

CHAPTER 8 : FOREIGN INVESTMENT BY TAIWAN'S HIGH-TECH SECTOR AND ITS IMPACT

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The chapter focuses on the Taiwanese high-tech sector's investments in several geographic areas. Against the backdrop of global supply chain restructuring and emerging technology competition, it analyzes Taiwan's two representative industries: electronics manufacturing service (EMS) with a long production history in China, and the semiconductor foundry service with its well-established local cluster. Taiwanese EMS companies' investments in Central and Eastern Europe have facilitated the establishment of regional centers and led to a substantial economic impact on exports and employment. Meanwhile, owing to the trade and technology war between the US and China, and the launch of Taiwan's New South Bound Policy, the investments by Taiwan's EMS companies in Southeast and South Asia have become very substantial. For the semiconductor industry, sometimes known as the Silicon Shield, the highly efficient local cluster will continue to grow. Some critical foreign investments have been made lately to address global concerns over chip shortages and economic security. Policy initiatives to better support the global expansion of Taiwanese high-tech companies and relate them to foreign relations development are discussed.

8.1 Introduction

This chapter focuses on trade and investment involving Taiwan's high-tech sector in several geographic areas, complementing other chapters that focused on the contest for diplomatic recognition and on countries that have been targeted or courted by China. The studies have been made mainly from the point of view of the private sector by considering the business logic and decision-making processes of technology companies headquartered in Taiwan. Nonetheless, the major policies and actions of the governments of Taiwan, China, and the countries involved in a trade or investment relationship with Taiwan are examined. In addition, policy implications from the aspect of international relationship development are discussed whenever appropriate. Two representative high-tech subsectors of Taiwan are selected for the studies, focusing on regions or countries with substantial investments from Taiwan.

The first part of the chapter addresses the subsector of the EMS (Electronics Manufacturing Service) industry, for which Taiwanese companies have demonstrated their global significance. EMS providers offer a wide range of manufacturing and design services for electronic production, which may be complemented by additional value-added

activities, such as global supply chain management and after-sales customer support during the entire product life cycle. Of the top 40 global EMS or ODM (Original Design Manufacturing) companies listed in 2020, ten were Taiwanese.¹ The leading five are Foxconn/Hon Hai, Pegatron, Quanta, Compal, and Wistron, with a combined revenue accounting for more than 70% of the overall revenue of the top 40. Hon Hai's revenue alone reached US\$190 billion.

The EMS industry has relied heavily on production sites in China, which account for more than 70% of production capacity.² However, as part of a globalization strategy, many Taiwanese hi-tech companies began to invest in Central and Eastern Europe (CEE), including Foxconn's moves into the Czech Republic in 2000. Moreover, with the intensification of the US-China trade and technology war starting from 2018, many multinational enterprises (MNEs) have been trying to seek production sites outside China to restructure their supply chains. As a result, some developing countries, such as Vietnam, Thailand and India, began to receive substantial investments from Taiwanese EMS companies and their upstream suppliers, giving these countries an indispensable future role in the EMS industry.

The second part of this chapter focuses on the semiconductor industry. In particular, Taiwan Semiconductor Manufacturing Co. Ltd. (TSMC), as the top semiconductor foundry service provider, has achieved a dominating market share of 55%, supplying global customers including Apple, Nvidia, AMD, Qualcomm and Broadcom. TSMC is also one of the largest buyers of semiconductor materials and equipment. Although foreign investments by Taiwanese semiconductor companies were rare in the past, recent investments by TSMC in the US and Japan, and potential plans for expansion elsewhere, have drawn global attention, accentuated by the worldwide chip shortage.

8.2 Taiwanese EMS Companies' Investments in CEE

8.2.1 The Prominent Near-Shoring Status of CEE Countries

The CEE countries have been through the processes of democratic transition, economic transformation and integration into the European Union over the last three decades. Many CEE countries have become FDI (foreign direct investment) destinations for MNEs. The main advantages of the CEE countries were their competitive workforce and geographic proximity to European markets, while also exhibiting significant variations amongst them (Szent-Iványi, 2017).

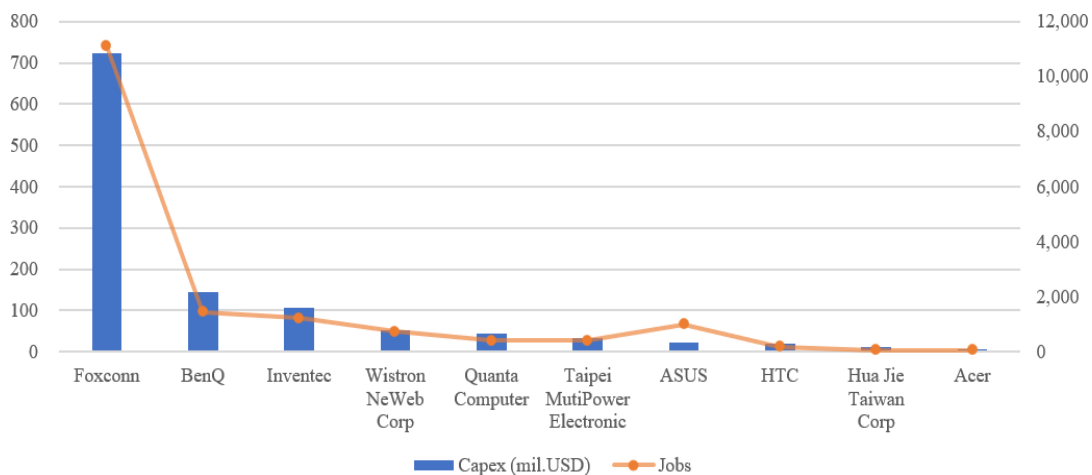
With changes in industrial patterns, cheap labor costs are no longer the sole consideration for companies when choosing manufacturing locations. Traditional supply chains are evolving to follow a trend of "short-chains," from so-called "off-shoring" to "near-shoring." The Savills Nearshoring Index (Savills Research, 2020) serves as an

indicator for the suitability of near-shore outsourcing for countries worldwide by comprehensively considering the figures in three different areas. It includes manufacturing labor costs, electricity costs, as well as infrastructure and trade openness.

The Czech Republic and Hungary ranked first and second, respectively, among EU member states in 2020. The Czech Republic became first choice with its excellent infrastructure, mature manufacturing bases and appropriate input costs. In 2019, Czech exports accounted for 74% of annual GDP, with Foxconn the second-largest exporter after only Skoda. Also, Hungary has a highly educated, skilled labor force with relatively low labor costs, making it another popular location for near-shore outsourcing.

According to the statistics on Taiwan’s direct investment in the Czech Republic (fDi Markets, 2018), Taiwan's investment has been distributed in eight Czech regions, mainly in Prague, Central Bohemia, and South Moravia. The top ten Taiwanese companies contributed US\$1.169 billion dollars of capital expenditure and created 16,605 jobs. Foxconn alone made 13 investments, with a capital expenditure of more than US\$720 million dollars and the creation of more than 10,000 jobs. It was followed by BenQ, which had three projects, and Inventec with four projects, as outlined in Figure 8.1. For more recent developments, in response to the surging demand for cloud services and rising concerns about information security, Foxconn, Inventec, Wistron, and Wiyynn have all added production lines for servers and motherboards in the Czech Republic to increase the proportion of production outside China.

