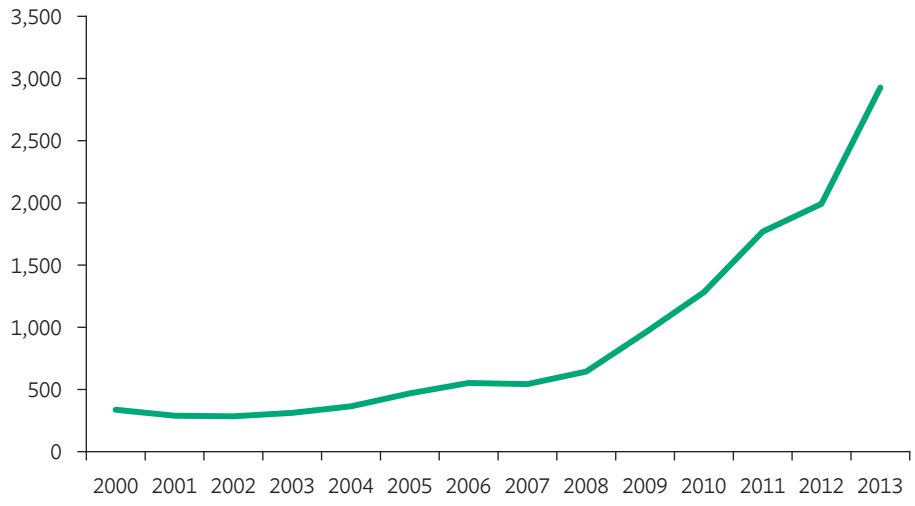
Source: World Bank.

Figure 4.9: Number of Scientific Publications in Selected Countries, 1996–2015 ('000)



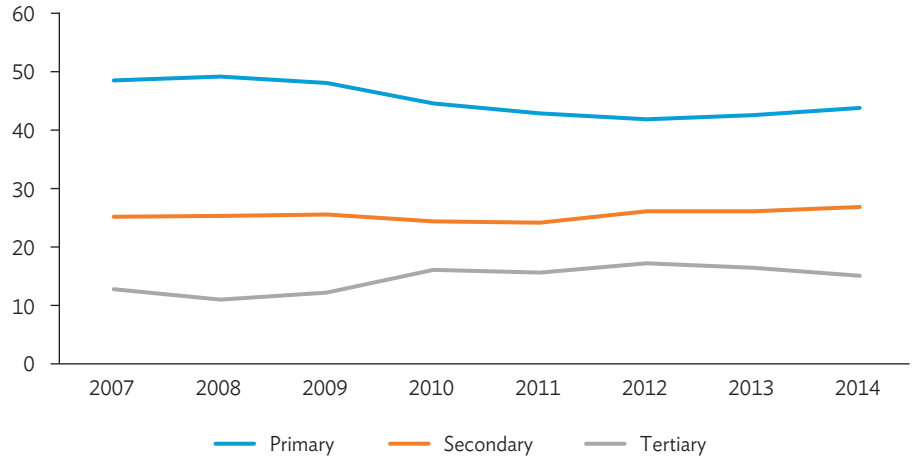
Source: SCImago Journal Rank.

Figure 4.10: Number of Scientific and Technical Journal Articles from Indonesia, 2000–2013



Source: World Bank.

Figure 4.11: Government Spending on Education by Category
(% of total education spending)



Source: World Bank.

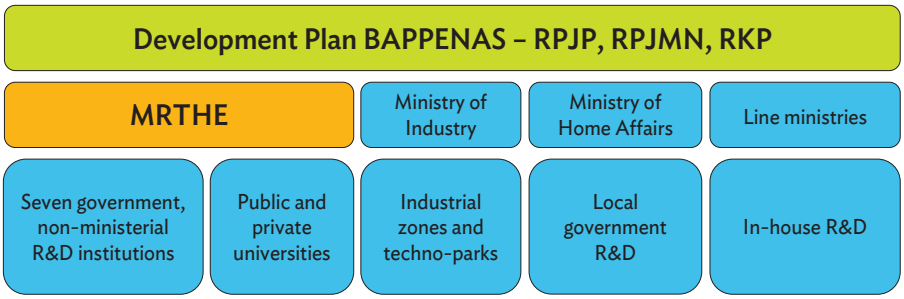
4.3 | Lessons from Past Innovation Policies in Indonesia

Indonesia is still in the relatively early stages of adopting a formal and fully integrated national innovation system. It also lacks a single-referenced, integrated, grand strategy underpinning all the innovation-related policies in the country, as policy action plans to promote more innovation in the economy are scattered across the different documents of various government agencies. Currently, there is no single high-level body with the responsibility to oversee and coordinate the various innovation policies and undertakings happening across the ministries. In 2010, the National Innovation Committee was set up to assume this function. Not long after its establishment, the committee submitted a proposal providing suggestions for the future national innovation system in Indonesia. However, the committee was dissolved amid efforts by the newly elected president to streamline bureaucracy, setting back efforts to harmonise innovation policies at the national level. The closest thing that Indonesia has to a coordinating institution for innovation is the Directorate General for Innovation Strengthening, under the supervision of the Ministry of Research, Technology and Higher Education. However, given the committee's position in the state hierarchical system, it lacks the necessary political authority to conduct inter-ministerial coordination.

