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1. Introduction

The semiconductor industry of Taiwan has been receiving growing attention throughout the world in recent years. Semiconductor technology is often described as the innovation to all other innovations. The silicon microchips are in everyday's life in our modern information technology-based society, in our computers, smart phones, electric appliances, automobiles etc (Kingler-Vidra & Kuo 2021). And it is a crucial element to future economic growth, for example in fields such as robotics and artificial intelligence products (SIA 2019). Amidst the US-China trade war and the COVID-19 Pandemic, Taiwan's semiconductor industry gets in the centre of the debate. In the former, it is its role in supplying semiconductors to the Chinese enterprise Huawei; in the latter, it is its major supplier role during a global chip shortage which affected the supply chains to other industries (such as automobiles).

Started in the 1960s from low-end outsource assembly and test process, the Taiwan semiconductor industry has experienced great success in upgrading and inserting itself into the important position in the globalisation of semiconductor production. Concentrating in the foundry sector (which is fabrication of semiconductors, discussing below), Taiwan is accounting for 73% of the total revenue in the world in 2018, with the largest company Taiwanese Semiconductor Manufacturing Company (TSMC) alone responsible for more than 50% of the world total revenue (Grimes & Du 2022). In domestic, the semiconductor industry also plays a crucial part in the Taiwanese economy. As of 2018, integrated circuits (ICs) and micro-assemblies contributed 28.5% of total Taiwan exports. And the Information Communication Technology Industry combined contributed around 17% of GDP in 2019 (Pang 2021).

As we can see, as a Newly Industrialised Economy (NIE), Taiwan has managed to occupy an important role in the global value chain of semiconductor industry. However, at the same time, semiconductor companies, driven by the force of globalisation, have also

been offshoring low-end factories to China for its cheap labour force and favourable tax-waiving policies (Lee 2017). Through this process, there has been significant capital, talent, and technology migration from Taiwan to China, which was fostering the development of the industry in China (Chu 2013). And China has been catching up with upgrading its position in the value chain, and developing its own technological innovations. Given the context of geopolitical relations between Taiwan and China, and the US and China, it is in one sense fostering a strategic competitor to Taiwan's own semiconductor industry; in other sense creating national and economic security problems for Taiwan.

In the era of globalisation in our world economy, It is vital to understand the force of globalisation in production networks, and how it interplays with geopolitical relations. Globalisation has been the dominant political and economical phenomenon in the past decades. In recent years, the pandemic, war in Ukraine and China-US rivalry stirred up debates on the future of globalisation, amidst geopolitical reconfiguration in the chaning world. Some announce the death of globalisation, while others argue that the world might become more fragmented but globalisation is transforming into a new form (Power 2023; Bremmer 2023; Qobo 2023; Hunt 2018). This thesis, focusing on the case of the semiconductor industry of Taiwan, would try to examine and analyse the impacts and implications of globalisation and geopolitics tension on a strategic industry that is crucial to national and economic security. The thesis will try to answer the following research question:

Why is Taiwan successful in holding a key position in the global value chain in the semiconductor industry, but at the same time the industry in Taiwan has been collaborating with China, its potential competitor and rivalry?

In order to better answer this research question, the research will be further supported by the following three sub-questions:

1. How did the Taiwan semiconductor industry occupy its current position in the global value chain?
2. What allowed the sectoral migration of the Taiwan semiconductor industry to China? What was the response and reaction of the Taiwanese state?
3. How changes in geopolitics have reverted the trend and forced key industry and state actors to take responsive actions?

2. Literature Review

Substantial literature can be found discussing the development of the Taiwan semiconductor industry and the impacts of regional integration on the industry, specifically migration to and collaboration with China. Existing academic debate on the issue could be generally put into the two traditional camps on global political economy. From the statist perspectives, scholars identify the developmental state strategies or neomercantilist origins of the development of the industry. And they try to explain the migration by the developmental/neomercantilist state's transformation and reconfiguration under the globalising world. On the other hand, from the liberal perspectives, scholars attempt to explain by the intrinsic logic of economic integration and globalisation which lead to interdependence among economies and within industries, and the enabling factors of the global value chain which encourage the migration. In the following section, I will try to summarise and contextualise the debate, examine some existing gaps, and try to offer plausible explanations drawn from existing theories.