FIGURE 8.1 TOP TEN TAIWANESE INVESTORS IN THE CZECH REPUBLIC



Source: Own compilation based on fDi Markets

8.2.2 The Development of Foxconn's Regional Operations Center

Foxconn started with a brownfield investment in the Czech Republic in 2000 and utilized localization strategies to develop its EMEA (Europe, the Middle East, and Africa) regional center. Foxconn purchased land and buildings from the bankrupt enterprise, HTT Tesla, in Pardubice. This transaction was the first major direct foreign investment in the electronics industry in Pardubice. Foxconn soon became a key foreign investor in the Czech Republic and neighboring CEE countries. Foxconn expanded its production capacities in Kutná Hora in 2007 with tax incentives from the Czech government. It further established a data processing service center in Prague for cloud services in 2015. The company currently has three factories and 12 subsidiaries in the Czech Republic, one factory and four subsidiaries in Hungary, and one factory and one subsidiary in Slovakia, with the key investments shown in Figure 8.2.

Foxconn's rapid growth in the Czech Republic is closely related to its localization strategy in Europe, which aims for the integration of part suppliers and proximity to major customers and seeks benefits from the EU free trade zone. In line with this expansion strategy, Foxconn acquired or established strategic alliances with key European component manufacturers. In addition, some Foxconn customers moved their factories (such as HP's factory near Glasgow, UK) to the Czech Republic in order to improve efficiency. These accomplishments allowed Foxconn to build an operational center for the region with Pardubice as a logistics hub.

In terms of employment, there are two major channels for Foxconn's employees in the Czech Republic: a permanent contract directly with Foxconn, or employment through temporary worker agencies (Rutvica, 2014). Managers are mainly Czech, Chinese, and Scottish, aged between 40 and 50, on long-term contracts. Most production line supervisors with technical backgrounds are Czech and Slovak, aged between 30 and 40. In addition, the majority of production line workers employed via temporary worker agencies are from other CEE countries, such as Slovakia, Poland, Romania and Bulgaria and aged between 20 and 35.

According to an interview with a Czech labor union leader, Taiwanese companies create eight times more jobs than Chinese companies, with value added about 60% higher.³ Taiwanese investments can also benefit smaller Czech parts suppliers. Although a positive influence on employment has been observed, several labor issues, such as workplace culture and flexible labor use, remain challenging for Foxconn according to a comparative study examining the company's production regimes in China and the Czech Republic (Pun et al., 2020).

8.2.3 China's Actions and Chinese Companies' Investments in CEE

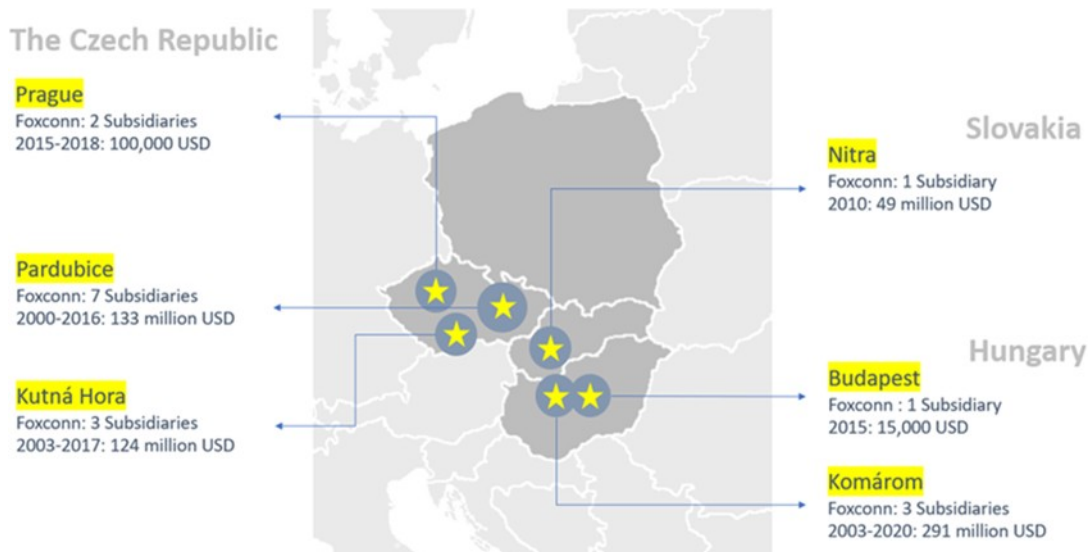
According to Matura (2021), Chinese levels of FDI in the CEE countries are modest, not comparable with Germany, the United States or other Asian countries such as Japan and South Korea. Nonetheless, it is difficult to identify the real amount of Chinese investment in the region as figures from different sources (e.g., national government agencies, Chinese embassies, and national banks) are rarely consistent.

Loans constitute a significant part of China's CEE investments. Nearly 80% of its infrastructure-related projects are located in non-EU member countries of the western Balkans. Of these projects, 75-85% of the cost is financed by Chinese loans, leading to significant debts compared to these countries' GDPs. For example, the percentages are 18% of GDP in Montenegro, 12% in Serbia, 10% in Bosnia-Herzegovina and 7% in North-Macedonia.

In the case of the Czech Republic, during bilateral visits by presidents Miloš Zeman and Xi Jinping between 2015 and 2016, seventeen agreements for eight billion euros in new Chinese investments in the Czech Republic were signed. CEFC China Energy was the biggest Chinese investor, accounting for US\$510 million (AEI, 2021). Its CEO, Jianming Ye, was appointed as Zeman's personal advisor. However, CEFC China Energy got into financial and political trouble in 2018 and was saddled with 450 million euros in unpaid debts in the Czech Republic.⁴ Its investments were taken over by China's CITIC Bank International. China's investment in the country reached its peak at 350 million dollars in 2018. CEFC declared bankruptcy in March 2020.

FIGURE 8.2 GENERAL INFORMATION ON FOXCONN’S INVESTMENTS IN CEE COUNTRIES

(a) Facility locations and registered Capital



Source: Hon Hai Annual Reports (2002-2020)

(b) Main activities and job opportunities

Country	Locations	Main Activities	Job Opportunites
Czechia	Pardubice	1. Computer & monitor manufacturing and component assembly 2. Communication technologies product manufacturing 3. Repairs, purchasing and logistics 4. Metal chassis and plastic element manufacturing 5. Smart factory solution 6. Computer system design	11,095
	Kutná Hora	1. Server manufacturing and assembly 2. Service center for repairs 3. Data processing and hosting	
	Prague	1. Data processing and hosting 2. Solution for charging infrastructure	
Hungary	Komárom	Electronic and telecommunication equipment manufacturing	1,085
	Budapest	1. Intellectual property monetization 2. Management consulting	
Slovakia	Nitra	1. TV production 2. Circuit board printing	1,410

Source: Own compilation based on reviewed literature

8.2.4 The Opportunities and Prospects for Taiwanese Hi-Tech Companies in CEE

In 2015, the president of Foxconn, Terry Gou, signed an MOU with the Czech Prime Minister, Bohuslav Sobotka, and promised an investment of about US\$116 million by 2018, focusing on a partnership to promote automation, research, and data centers. Foxconn has

thereby expanded its core investments in CEE from manufacturing activities to operations and businesses based on technology and innovation. According to the annual financial reports of the Hon Hai Group, seven technology-based subsidiaries were established in the Czech Republic after 2015, as shown in Table 8.1. Furthermore, Foxconn ranked among the top ten most significant investors in 2015 and 2016. Some US\$154 million was invested, and 2,677 new jobs were created in Pardubice within these two years (CzechInvest, 2015, 2016).