There are plans to introduce a more formal and comprehensive innovation system. The development of the Sistem Inovasi Nasional (SINAS) (National Innovation System), based on the mandate from the Medium-term Development Plan, 2015–2019, is seen as the primary means for improving Indonesia's innovation capacity and science and technology (S&T) performance. In early 2017, SINAS was still in the development phase through various ministerial meetings. In the current absence of a formal innovation system, innovation governance in Indonesia can be understood by mapping the existing 'triple-helix' innovation actors – government, university, and industry – and the interactions among them.

In Indonesia, one of the primary roles of government related to innovation is formulating S&T development policy. This function has been assumed by the Ministry of Research and Technology and Higher Education (MRTHE). The government not only facilitates and creates a supportive environment for innovation but also actively drives, conducts, and, in some cases, even leads R&D activities. The government also decides on the priority sectors for R&D.

Figure 4.12: Institutional Setting for Research and Development in Indonesia



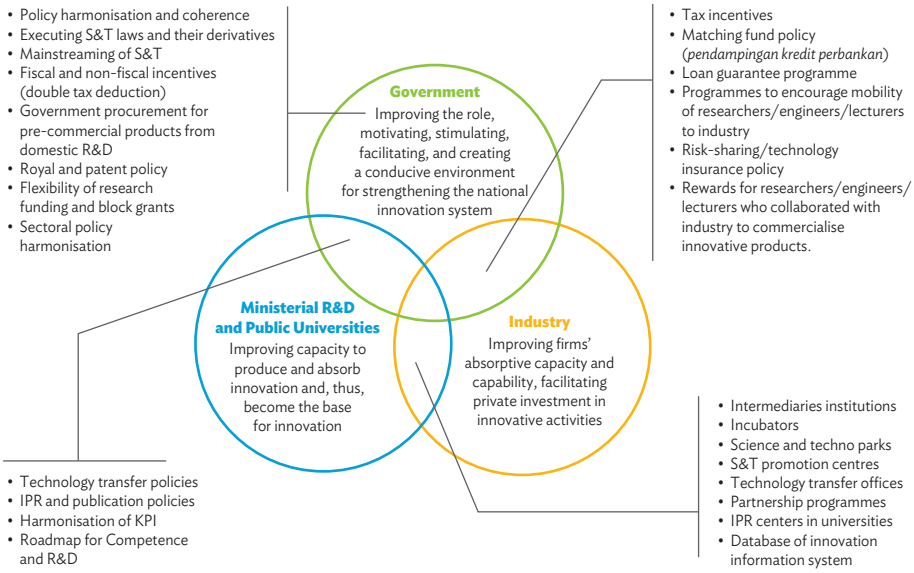
BAPPENAS = Ministry of National Development Planning, MRTHE = Ministry of Research, Technology, and Higher Education, R&D = research and development, RKP = Government Work Plan (1-year period), RPJMN = National Medium Term Development Plan (5-year period), RPJP = National Long Term Development Plan (25-year period).

Source: Authors' compilation.

Several public institutions conduct R&D activities with different scopes and intensities (Figure 4.12). The MRTHE is responsible for spearheading public R&D enterprises and has the authority to oversee seven non-ministerial government R&D institutions, including the Indonesian Institute of Sciences, a government think tank focusing on science development and basic research; the Agency for the Assessment and Application of Technology, which focuses on technology application and diffusion; and more than 30 applied research institutions. Public universities' R&D activities, which take up a significant portion of public R&D spending, are coordinated by the Directorate General of Higher Education, which was recently merged to the MRTHE. Every year, the central government allocates and distributes funds for R&D to ministries, non-ministerial government institutions, and public universities by direct and usually non-competitive funding, such as research grants. Other R&D capacities, albeit relatively limited, exist in local governments and technical ministries.

In the past, innovation policies related to the diffusion of knowledge were almost non-existent in Indonesia, except indirectly through FDI-facilitating reforms in the mid-1980s, which brought in knowledge diffusion from FDI firms. It was only in the mid-1990s that the government began to launch formal innovation policies that were specifically intended to facilitate technological diffusion. Through these policies, the government attempted to create and strengthen collaboration with universities and firms, as shown in Figure 4.13.

Figure 4.13: Basic Framework for the Design of Indonesia's National Innovation System



IPR = intellectual property rights, KPI = key performance indicator, R&D = research and development, S&T = science and technology.

Source: Adapted from the Ministry of Research and Technology (2016).

The initiatives to stimulate R&D and technological diffusion usually fall into the following three categories:

i. **Funding and incentives for research and development.** This is the earliest type of innovation policy in Indonesia. It consists of various measures to facilitate more R&D in both universities and firms, and includes direct, non-competitive R&D funding to public universities; competitive research grants; tax credits; tax deductions for R&D; a technology insurance scheme; the establishment of government R&D institutions (*balitbang*); R&D subsidies for firms; and R&D partnerships between the government, universities, and industry.

ii. **Platforms to trigger, facilitate, and diffuse innovation.** Some platforms were established long ago, but most have been set up in the last 5–10 years. Undertakings such as the Business Innovation Center, technology transfer offices, the Techno Park, science parks, industrial clusters (*kawasan industri*), special economic zones, entrepreneurship centres and incubators, testing and certification centres, and various ad hoc collaborations with foreign companies to set up innovation or training centres fall into this classification.

iii. **Building capacity and improving absorptive capacity.** This includes most of the government's in-house training programmes, exchange programmes for local engineers under government-to-government arrangements, (e.g. with the Government of Germany), research training in and by public universities, scholarship programmes for Indonesian students to study abroad, and general education and S&T development policies.

The innovation initiatives or programmes undertaken by the government vary in their degree of effectiveness in promoting knowledge diffusion. Nevertheless, there are three general patterns from which lessons can be drawn.

First, most of the initiatives are top-down, yet lack coordination. Most have been too reliant on the initiatives and resources of the public sector, particularly central government. This corresponds with the fact that most of the R&D budget and activities have been allocated to and performed by public institutions, such as universities or technical ministries. The development of innovation and S&T infrastructure has been carried out almost exclusively with public funding.

Despite being highly government-centric, many such initiatives are poorly coordinated. This is not surprising, given the absence of a formal and integrated national innovation system and grand strategy until very recently. Most of the innovation platforms offered by the government in the past were sporadic, short-lived, and likely to be discontinued in the event of a crisis or change of administration. Training programmes, the awarding of grants, exchanges, and partnership programmes took place infrequently and were detached from the government's broader policy framework. A lack of coherence between innovation policies and policies on innovation enablers (e.g. trade protection, investment restrictions, performance requirements, and rigid labour regulation) also restrained diffusion activities. Poor policy coordination reflects the dispersed nature of institutional governance of innovation in Indonesia. The execution of innovation policies is scattered across various ministries and agencies, and there is no single national innovation coordination agency to harmonise all such initiatives. In the absence of a national innovation agency, the continuous monitoring and evaluation of innovation initiatives has been almost non-existent, further undermining the effectiveness of such policies.

The lack of policy and institutional coordination results in limited links among the triple-helix actors of innovation. Interactions among government, industry, and university are generally weak. Although some innovation policies have aimed to bridge

the gap and create links between actors (e.g. collaborative programmes in the form of competitive grants), most have not had significant success. Given this predicament and the uncertainty it creates, it is not surprising that most initiatives have not been very successful in attracting prospective suitors. Private participation in R&D activities generated as a direct result of government innovation programmes has been limited and, thus, often considered not very effective in promoting sufficient knowledge diffusion.

Second, funding and incentives for R&D are the most prominent methods used by the government to promote innovation. Most innovation policies in Indonesia originated from the Ministry of Research and Technology and the Ministry of Higher Education, which are now merged. The vast majority of innovation policies are aimed at S&T development, especially by facilitating R&D activities in universities and firms. However, the R&D facilitation offered by the government is primarily in the form of monetary incentives, such as grants, R&D funding, tax relief, or subsidies. R&D funding is often problematic because the amounts are too small, and most incentives are for a single year rather than multiple years. This creates uncertainty because R&D projects pose a greater risk of being commercially unsuccessful. The Insurance for Technology Development (ASTEKNO) programme was meant to answer this problem, but it did not receive enough interest from firms. Funding was primarily non-competitive.

Implementation problems are also common. Some firms and universities found that administrative procedures to obtain some of the incentives were burdensome with difficult requirements and lengthy processes. Those that received funds sometimes experienced disbursement delays. Furthermore, simply offering funds has not been effective in helping local firms perform R&D activities. For example, Hidayat et al. (2013) suggest that in addition to funds, industry expects assistance in providing information technology and guidance for technology users, joint R&D activities, training for technical personnel, and managerial training, among other things. Although some programmes have addressed such concerns to a degree, there have not been enough of them, and still some are lacking in implementation or socialisation. As a result, most firms have been reluctant to join these programmes as they prefer to import the technology directly rather than trust local R&D capability or develop the technology themselves. For economic and practical reasons, they have not responded well to the incentives offered. Most of the R&D collaboration projects between government, universities, and firms are not fruitful due to difficulty in achieving a common R&D objective, and sometimes even vulnerability to rent-seeking behaviour.

Third, for various reasons, the programmes are not effective. For all their good intentions, many government projects or policies, which in theory should be useful instruments to facilitate innovation, are not effective in promoting diffusion activities and even struggle to remain in operation. Some of these projects are very young (five years old or less), so it may be too early to judge their success or failure. However, although in theory such platforms should have brought innovation, many programmes have stagnated. Among the primary reasons for their ineffectiveness in stimulating innovation and diffusion so far is the severe lack of one or more of the following factors: (i) most importantly, a clear strategy for moving forward; (ii) enough technical human resources for operation, management, and maintenance; (iii) a sustainable financial plan; and (iv) sufficient participation from the segment of the enterprises initially targeted, especially the private sector.

In some cases, the government lacks ideas on how to bring the innovation actors and activities into the established platforms or infrastructure. The lack of progress in special economic zone projects – a recent industrial clustering policy in Indonesia – is a prominent example. The government has had enormous difficulty in even attracting firms to locate in such clusters, let alone induce agglomeration or diffusion. Other public projects, such as technology or science parks or technology transfer offices, have also suffered from similar problems.

4.3.1 Examples of past innovation initiatives or interventions

Especially since the massive economic reforms carried out in the mid-1980s, Indonesia has embarked on some specific policies and interventions to infuse the economy with more innovation. Some have been successful, and others have not. This section briefly describes examples of such initiatives and analyses the reasons behind their success or failure.

The automotive and component industry. Indonesia's manufacturing sector has plenty of experience of receiving knowledge diffusion through FDI arrangements or joint ventures with MNEs closer to the technological frontier. Two such cases can be found in the automotive industry. From the 1980s, Indonesia developed its automotive assembly industry with the aid of FDI from Japanese auto manufacturers acting as principals.