TABLE 8.1 FOXCONN’S TECHNOLOGY-BASED SUBSIDIARIES IN THE CZECH REPUBLIC

Company Name	Main Activities
Foxconn 4Tech s.r.o	Industry 4.0
Foxconn DRC s.r.o	Computer Systems Design
Foxconn Europe Digital Solutions s.r.o.	Metal products manufacturing
VaultDX s.r.o	Software, information technology consulting, Data processing and hosting
Trade DX, s.r.o.	Design and manufacture of servers, solid state drives and cloud data center-level switches
SafeDX s.r.o	Data processing and hosting
FITA Energy Solutions a.s.	Solution for charging infrastructure

Source: Hon Hai Annual Reports (2015-2020)

The Czech Republic's ambition to develop data centers and Industry 4.0 technologies aligns with Taiwan's strengths in information science, communication technology and smart machinery. Cooperation between the two countries provides an excellent basis for mutually beneficial outcomes. In particular, intensive foreign investment in CEE countries has led to a severe labor shortage and an urgent need for smart manufacturing and related technologies. Much business potential can be expected. (TAITRA, 2018).

For further collaboration, four typical international cooperation models, including service agreements, joint research projects, intellectual property rights and technology transfers, and joint ventures are all in place between the Czech Republic and Taiwan. In particular, the DELTA Program, managed by the Technology Agency of the Czech Republic (TACR), is a multinational joint research project aiming to facilitate cooperation in applied research and experimental development. As a cooperative agency for the initiative, Taiwan’s Ministry of Science and Technology drew attention to ten Taiwanese projects that were selected from 2017 to 2020.⁵ The subsequent DELTA 2 Program, for 2020 to 2025, has been included in the A-plus Industrial Innovation R&D Program of Taiwan’s Ministry of Economic Affairs, with the key areas of next-generation communication, innovative IoT applications, smart manufacturing, and high-end medical material.

In recent years, bilateral investment forums, business matchmaking meetings, and summits of city leaders have become important interactions between Taiwan and CEE countries. Moreover, there are growing numbers of joint ventures with the Czech Republic, such as the SafeDX data center established in Prague in 2015 by Foxconn and the Czech investment group KKCG. More frequent technical exchanges and business collaborations between Taiwan and CEE countries can be expected.

In conclusion, Foxconn’s global strategy has led to the evolution of the EMS industry and its facilities and operations in CEE have highlighted the economic benefits of hi-tech companies’ investments. The major events are illustrated in the following timeline. The revenue growth of Foxconn in CEE indicates that Foxconn’s move has led to positive results for the company, as shown in Figure 8.3.

20 Years of Foxconn in CEE countries

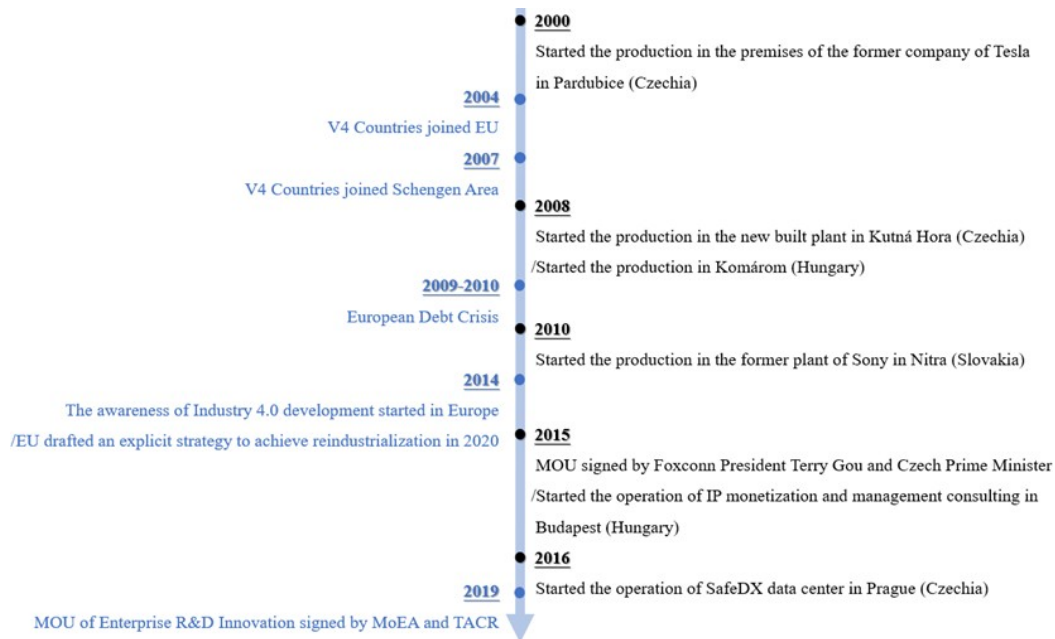
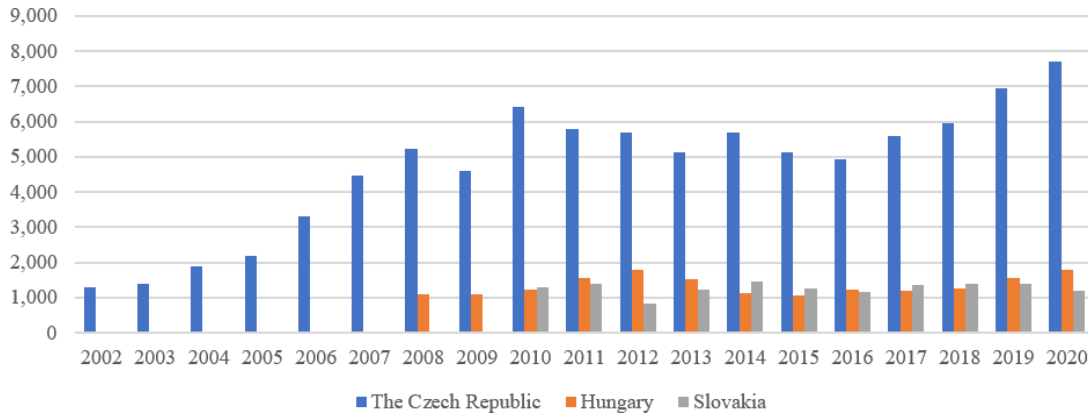


FIGURE 8.3 FOXCONN’S REVENUE IN CEE BY YEAR (2002-2020) (IN\$ MIL)



Source: Hon Hai Annual Reports (2002-2020)

8.3 Taiwanese EMS Companies’ Investments in Southeast and South Asia

8.3.1 Alignment with Taiwan’s New Southbound Policy

The intensification of the US-China trade and technology war after 2018 has driven many MNEs to relocate their production sites in China to Southeast Asia and South Asia, which are the key areas for the New Southbound Policy of the Taiwan government (NSP).⁶

The trade relationship between Taiwan and the NSP countries has been steadily growing. Trade data for the sub-region of ASEAN and the major recipients of investment from Taiwan’s EMS companies are summarized in Table 8.2. Taiwan’s bilateral trade values generally show some positive development after 2016, the launching year of the NSP, especially for ASEAN and India. According to ASEAN statistics, Taiwan was among ASEAN’s top ten trading partners in 2019, ranked 7th and 9th for imports and exports, respectively (ASEAN, 2020a).