Pane (2005), as quoted in Aminullah and Adnan (2011), describes the example of innovation by Suzuki. In 1976, PT Indomobil, the Indonesian subsidiary of Suzuki Motors, proposed a product innovation to its principal in Japan: to assemble

a new pickup car (later known as the Suzuki ST20) by installing a Japanese motorcycle engine into the assembled body. With its unique characteristics, this car was designed to provide the local Sulawesi market with affordable transportation for clove farmers in mountainous terrain. The innovation became a marketing success. In the years that followed, Suzuki carried out more product innovation using a similar sequence (propose-approve-diffuse-produce) involving the Japanese principal. They went on to upgrade the technological capabilities of the subsidiary to be able to produce the engine for the ST100 (improving upon the ST80 that previously existed in Japan), the chassis, and other components. Innovation in Suzuki happened in the form of product design and engineering by putting Japanese engines in different types of bodies modified to suit the Indonesian market.

Interaction with FDI firms not only stimulates product, process, and managerial innovation (as is well-documented in the literature) but also marketing to create products able to serve a new market segment that previously either did not exist or was unexploited. This was the practice of automotive components producers, such as ASPIRA, a local brand of PT Astra International, an MNE conglomerate whose business line is auto components and spare parts for cars and motorcycles. ASPIRA provides a wide range of spare parts. With the Asian financial crisis in 1997 and the subsequent exchange rate devaluation, importing genuine, original equipment manufacturer automotive spare parts became far more expensive. Around the same time, the far cheaper imports of low-quality Chinese components flooded the Indonesian market. However, innovation by ASPIRA provided the Indonesian market with a third alternative. Using the existing pool of knowledge in terms of technology, management, and production methods diffused and accumulated from a long period of engagement with Japanese automotive firms, ASPIRA managed to produce high-quality, multi-platform (installable across various vehicle brands) spare parts at more affordable prices. This innovation has served the domestic market very well.

Such examples show how frequent and profound interactions with advanced foreign firms possessing sufficient innovation capital, enabled by FDI and joint venture arrangements, have proved an excellent way for technologically underdeveloped Indonesian firms to absorb innovation and gradually upgrade their technological capabilities.

Aircraft industry promotion. Since the late 1970s, the Government of Indonesia, led by BJ Habibie, then the State Minister for Research and Technology, put forward plans to develop industries, including the high-tech aircraft industry. The plans covered design, manufacture, and assembly. This endeavour was primarily led by Industri Pesawat

Terbang Nusantara, a heavily subsidised and protected state-owned enterprise. Among its major products was the CN-235 aircraft. The essential objective of the programme was to prop up Indonesia to enable it to be more reliant on technologically sophisticated industries requiring substantial innovation and, thus, to compete and catch up with firms from more developed countries. Unfortunately, the programme was not successful as the aircraft were costly to produce and, ultimately, could not be marketed successfully. Given its massive financial cost, which greatly exceeded its benefits, the endeavour collapsed after the crisis, triggering massive layoffs.

McKendrick (1992) offers an insightful explanation of the main reason behind the project's failure. Despite possessing a sufficient pool of S&T resources and generally able engineers to enable the project to survive, the company lacked managerial skills. This subtle, yet impactful, managerial inability to manage information exchange and the efficient assimilation and adaptation of the transferred technology, as well as insufficient marketing know-how to commercialise the sophisticated product, proved to be highly detrimental.

Two important lessons can be drawn from this undertaking. First, the diffusion of knowledge should not focus merely on technology transfer but should also consider equally important managerial know-how, which is probably harder to attain independently. Upgrading the innovation capabilities of firms requires managerial skills as much as properly incentivised scientific and technical ones. FDI could play a role in achieving this balance. Second, although seemingly more a lesson for industrial policy, this experience also demonstrates that making the leap into overly complex and technologically demanding innovation projects, enterprises, or policies will not necessarily bring about the desired innovation and diffusion. Rather, in the Indonesian case, innovation should be gradual, starting with minor or incremental processes or product adaptation in labour-intensive industries, and should consist of importing and learning technologies that may even be considered outdated or lower-tier in developed countries, while slowly building up local firms' major change capabilities.

4.3.2 Tax incentives for research and development activities

In the past, the government has often attempted to trigger and facilitate innovation and the diffusion of knowledge through R&D activities. Incentive schemes have been offered to firms and universities to conduct R&D activities. Unfortunately, most of these programmes received scant attention and have generally been considered unsuccessful at promoting innovative activities in firms.

One such case is the launch of tax deduction incentives. In 2010, for example, as stipulated in Government Regulation 93/2010, the government offered a 5% tax deduction for firms making R&D expenditures or undertaking other projects considered to generate positive externalities, such as developing sports and education facilities. However, a 2013 study by the World Bank explained that some firms found it very difficult to receive the tax deduction due to the complicated and lengthy administrative tax procedures. No significant improvements took place, even though a clarifying Minister of Finance decree (PMK 76/2011) on this matter was issued a year later. Some firms chose to get the same amount of tax deductions by spending more on straightforward sports facilities rather than riskier R&D undertakings.