TABLE 8.2 TAIWANESE NSP-RELATED TRADE RELATIONSHIPS, 2010-2019 (IN \$MIL)

	ASEAN		Vietnam	
	Trade	CAGR	Trade	CAGR
2010-2015	70,845 - 79,251	1.89%	8,815 - 11,986	5.25%
2016-2019	78,433 - 88,904	3.18%	12,259 - 16,054	6.97%
	Thailand		India	
	Trade	CAGR	Trade	CAGR
2010-2015	9,117 - 9,597	0.86%	6,465 - 4,811	-4.81%
2016-2019	9,308 - 9,771	1.22%	5,006 - 5,797	3.74%

Source: Bureau of Foreign Trade, Ministry of Economic Affairs, Taiwan

For overall inward FDI flows to ASEAN, Singapore has been the country receiving the most. It is followed by Indonesia and Viet Nam with an annual amount of about US\$20 and US\$15 billion dollars respectively for the past three years. The inward FDI for Thailand, Malaysia, and the Philippines are also significant, but there is serious fluctuation, with some peaks of more than US\$10 billion dollars per year (ASEAN, 2020a). Manufacturing is now the largest sector, from less than 13.4% in 2012 to 35% in 2019 (ASEAN, 2020b).

Taiwan was ranked 10th in terms of ASEAN's inbound investors in 2019 (ASEAN, 2020a). Taiwanese investments, concentrated in Vietnam and Thailand, have been dominated by the electronics manufacturing industry. According to the Investment Commission, Ministry of Economic Affairs, Taiwan, the investment amounts in 2019 for ASEAN, Vietnam, Thailand and India were \$2,404, \$915, \$328, and \$70 million US dollars respectively. In particular, due to the US-China trade and technology war and rising production costs in China, Foxconn and the so-called big five EMS companies (Qunta, Compal, Wistron, Pegatron, and Inventec) have all accelerated the relocation of production capacity from China to Vietnam and Thailand.

At the same time, Taiwanese investments in China have substantially decreased. The average annual investment amount fell from US\$12.03 billion for 2010 to 2015 to US\$7.89

billion for 2016 to 2019. The share of Taiwan's overall outbound investments fell from 66.15% to 40.98% over the period, according to the Investment Commission at the Ministry of Economic Affairs, Taiwan.

As for Chinese investments in ASEAN, China was ranked sixth for FDI in ASEAN in 2019 (ASEAN, 2020a). According to ASEAN figures, most investments were made by state-owned enterprises, mainly in real estate, commercial services and construction industries (ASEAN, 2021).

For Taiwan's outward investments, there has long been a serious concentration in China, accounting 84% in 2010 against 6% for ASEAN, according to the Investment Commission, Ministry of Economic Affairs, Taiwan. However, mainly owing to the recent investments of Taiwanese EMS companies in Southeast Asia, the shares for China and ASEAN were 32% vs. 31% for 2021. The three countries - Vietnam, Thailand, and India - receiving the most significant investments from Taiwan's high-tech companies are assessed in the following subsections.

8.3.2 Vietnam

8.3.2.1 FDI Policy and the Business Environment in Vietnam

According to Vietnamese investment laws adopted in 2015, investments in specific industries can enjoy two to four years of corporate income tax reduction, including those in high-tech electronic components, semiconductor technology and computer software (ITRI, 2020). Although Vietnam's corporate income tax reduction is smaller than in Thailand and other ASEAN countries, Vietnam has the largest number of free trade agreements, including the CPTPP and agreements with the EU, the UK, and other large economies (KPMG, 2021). In addition, a relatively low minimum wage compared with Thailand⁷ and geographical proximity to China make it very attractive to Taiwanese companies.

Taiwan and China are both major source countries for Vietnam's inward investment. By the end of 2020, Taiwan was ranked fourth, with an accumulated investment of \$33.7 billion, while Chinese investment in Vietnam reached \$18.4 billion, ranked seventh. South Korea, Japan and Singapore are the top three countries, with investments ranging from 56 to 70 billion US dollars.⁸

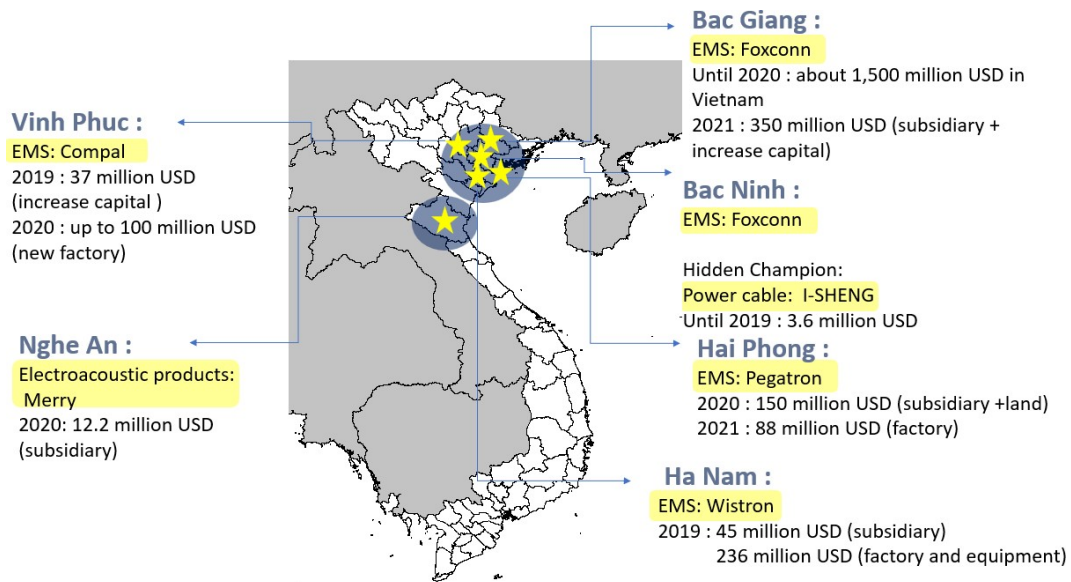
Although Vietnam has attracted a lot of foreign investment in recent years, complete supply chains and good technical skills are still lacking. Therefore, the Vietnamese government launched a new version of its investment promotion law in 2020, focusing on products or services that facilitate the formation of industrial value chains that support the establishment of innovative research and development centers (ITRI, 2020).

8.3.2.2 Taiwan's Electronics Investments and their Impact on Vietnam

The major investments of Taiwanese EMS companies are summarized in Figure 8.4, including Foxconn and the big five. In addition, several so-called *hidden champions*⁹ from Taiwan for electronic parts and components have made substantial investments. For example, I-sheng, with an early investment dating from 2007, is the world's largest power cable supplier, and Merry is a world leader in acoustic components.

Taiwanese companies have earned a better reputation in Vietnam than their counterparts from China. According to a survey of 120 Vietnamese executives (TAEF, 2020), Taiwanese companies tend to be positively evaluated in Vietnam, ranked second only to those from Japan. In addition, 80.8% of respondents believed that Taiwanese companies could provide employment opportunities and 54.2% expected investment capital.

FIGURE 8.4 MAJOR ELECTRONICS INVESTMENTS BY TAIWANESE COMPANIES IN VIETNAM



Source: Own compilation based on company reports and MOPS (Market Observation Post System)

On the other hand, according to another survey, China is seen in ASEAN as powerful but also perturbing (Yusof Ishak Institute, 2020). 76.3% of Vietnamese and 86.5% of Thai respondents agreed that China is Southeast Asia's most influential economic power. However, 80.2% and 75.9% of the respondents in Vietnam and Thailand were concerned about China's growing economic influence, contrasting with only 22.2% and 40% worried about US economic influence.

8.3.3 Thailand

8.3.3.1 FDI Policy and the Business Environment in Thailand

Thailand has a relatively sound business environment. Among 190 economies, Thailand was ranked 21st in 2019 for ease of doing business, based on indices including tax, power supply, and dealing with permits (World Bank, 2020). Amongst other Asian countries attractive to investors, China and Vietnam were ranked 31st and 70th, respectively.

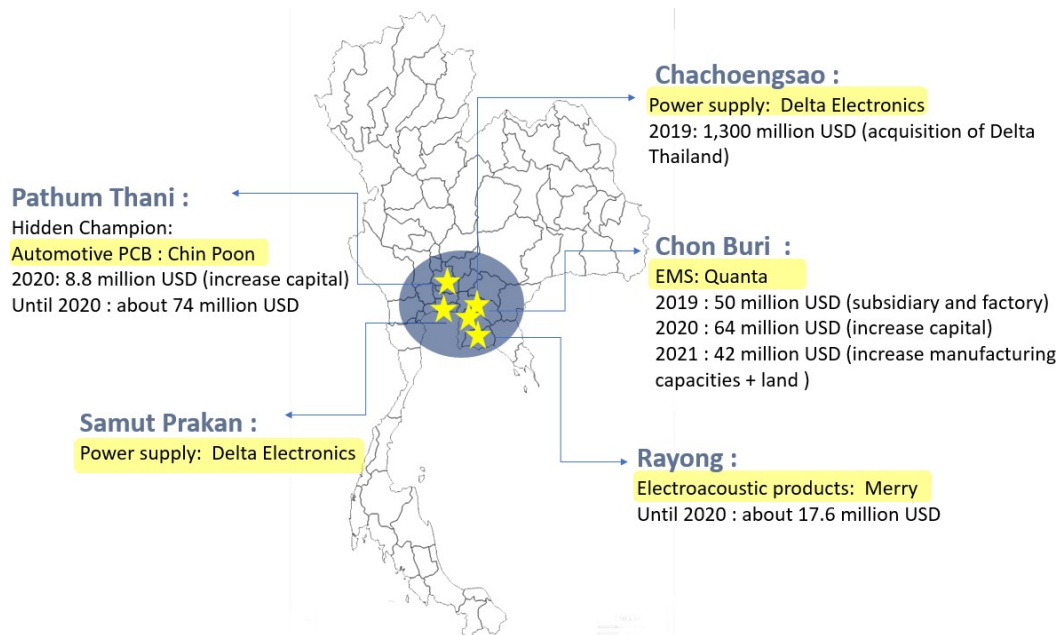
For approved investment amounts in Thailand within the period of 2016 to 2020, the annual averages were about \$1.4 billion and \$400 million for China and Taiwan respectively, indicating a more substantial economic influence from China. Nonetheless, Taiwan is still a significant investor in Thailand, ranked fifth in 2020 (Thailand BOI, 2021).

Thailand's government has refined its policies for promoting investment. Starting from 2015, corporate income tax can be exempt for up to eight years for specific industries. In addition, for investment in a few industries in the Eastern Economic Corridor (EEC), corporate income tax exemption can be extended up to 13 years. Launched in 2016, Thailand 4.0 is one of the most important components of its drive for industrial transformation, from traditional manufacturing to innovation-oriented technologies, such as biotechnology, digital technology, nanotechnology and advanced materials (ITRI, 2020).

8.3.3.2 Taiwan's Electronics Investments and their Impact on Thailand

As summarized in Figure 8.5, the large-scale investments of Taiwanese electronics companies in Thailand are concentrated near the Bangkok metropolitan area. For example, Quanta has invested more than \$156 million in Chon Buri Province, one of the selected provinces for the EEC initiative. Foxconn also signed an agreement for a joint venture with PTT Public Company Limited in September 2021. The investment is worth between one and two billion dollars for a plan to build manufacturing sites for electric vehicles, most likely in the EEC area as well.¹⁰

FIGURE 8.5 MAJOR ELECTRONICS INVESTMENTS BY TAIWANESE COMPANIES IN THAILAND



Source: Own compilation based on companies reports and MOPS (Market Observation Post System)

Thailand is now second only to China in hosting production sites for Taiwan's printed circuit board (PCB) industry, a world leader with one-third of global output in 2020.¹¹ Chin-Poon, APEX, and APCB are the best-known PCB companies, focusing on consumer electronics and automotive applications.

8.3.4 India

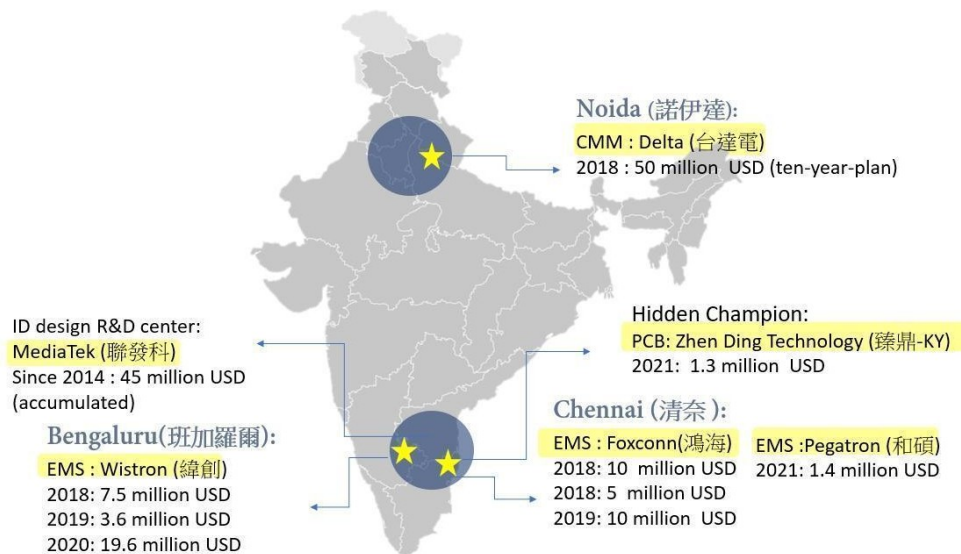
8.3.4.1 FDI Policy and the Business Environment in India

The Indian government's current policies are heavily focused on the mobile industry. To position India as a global center, the government launched the NPE (National Policy on Electronics) in 2019 and other prominent initiatives, such as PLI (Production Linked Incentive), SPECS (Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors), and EMC 2.0 (Modified Electronics Manufacturing Clusters Scheme), as highlighted by ITRI (2020). In particular, based on the PLI policy, a financial incentive of approximately US\$5.45 billion has been provided for five years to promote domestic electronic manufacturing investment and enhance electronics value chains.¹² In addition, the PMP (Phased Manufacturing Program) has been implemented in stages since 2015 with a tariff policy restricting the import of smartphones from China and promoting the concept of "Made in India."

8.3.4.2 Taiwan's Electronics Investments and their Impact on India

As the second-largest mobile communication market globally, India has vast business potential given its large population and low penetration rate of mobile devices. Along with Apple's shift of supply chains from China to India, Taiwanese EMS companies, such as Foxconn, Wistron, and Pegatron, began to gain ground in India's mobile device manufacturing business. According to the Investment Commission at the Taiwanese Ministry of Economic Affairs, more than one hundred investments have been made by Taiwanese companies in India¹³ and these companies have gradually formed more complete supply chains. The key EMS-related investments are depicted in Figure 8.6.

FIGURE 8.6 TAIWANESE COMPANIES' MAJOR INVESTMENT IN INDIA FOR MOBILE DEVICES



Source: Own compilation based on company reports and MOPS (Market Observation Post System)

As shown in Figure 8.6, Foxconn has invested the most in India, given Apple's intention to relocate 7-10% of its production capacity in China to India.¹⁴ After selling its factory in Kunshan, China, Wistron began to shift its mobile device business to India, in cooperation with India's Optimus Electronics.¹⁵ Pegatron planned to build a new factory with mass-production to begin in 2021, with job opportunities estimated at about 14,000.¹⁵ Pegatron also signed an MOU with Tamil Nadu to accelerate its subsequent arrangements in India. These three leading Taiwanese EMS companies have participated in India's PLI programs with the planned investment of hundreds of millions of dollars in the next five to six years. All three companies are involved in the financial reward program.