Two lessons can be learned from this programme. First, implementation is as important as launching an initiative. Thus, reducing unnecessary administrative burden is the key to any successful innovation programme, along with continual monitoring and evaluation. This is an area where most innovation programmes could have done better. Second, and perhaps more importantly, the experience shows that to gain meaningful reception from firms, any innovation programme must offer substantially larger incentives and benefits, not just small monetary ones, to overcome firms' perennially adverse attitudes toward R&D activities. However, past initiatives show that stand-alone R&D incentives have generally not been enough to spur innovation and diffusion. Rather, the Indonesian case suggests that exposure to competition in the market – especially the global market – is arguably a greater incentive for innovation and diffusion. Facilitation and competition should always go together.

4.3.3 Local innovation initiatives in Bandung

Innovation needs to be facilitated at both the national and local levels. There are several Indonesian cities in which the local governments have established a conducive ecosystem for stimulating innovation and initiated effective programmes to facilitate extensive knowledge flows among innovation actors.[2] One of the few successful examples of such local-level innovation enterprises is Bandung, the capital city of West Java Province. Bandung possesses the most mature quadruple-helix collaboration (government–industry–university–community), and it is commonly referred to as one of the smartest, most creative, and innovation-led cities in Indonesia.

[2] Jakarta, Pekalongan, and Surakarta are three other interesting cases of successful local-level innovation initiatives in Indonesia.

Innovation initiatives in Bandung include the Bandung Creative Hub, start-up incubators, Bandung Creative City Forum, the Creative Tourism Village, Bandung Digital Valley, the Little Bandung Initiative, the Bandung Creative Center, Bandung Technopark, the New Entrepreneurs Program, Bandung Technopolis, and many more. Such initiatives, most of which are led by young, educated people, have been successful in producing innovation and developing entrepreneurship projects with the local community.

At least four factors explain the success of the local innovation ecosystem in Bandung. First, the critical role of strong and tangible political support and commitment by a local leader with high innovation literacy and awareness cannot be overstressed. These innovation initiatives are not stand-alone but are embedded within the urban planning. Innovation is at the forefront of the development vision of the city. Second, Bandung has sufficient innovation resources available nearby, especially universities, such as Bandung Institute of Technology, Telkom Institute of Technology, and Padjadjaran University. However, the local government has gone beyond mere funding and has expertly crafted and properly maintained the implementation of platforms that link innovation actors and resources. Third, many of these platforms have strong private participation. For example, the Bandung city government regularly invited MNEs (e.g. Intel for the incubator programmes) with advanced technology to collaborate with local universities or communities, creating important channels for knowledge diffusion at the local level. Fourth, local community and characteristics are not ignored. As a result, citizens are empowered to produce innovation, and real diffusion takes place. For example, innovation gave rise to the development of the Sundanese handicraft industry through the addition of technology developed by engineering students from a Bandung university. This resulted in a unique and innovative product with embedded local culture.

Many other Indonesian cities can emulate Bandung's innovation governance, although emulation may not be possible in every region due to their differing characteristics and endowments. Nevertheless, the success story of Bandung can be seen as a microcosm of what a successful triple- or quadruple-helix collaboration should look like at the national level. Furthermore, this case also demonstrates that local and micro-level innovation platforms are generally more manageable and, thus, a reliable way of producing substantial knowledge diffusion.

4.4 | Toward a More Conducive Environment for Innovation

Given the importance of innovation for achieving a competitive and sustainable economy, Indonesia needs to immediately address some of the problems and bottlenecks preventing sufficient innovation and knowledge diffusion from taking place. However, the solution is far more comprehensive than simply allocating more budget for R&D activities. The following four factors must be considered and calibrated to constitute an effective national innovation system in the future.

4.4.1 The role of foreign direct investment and global value chain participation for inducing greater innovation

Considering Indonesia's shallow innovation and technological base, it is not surprising that at this stage of development, FDI and joint venture arrangements with MNEs have been the most important channel for innovation, particularly knowledge or technological diffusion, to Indonesian firms. This is true at both the aggregate and micro levels.

Several studies have shown that FDI firms in general achieve higher productivity, export performance, and value added per worker, which likely stem from process innovation, higher technological attainment, and more complex production methods. Plenty of firm-level cases, like the Suzuki example depicted earlier, have demonstrated how frequent interaction with MNEs under such arrangements can successfully produce innovation (in terms of either product, process, organisational, management, or marketing innovation) and, to some extent, technological upgrading among domestic firms. Various forms of technical assistance and technology transfer from foreign principals have resulted in at least minor improvements in the change capabilities of local firms in several sectors (Thee and Pangestu, 1998). Therefore, the government should consider attracting more private FDI inflows, along with the innovation they bring, rather than placing all the responsibility for innovation on public institutions.

Indonesia still requires more FDI to spur innovation because FDI firms possess the necessary innovation capital (primarily in technology and management processes) that is closer to the frontier. By engaging in FDI or joint ventures, local firms can access not only the principals' innovation capital but also their other capital indirectly, leading to an urge for more innovation. This capital includes, among other things, marketing links, global market access, and global competition.

For now, technological progress should involve the adoption or mere adaptation of technologies (even outdated ones) and not the creation of new technology. FDI provides an excellent channel for this purpose. FDI can promote diffusion through direct technology transfer, technical licensing, R&D facilities, and even the movement of workers from MNEs to other local firms. It creates imitation and demonstration effects and, when used properly, can be an important basis for building up domestic technological capabilities.