8.3.5 Prospects for Bilateral Collaboration Development under the NSP

The New Southbound Policy is aimed at establishing a "sense of economic community" and creating a new cooperation model that is mutually beneficial. As a result, various action plans have been implemented. For example, the Taiwanese government has adopted three major credit guarantee funds to finance overseas development and has signed new versions of bilateral investment agreements to enhance the protection of Taiwanese companies.

For NSP-related countries, the initiative has also led to significant job creation. The statistics for the three selected countries are summarized in Table 8.3. In many cases, Taiwanese companies offer higher than the national minimum wages in these countries.

TABLE 8.3 JOB CREATION BY TAIWAN’S ELECTRONICS COMPANIES IN THREE NSP COUNTRIES

Location	Northern Vietnam				Central Vietnam	Southern Vietnam	
Company	Foxconn	Compal	UMEC	PHIHONG	Merry	AOET	
Main business	EMS	EMS	Power Supply	Power Supply	Acoustic Components	Optical Lens	
Employee	53000	5623	1000	705	1462	500-1000	
Wage ratio	1.33	1.36	-	-	1.14	-	

Location	Thailand				India		
Company	Quanta	Merry	Delta	APEX	Foxconn	Wistron	Pegatron
Main business	EMS	Acoustic Components	Power Supply	PCB	EMS	EMS	EMS
Employee	1928	672	13801	7363	25000-50000 (expected)	1000 (estimated)	14000 (expected)
Wage ratio	1	1	1.3	-	-	-	-

Source: Companies’ CSR Report (wage ratio = company wage / local minimum wage)

To further strengthen bilateral relationships, Taiwan also committed to hosting more international students from the 18 NSP countries, with the percentage of total inbound students growing from 27.65% in 2016 to 56.47% in 2020. Vietnam has sent the most international students, accounting for 17.8% (17,534 students) of total inbound students in 2020 compared to a share of only 4.3% in 2016.¹⁶

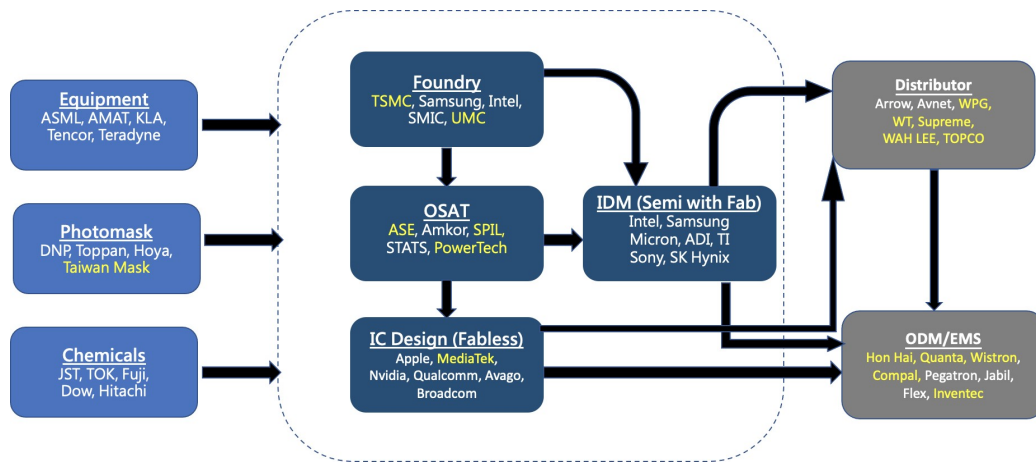
8.4 Global Impact of Taiwan’s Semiconductor Foundry Services

8.4.1 Development of Semiconductor Foundry Services

The semiconductor foundry business model, pioneered by TSMC in the late 1980s, has outgrown the overall semiconductor market over the last several decades. In particular, given the emerging trend of fabless semiconductor businesses (e.g., Qualcomm, Broadcom, Nvidia, and MediaTek), many companies now rely on foundries for chip manufacturing. The rising fab costs have incentivized vertically-integrated IDMs (integrated device manufacturers, such as NXP, Analog Devices, and Maxim) to go fab-lite. In addition, the

OSAT (Outsourced Semiconductor Assembly and Test) companies, focusing on so-called backend processes, are an essential part of IC supply chains. In terms of upstream partners, the equipment makers are crucial for advancing fabrication technologies and productivity. In addition, support from the companies for photomasks and chemicals is a prerequisite for efficient fabrication processes. The finished ICs are distributed by major channel players or moved to the downstream manufacturing service providers for inclusion in a wide range of products. The players in the global semiconductor industry are summarized in Figure 8.7, with Taiwanese companies highlighted.

FIGURE 8.7 SUPPLY CHAINS AND THE GLOBAL SEMICONDUCTOR INDUSTRY



Source: Own compilation based on Morgan Stanley Research and Digitimes

TSMC held 55% of the global market in foundry services in 2020 and the top five players represented over 85% of global foundry revenue (Samsung 17%, UMC 7%, GobaFoundry 4%, SMIC 5%). Driven by strong demand for both mature and advanced technologies, and Intel's potential outsourcing, the new addressable market (TAM) for foundries is very promising.

In particular, companies are restricted in the acquisition of ICs requiring advanced processes (below 28nm). The key players are limited to TSMC and Samsung, with some future potential for Intel. TSMC is the clear leader, with a technology advantage leading to most of the growth of the TAM. Lu et al. (2021) forecast that TSMC's 3nm revenue will reach \$2.0 billion in 2022 and \$12.4 in 2023, accounting for 10% of the overall foundry TAM in 2023. In addition, revenue from 5nm/4nm will be \$16.5 billion and \$19.7 billion in 2022 and 2023. In other words, TSMC's most advanced technologies may command 25% of the global market for foundry services by 2023. Samsung will hold a steady market share over the long term given its status as the only second source for advanced processes.

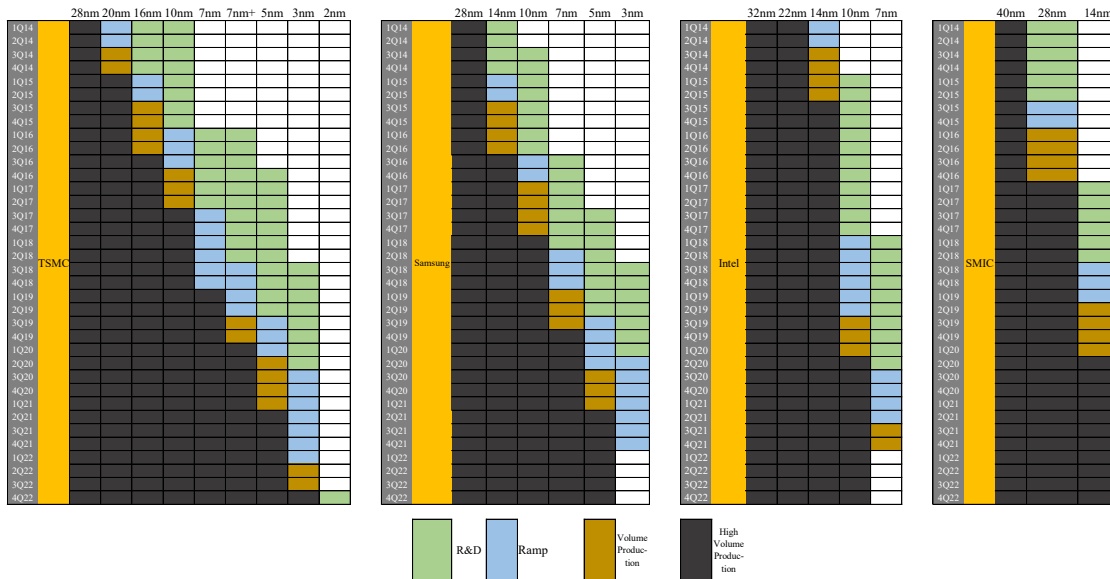
Intel's market share impact will diminish by 2023, and its future ups and downs will depend on its process technology and service capability development.

The rest of the players are mostly fighting an uphill battle due to a lack of leading-edge technology, the critical area responsible for substantial growth. As a result, most companies have gradually lost share over the last ten years. GlobalFoundries lost the biggest share after AMD moved to TSMC in 2019 for the 7nm process.

8.4.2 TSMC's Global Competitiveness

TSMC now controls 84% of the market for chips in the most advanced semiconductor manufacturing technologies, which provide the smallest and most efficient circuits for the world's biggest technology brands, from fast communication networks to cloud computing. As highlighted in Figure 8.8, the leading technological specifications and the comprehensive technology profile have further sustained its leading position. It may not be an easy task for Samsung, the only player also with available advanced processes, to gain market share from TSMC and, at the same time, it has to defend against Intel's potential entry. Its opportunity depends on its production yield improvement for advanced processes and the successful transition to the GAA (Gate All Around) technology for 3nm. Finally, Intel would first need to demonstrate to its customer base that it is indeed capable of providing industry-leading process technology (i.e., at least positioned in line with TSMC and Samsung). The largest Chinese foundry company, SMIC, has fallen behind the competition by at least one generation.

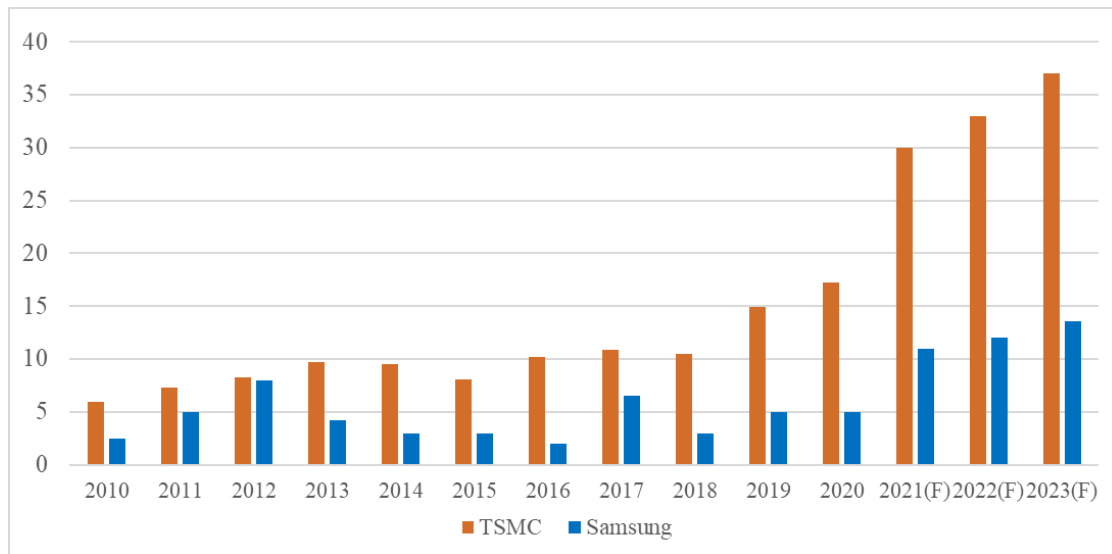
FIGURE 8.8 PROGRESS OF ADVANCED PROCESSES FOR MAJOR FOUNDRY SERVICES PROVIDERS



Source: Figures based on the data of Goldman Sachs Global Investment Research

To further ensure its long-term advantages, TSMC announced it will spend \$100 billion on capacity expansion in 2021-2023 to cope with the expected stronger and longer semiconductor sector cycle, mainly driven by 5G/HPC/AI/Automotive. The move also aims to regain customers' trust in the foundry service provider's determination to address the capacity shortage issue. Capital intensity reached 55% in 2021, much higher than the average in the last seven years of 35%. Meanwhile, significant capital investments are also expected for other foundry companies; however, they are not comparable with TSMC's aggressive capacity expansion. The capital expenditures of TSMC and Samsung after 2010 are presented in Figure 8.9 to illustrate the increasing gap.

FIGURE 8.9 ELEVATED FOUNDRY CAPITAL EXPENDITURE, TSMC VS. SAMSUNG (IN \$BN)



Source: Compilation based on TSMC reports and Goldman Sachs Global Investment Research

8.4.3 Overseas Investments of Taiwan's Foundry Industry

Given the highly efficient cluster in Taiwan, Taiwanese semiconductor companies have been relatively conservative in making foreign investments, as summarized in Figure 8.10. Reflecting this situation, 97% of TSMC's long-term assets (\$57 billion) remain in Taiwan, including all of its most advanced fabs. In addition, 90% of its 56,800 staff, more than half with an advanced degree, are based in Taiwan.

TSMC made a formal statement at its institutional investors' conference on July 15, 2020, about building chip manufacturing facilities in foreign countries. Three guidelines were reiterated, namely: customer demand, operational efficiency and cost economy. First, customer demand must be foreseeable for five to ten years. In addition, a sound semiconductor cluster is required in the local area for the potential site under consideration

to keep up operational efficiency. Finally, the various components of fixed costs, such as water, electricity, land, and tax rates, should be reduced, probably through substantial incentive programs.

8.4.4 Global Engagement and the Future Prospects for Taiwan's Semiconductor Industry

The US took steps aimed at restoring its leadership in semiconductor manufacturing when it passed the CHIPS (Creating Helpful Incentives to Produce Semiconductors) for America Act.¹⁷ Federal incentives were increased to enable advanced research and development, secure reliable supply chains and ensure long-term national security and economic competitiveness.

FIGURE 8.10 HISTORICAL AND POTENTIAL INVESTMENTS BY TAIWAN'S FOUNDRY SERVICES



Source: Compilation based on TSMC and UMC reports

In response to the act, TSMC announced on May 15, 2020, that it was planning to build a fab in Arizona, utilizing its most advanced 5nm technology. Construction was scheduled to start in 2021, with production foreseen to begin by 2024. TSMC's total spending on the project will be approximately \$12 billion from 2021 to 2029. TSMC believes the fab will enable leading US companies to fabricate cutting-edge semiconductor products within the US, including military-related chips.¹⁸

Japan has an almost monopoly position in the market for semiconductor equipment and materials that are required for many chip manufacturing processes. The Japanese government has been trying to cooperate with foreign foundry service providers, such as TSMC, to further strengthen its advantages in developing even more innovative

manufacturing equipment and materials.¹⁹ This intention has led to an existing joint 3DIC R&D center in Japan. In addition, TSMC also announced on October 14, 2021, that it would build a fab in Kyushu, Japan, in 2022. The facility will utilize the relatively mature 22/28 nm special processes and will start production before 2025. The new company JSAM (Advanced Semiconductor Manufacturing, Inc.) will be a joint venture with Sony. It is estimated that the Japanese government will provide more than \$3.5 billion in financial support.