Knowledge diffusion occurs not just in the form of technology adoption but also equally importantly, yet more difficult to achieve, in the form of organisational and managerial capabilities, as was demonstrated by the failure of the aircraft industry. At this point, FDI can provide the most powerful and effective impetus and know-how for innovation. This is an important point to consider since most of the current innovation programmes tend to not have any real engagement with foreign firms or markets. Therefore, in the short run, the most effective policy to generate diffusion of knowledge to the economy should primarily involve facilitating the entry of more FDI into Indonesia by having a generally open and friendly regime towards it.

The government can achieve this objective by addressing problems related to the general investment climate, such as ensuring regulatory certainty and coherence and pro-competition policies, and enhancing the quality of hard (logistics and physical connectivity) and soft (information and communication technology and bureaucracy) infrastructure. Any investment policy that discourages FDI will indirectly restrain potential innovation diffusion, so it must be seriously and carefully reconsidered. Various local content regulations, performance requirements, and forms of investment restriction or stipulations in the negative investment list fall into this category. Even trade policy on intermediate goods imports matters. In addition, firms that both possess significant diffusion potential and are willing to transfer their technology should be further facilitated.

FDI is simply not enough to guarantee that a satisfactory amount of innovation and knowledge diffusion will happen, however, and two important caveats have been raised. First, for the Indonesian case, a study by Qoyum (2017) showed that export orientation is a more significant factor for inducing product innovation than mere foreign ownership. Although innovation can and has existed in FDI catering to the domestic market (as in the automotive industry case described), more export-oriented FDI – particularly FDI that participates in global value chains (GVCs) – can provide greater impetus and the necessary context for even more innovation and diffusion to take place.

There are two main reasons why export- or GVC-oriented FDI tends to produce more innovation than domestic-oriented FDI. First, developed countries' higher and more demanding technical standards and requirements usually call for more complex technology and production methods. Therefore, foreign principals or lead firms have more incentive to ensure their subsidiaries can produce in an efficient and competitive manner. Diffusion of knowledge in the form of either technology, technical assistance, or managerial know-how usually follows. Second, exposure to the global market creates more intense competition from similarly positioned firms in other countries, which in turn makes innovation indispensable for firms. This also gives foreign principals more incentive to transfer the necessary technology to their facilities in Indonesia, for fear of losing their competitive edge over rivals in nearby countries.

In the last two decades, the nature of production has been shifting closer to the concept of GVCs, which are modular, happen across numerous countries, and rely on transferable codified knowledge. Indonesia no longer needs to have the resources and technological diversity to produce an entire product domestically to improve its export performance. On the contrary, the country can focus on some parts of the goods or stages of production within a few industries in which it has comparative advantage and gradually learn through interaction with FDI firms to upgrade its technological and innovation capabilities. GVC production essentially relieves developing countries of the need to master too many industries or to jump directly into high-tech industries, as Indonesia has in the past, in order to produce meaningful innovation that is well-rewarded by the market. Improving GVC participation caters more effectively to the global market and, thus, improves competitiveness and innovation. Indonesia's automotive industry is a perfect case of this. In the medium term, the challenge will be how to upgrade styles of GVC governance from primarily captive and hierarchical styles, which allow for limited innovation, to styles that allow for more innovation. Examples include market and modular arrangements, which require a higher degree of codification and supplier competence. Other labour-intensive industries, such as textiles, garments, and electronics, which are naturally GVC-oriented, need to be facilitated to stimulate more innovation and technological upgrading.

The second caveat is that Indonesia should not necessarily remain forever reliant on FDI to conduct innovation. In the long run, Indonesia also needs to improve its technological attainment and capabilities to perform major product change. Therefore, alongside measures to attract FDI, the government must also consider preparing attractive incentives to ensure sufficient technology transfer takes place. Currently, no regulatory framework on, or explicit incentives for, technology transfer activities exists.

The government should re-evaluate and revitalise the strategies of the existing Technology Transfer Office. But any future regulation concerning technology transfer should strike the right balance so as not to deter firms from entering in the first place. As important as these measures are, it should be acknowledged that the most powerful incentive government can offer to attract FDI firms to enter and perform diffusion activities is to address innovation supply-side issues, as will be elaborated in the following subsection.

4.4.2 The role of improved key innovation enablers and infrastructure

To effectively promote knowledge diffusion, the government should (i) avoid micromanaging innovation policies, (ii) abandon an interventionist and winner-picking approach to industrial promotion, and (iii) cease to be the main agent of innovation undertaking the bulk of innovation or R&D activities. Rather, the government should restrict its role to that of a facilitator of innovation and create a necessary environment for the private sector to thrive. One of the main ways of doing this is by significantly enhancing the quantity and quality of the following four types of innovation enablers: absorptive capacity, S&T infrastructure, IPR, and the regulatory climate. Attracting reputable MNEs to invest in R&D facilities in Indonesia, which is a huge channel for diffusion, will be almost impossible without first addressing these problems.

Absorptive capacity. The diffusion of foreign knowledge can only effectively occur if there is sufficient domestic absorptive capacity. Among other things, this refers to the basic skills and knowledge needed by the domestic labour force to understand and improve upon imported knowledge. Given the current lack of absorptive capacity, improving it should rank high on the government's list of priorities.

To this end, substantial investment in human capital is needed, particularly in higher education and in the engineering sector. Universities' basic research capabilities must be enhanced. Given the more rapid pace of technological change, especially with the development of Industry 4.0,[3] academic training in universities must be agile and flexible enough to quickly adapt to the new technological trends.