Germany, France, the Netherlands, and 17 other European Union countries signed the "Declaration: A European Initiative on Processors and semiconductor technologies." They are planning to invest 145 billion euros in the design and production of customized processors and semiconductors in the next two to three years, and at the same time strive to introduce the 2nm advanced manufacturing process in the hope of increasing their global share of wafer production from the current 10% to 20% by 2030. At the moment, no firm response has been made by TSMC to this proposal.

For China, currently in the 14th Five-Year Plan, RMB 10 trillion (about US\$1.6 trillion) will be invested to support the development of the third-generation semiconductor industry. China intends to build its own semiconductor ecosystem without any involvement from the West or from Japan, Korea, and Taiwan. However, Chan et al. (2019) pointed out that Chinese fabs are still heavily dependent on equipment and material from foreign companies.

Broader and deeper global engagement by Taiwan's semiconductor industry seems inevitable. TSMC's recipe is not something Chinese companies can replicate. The key ingredient is trust. With the company slogan of "everyone's foundry," TSMC has built a remarkable ecosystem of trusted partners that share their intellectual property to build their proprietary chips. At the same time, leading manufacturing equipment companies, such as ASML and Applied Materials, have been TSMC's close partners that have jointly extended the limitations of Moore's Law²⁰ multiple times, through offering cutting-edge chip-making tools. TSMC's aim is to continue to play a pivotal role in maintaining the platform's integrity and momentum.

8.5 Conclusions and Implications

The chapter focuses on the real-world trade and investment of Taiwan's high-tech industries and their dominant global role. The countries under investigation are different from those with a tendency to switch diplomatic relations between Taiwan and China, as discussed in previous chapters. However, the countries without diplomatic ties are still crucial for developing Taiwan's foreign relations. The first part addresses the subsector of the EMS industry, with a long history of production in China, and analyzes its investments

and operations in two geographic areas, Central and Eastern Europe (including the Czech Republic and Hungary) and Southeastern and South Asia (including Vietnam, Thailand, and India). The second part is related to the semiconductor industry, sometimes referred to as the Silicon Shield for Taiwan because of its geostrategic importance. In particular, the company in focus is the leading global foundry service provider, TSMC, which has received global attention due to the worldwide chip shortage.

To better support the global expansion of Taiwanese high-tech companies and relate it to progress in foreign relations, the Taiwanese government needs to align its strategies and policies with business decisions made by the private sector. Its approach has been dramatically different from the one adopted by China, which utilizes the resources of national agencies, state-owned enterprises as well as malleable private companies. Although the diplomatic relationship between Taiwan and other countries was not a decisive factor in many high-tech companies' past investments (e.g., Foxconn's presence in the Czech Republic), partnership and synergy between the Taiwanese government and high-tech industries could be a key for future success.

Most countries receiving investments from Taiwan's high-tech sector are set on progressing from the manufacture of finished goods to technological development. Their development strategies fit well with Taiwan's strength in technology. Therefore, the Taiwanese government and such governments could launch joint programs to facilitate technological cooperation and transfer, which would help the transformation of industries and enhance the position of Taiwanese EMS companies against global competitors. Several existing collaboration programs between CEE countries and Taiwan serve as a good starting point to implement future projects that emphasize the application and commercialization of technologies.

Investment by Taiwanese EMS companies in South and Southeast Asia has been surging lately due to the trade and technology war between the US and China and the launch of Taiwan's New South Bound Policy. Nonetheless, China's critical role as the "world's factory" is unlikely to be challenged in the near term, given that restructuring supply chains for any EMS company is challenging. The joint development of science-based industry parks is a practical approach by Taiwan to develop relationships with other governments that want to develop their electronics industries, particularly given the opportunities arising from US-China tension. Such a move also offers valuable support to Taiwanese EMS companies keen on building industry clusters overseas. Taiwan's New South Bound Policy is a useful existing platform.

The Taiwanese government has done very little to enhance relations through ODA with countries where it lacks diplomatic ties. Given the globally dominant power of Taiwanese EMS companies, the Taiwanese government could provide ODA resources to

support digital infrastructure projects, leading to more solid relations than can be achieved by the private sector alone.

For the semiconductor foundry service, Taiwanese companies' advantages are clear and are expected to be maintained for some time. In particular, with unprecedented levels of investment (\$100 billion in three years), TSMC will continue to dominate the market in advanced manufacturing technologies. Given the highly interactive ecosystem, Taiwanese semiconductor companies need to expand their operations in foreign countries even though the local cluster has been highly efficient. Concern over the economic and national security implications of semiconductor supply chains has been expressed by many countries. Meanwhile, many governments have tightened controls regulating dual-use exports, such as the US regime under the Export Control Reform Act²¹ of 2018 (ECRA). Therefore, the Taiwanese government needs to work actively with other governments to resolve the current chip shortage crisis, harmonize the future operations of semiconductor supply chains and facilitate the formation of a global semiconductor alliance. The two recent investments by TSMC in the US and Japan are good examples of a joint effort by government and private companies.

To sustain industrial advantages, especially for the advanced manufacturing technologies of foundry services, the Taiwanese government needs to support the local semiconductor cluster's continuous growth by hosting more advanced manufacturing facilities and attracting more expertise and capital. The strategies and policies should aim to maintain the integrity and momentum of the semiconductor manufacturing platform based in Taiwan to serve the various players of the global semiconductor ecosystem.

NOTES

¹ <https://www.digitimes.com/news/a20210816VL202.html>

² <https://reurl.cc/Zjxgj6>

³ https://money.udn.com/money/story/5599/5850822?from=edn_search_result

⁴ <https://www.osw.waw.pl/en/publikacje/analyses/2018-06-06/chinese-investments-czech-republic-changing-expansion-model-0>

⁵ [Taiwanese-Czech joint R&D call for proposals 2021 webinar](#)

⁶ [New Southbound Policy, Executive Yuan, Taiwan](#)

⁷ <https://www.aseanbriefing.com/news/minimum-wages-in-asean-for-2021/>

⁸ <https://www.roc-taiwan.org/vn/post/20705.html>

⁹ Hermann, S., 1990. Speerspitze der deutschen Wirtschaft.

¹⁰ <https://www.foxconn.com/en-us/press-center/press-releases/latest-news/679>

¹¹ <https://www.tpca.org.tw/Message/MessageView?id=9786&mid=283>

- ¹² <https://www.investindia.gov.in/zh-tw/schemes-for-electronics-manufacturing>
- ¹³ <https://www.taitraesource.com/total01.asp?AreaID=00&CountryID=IN&tItem=w02>
- ¹⁴ <https://www.bnxt.com.tw/article/61679/apple-iphone-12-india>
- ¹⁵ <https://news.cnyes.com/news/id/4709692>
- ¹⁶ <https://news.cnyes.com/news/id/4567542>
- ¹⁷ <https://stats.moe.gov.tw/statedu/chart.aspx?pvalue=36>
- ¹⁸ <https://www.aip.org/fyi/federal-science-bill-tracker/116th/creating-helpful-incentives-produce-semiconductors-chips>
- ¹⁹ <https://asia.nikkei.com/Business/Tech/Semiconductors/TSMC-in-Arizona-Why-Taiwan-s-chip-titan-is-betting-on-the-desert>
- ²⁰ Initially named after Gordon Moore, the co-founder of Fairchild Semiconductor and Intel, Moore's law is the observed trend that the density of transistors in ICs doubles about every two years.
- ²¹ <https://www.congress.gov/bill/115th-congress/house-bill/5040>

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