[3] Industry 4.0, also known as the fourth industrial revolution, is a recent development in the industrialisation process, which will increasingly involve smart factories with more advanced technology. Among other things, this trend is categorised by the more ubiquitous use of automation, big data, artificial intelligence, and Internet of Things (IoT) in the industrial process.

Providers of basic technical labour, such as vocational schools (which ironically record the highest share of unemployment), need to be significantly improved. The government must ensure that basic scientific, language, and computer skill attainment is achieved, and the vocational school curriculum should be aligned with modern industrial needs. Finally, a national certification system must be created for specific sets of industrial occupations or technical skills to provide a ready pool of skilled workers for foreign firms when they set up their operations in Indonesia. This eventually allows for easier skills-matching and smoother knowledge diffusion to take place.

Science and technology infrastructure. Enhancing the availability and performance of S&T infrastructure is also crucial to facilitate innovation. The government needs to build more public laboratories that are open for use by private entities, as well as technology support services, including metrology, standards, testing, and quality assurance (MSTQ) facilities and various technology information services. According to Pietrobelli and Rabellotti (2010), MSTQ facilities, in particular, play an essential role in upgrading a country's ability to participate in the market and modular types of GVC, which require higher supplier competence and, thus, require more innovation and promote knowledge diffusion. Unfortunately, in Indonesia, MSTQ facilities are severely lacking in quantity and quality. This has created inefficiencies in the national standardisation process, for example.

The government, however, cannot and should not develop all S&T infrastructure using its own resources. Inviting the private sector to participate in building public innovation facilities, which eventually will be used by private sector as well, is key. To facilitate this, an attractive and effective public–private partnership mechanism is needed.

Existing S&T parks also need greater support and facilitation, chiefly in the form of a clearer and more effective long-term strategy, which is largely missing, and to a lesser extent, financial and operational support for the management and maintenance of the parks.

Intellectual property rights. Stronger IPRs in developing economies will bring about long-term growth and efficiency benefits as they attract additional FDI and induce further innovation and technology spillovers (Maskus, 1997). Consequently, improving IPR protection and enforcement is probably the most crucial factor for ensuring sufficient technical licensing, technology transfer, and other diffusion activities take place. In Indonesia, few FDI firms are willing to transfer their technology for fear that

it might be used inappropriately or spill over to competitors, given the currently weak IPR regime. Solving IPR protection issues, therefore, remains the key to stimulating more knowledge diffusion into the economy. Although regulatory framework on IPR in Indonesia exists and is frequently updated, the government needs to focus on the implementation side of the IPR regime, ensuring that punishments for IPR violations are strictly enforced according to the law.

Favourable regulatory climate for innovation and diffusion. As a regulation-producing agency, the government should remove any regulatory bottlenecks that impede innovation and diffusion activities, including regulations that do not seem to be directly related to innovation policy. One prominent example is the regulation on the movement of labour and experts. As a developing country with a limited technological base, successful technology diffusion happens not just by importing capital goods but also – and perhaps more importantly – through the transfer of skills from technical experts by foreign firms or suppliers who come to train domestic workers or engineers in the operation of newly installed technology or machinery. Some manufacturing firms complain about regulatory burdens, including lengthy procedures and the time needed to bring in foreign technical experts. Sometimes, a two-day visit by foreign experts requires weeks or months of administrative processes. Therefore, ensuring quicker and easier procedures in the labour regulations, and, hence, freer movement of labour and technical experts, is crucial for Indonesia to facilitate the diffusion of knowledge.

4.4.3 The role of a formal, integrated, well-functioning innovation system

In the medium to long run, sustainable innovation, and particularly diffusion activities, will happen effectively only if the country has a formal, integrated, and well-functioning national innovation system. Therefore, the development of SINAS is a step in the right direction and should be continued. SINAS needs to follow best practices from the innovation systems of countries at a similar development stage and with comparable characteristics. However, at this point, the aim should not be to build a full-fledged innovation system of the type found in advanced countries but to gradually advance the development process of the currently embryonic national innovation system.

The government should consider assigning a specific institution or task force with a strong political mandate to oversee the national innovation system, coordinate the various innovation policies and activities across ministries, and align them with the National Medium-term Development Plan. It is advisable to establish a new national

innovation body along the lines of the now dissolved National Innovation Committee. The system's effectiveness, however, depends to a large extent on the coherence of the innovation policy with investment, trade, S&T, and labour policies.

There are several issues to be considered, for which a good balance must be calibrated. The first is the triple-helix collaboration, especially the university–industry link. Solving the two following perennial problems should remain the highest priority. First is the skill mismatch involving the incompatibility of the labour force provided by local universities with industry's needs. Second is the research mismatch, which currently is more supply driven and based on university expertise rather than being demand driven and based on industry needs. Bridging these gaps requires frequent and sustained communication between the representatives of firms and academics, in which business associations can play an important role.

Second, policies to enhance the availability of and access to innovation finance must be formulated. A system should be devised to overcome the natural risk aversion of the banking sector towards innovation activities that involve plenty of risk. The government needs to creatively facilitate and mobilise, or artificially manipulate, the banking sector's incentive structures to encourage it to participate in funding firms' R&D activities. Venture capitalists need to be facilitated.

Third, industrial clustering is an important medium for horizontal and vertical diffusion and, therefore, needs to be facilitated. A more effective strategy, implementation, and incentives to attract firms – and, of course, physical infrastructure – are essential if industrial clusters are to avoid the fate of the various special economic zones, which have not attracted the interest of firms and have generally been deemed unsuccessful at stimulating innovation.

Finally, only when such a system exists will a larger R&D budget be more effective in producing innovation. The government should aim to gradually increase the budget for R&D activities, and it should complement this with a well-planned strategy and well-conceived incentives for firms.

The system should not stand alone, however, and thus cannot be relied on as the sole instrument to produce innovation. In the Indonesian context, attracting more incoming FDI is still the policy that is most likely to bring about the necessary innovation, technology, and knowledge diffusion into the country in the short run.

4.4.4 The role of local innovation initiatives

Local governments must stimulate and facilitate more city-level initiatives, similar to the ongoing efforts in Bandung, Jakarta, and Solo. A powerful national innovation system should consist of 'innovation pockets' in several regions with various programmes and initiatives by local government that take full advantage of the availability of innovation sources within and around the city. Local initiatives are likely to be a more sustainable and reliable way of providing quick wins and the necessary momentum for producing more tangible and widespread innovation. Conversely, conducting nationwide innovation initiatives is likely to be more difficult because of the massive resources required for monitoring and coordinating such endeavours, and the differences in regions' characteristics and endowments.

To promote local innovation, increasing the innovation literacy and awareness of local leaders about the benefits and practical know-how of innovation is essential. Given Indonesia's decentralised political structure, the development of innovation-related initiatives, programmes, and infrastructure in cities is greatly influenced by tangible political support (or lack thereof) from their mayors. Effective triple-helix collaboration should exist not only at the national level but also at the city level. Programmes to connect universities' technical skills with local entrepreneur projects under public initiatives and support need to be encouraged. Furthermore, given the limited innovation capital in the public sector, local governments should instead deploy strategies to attract and invite the private sector within or outside cities to participate in local innovation projects that bring about diffusion, such as training and collaboration provided by firms. Both factors are behind the success of the most innovative regions in Indonesia. Some local industries, especially the food, tourism, and creative industries, have shown excellent potential to be promoted and to benefit from the diffusion of knowledge at the local level.

A critical aspect of local innovation initiatives is entrepreneurship development. In large cities, start-ups should be encouraged and facilitated by the provision of co-working spaces, creative hubs for the exchange of ideas through training and workshops, and start-up incubator programmes. For the less-developed regions or parts of cities, however, providing access to entrepreneurship skills and finance for residents through entrepreneurship training and mentoring should be embedded in local development plans. Connecting them to the technical expertise of nearby universities will yield more diffusion. Given that diffusion requires frequent and extensive interactions with sources of knowledge, simply allocating more budget for entrepreneurship programmes is not enough.

4.5 | Conclusion and Summary of Recommendations

Innovation is an important issue that needs to be addressed immediately. Indonesia still lags behind in innovation indicators due to its generally lacking innovation culture. The limited amount of R&D undertaken corresponds to the absence of a formal, integrated, and well-functioning national innovation system. The limited innovation that has taken place has mostly involved only minor changes in capabilities. Few channels for diffusion exist, except for FDI or joint venture arrangements, or technical assistance from foreign buyers.

Unlike in advanced countries, which possess highly developed innovation policies within full-fledged innovation systems, the basic innovation prerequisites have been severely lacking in Indonesia. The explicit and sophisticated innovation policies applicable to developed countries would fail in Indonesia due to the severe lack of even a basic S&T and innovation base and resources. The government should, therefore, focus first on removing the obstacles for innovation and ensuring that a basic enabling environment for innovation is established before delving into more complex and technical innovation policies. Only then will more advanced innovation policies yield the desired results.

The government needs to reprioritise four different aspects to foster more innovative activities and the diffusion they usually bring. First, considering FDI's important role for innovation and diffusion in the past, the government needs to improve the current investment climate to attract more FDI to the country, especially in GVC-oriented sectors. Logistics infrastructure and regulatory coherence need to be improved. This open investment policy needs to be accompanied by incentives for technology transfer or diffusion by firms. So far, the country has not developed an explicit regulatory framework on technology transfer.

Second, beyond merely spending more on R&D activities, the government must invest heavily in improving other innovation enablers. Sufficient efforts should be made to strengthen local human resources, improve IPR protection, and prepare a financing mechanism for innovation activities. Infrastructure, such as public laboratories and MSTQ services, is very important to facilitate and upgrade innovation. Private participation in building and operating such infrastructure is essential given the government's limited financial and human resources.

Third, a formal innovation system must be prepared. The development of SINAS should be continued and encouraged. Establishing an institution along the lines of the National Innovation Committee to coordinate innovation governance across the ministries is advisable for better policy coordination across the triple-helix actors of innovation. University–industry collaboration should have a special focus within such a system.

Finally, local-level initiatives must be further encouraged and helped to flourish to create more momentum and quick wins, and to demonstrate good practices for other regions to follow. Top-down policies at the national level applied universally across regions have proved not to be an effective way of fostering national innovation.

This chapter is not exhaustive and does not have enough space to touch on many important innovation policies to promote more diffusion of knowledge. Perfect calibration of these diverse policy prescriptions needs a degree of trial and error. Many other aspects related to innovation are beyond the scope of this chapter. However, the chapter should provide the big picture of the current innovation condition and a general sense of what needs to be done to promote innovation and knowledge diffusion in Indonesia.

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