From the liberal perspectives, scholars try to explain the migration in a market-oriented approach. Scholars have been using the Global Value Chain (GVC) framework to examine the global semiconductor industry, and trying to identify the success of upgrading its position for the industry in Taiwan, and its dynamics between China and the United States.

Lee (2017) drawing from the GVC theory, argues that there are both positive aspects and negative aspects for both developed and developing countries in a GVC. For developed countries, GVC allows them to stay in higher earning profit nodes, spend more resources on

R&D. But at the same time, it does not guarantee creation of large job opportunities, as the nature of technology innovation means fewer domestic employment would be required. For developing countries, trade, investment and flow of knowledge in GVC not only allow them to have rapid learning, innovation and industrial upgrading, but also provide better access to information, create new opportunities for fast technological learning and skill acquisition. On the other hand, quality control systems and business standards of the GVCs also “push” the actors in developing countries to acquire new competences and skills. On the negative aspect, the “compressed” development through participating GVCs would create various policy challenges for the host countries at the same time. From these positive and negative aspects of GVC, Lee then focused on the flow of knowledge through the triangular links among Taiwan, the US, and China. Since the establishment of the Hsinchu Science Park (HSP) in the 1980s (which is the cluster where the majority of the semiconductor companies are located), there has been significant knowledge flow from Silicon Valley in the US to HSP in Taiwan. Many HSP engineers are educated and worked in Silicon Valley before returning to Taiwan. In addition to that, foreign partners also assisted fostering the semiconductor industry in Taiwan, in the form of foreign advisors or joint ventures with foreign ventures (Ouyang 2006). But Lee argued that the tie between US and Taiwan is complementary and mutually beneficial, because Taiwan is focusing on adapting cutting-edge technology innovations from the US, and commercialising and modifying the products. Hence, the knowledge flow triggered the “technology revolution” in Taiwan, and pushed the industry in the high-technology era. On the other hand, the Taiwanese IT industry was attracted by the cheap labour and governmental preferential tax-waiving policies in China, and increased their investment in China. While the advantages of low wages become less significant after the implementation of the New Labour Contract, China still offers a growing pool of skilled workers.

On the other hand, Chow (2015) contends that the cross-strait economic integration has reached interdependence relation (or mutual dependence) between Taiwan and China, especially after the implementation of the Cross-Strait Economic Cooperation Framework

Agreement (ECFA), which set institutionalised framework for the technology sectors to have closer ties and coopetition relations. In this sense, the Taiwan semiconductor industry underwent restructuring and a new division of labours under a bigger picture of economic interdependence. However, this explanation lacks the role of the Taiwanese state during this process, and does not address the concerns on broader economic and political securities.

Chu (2013) offers similar analysis following market-oriented logic in the global semiconductor value chain. She recognises that there are several enabling factors which determine the globalisation of the semiconductor industry. They include: 1) chip production stages are split into a number of separate procedures; 2) physical features of chips being so light weight that they allow chips being transported long distance in a affordable cost; 3) increasing automation in IC design activities; and 4) increasing complexity in IC design which requires highly skilled design engineers. For the Taiwan semiconductor industry, there are a number of driving forces that push-and-pull them into migrating to China. Chu contends that the two primary pull factors are to gain access to China's market and exploit location-specific resources, namely engineers and technicians. Secondary factors are government policies which offer subsidies and tax incentives, improving infrastructures; cost reductions; political motives, particularly the fear of cross-strait economic instability and the desire to contribute to the rise of China. While this view sheds some light on the economic logic of the migration, it neglects the broader context of the industry as a security strategy of the Taiwanese state, and why the state seems to just let it happen and eroding national security concerns.

From the statist perspectives, scholars of developmental state theory have been analysing the role of state in the development of the semiconductor industry. In order to initiate technology intensive industries to grow, such as the semiconductor industry, the state needs to closely interact and evolve a division of labour with the local industry. Breznitz (2005) stated 4 requirements for a state to be a successful neodevelopmental state: 1) focusing on national interests rather than private interests when making decisions; 2) being

informed by the industry's needs, abilities and difficulties when tailoring policy initiatives; 3) changing its policies in time for the changing needs of the industry; 4) letting the industry gain more and more power and autonomy for its business. Although Breznitz focused his research on the IC[1] design sectors instead of the foundry sector which Taiwan is dominating in, the same development model applies. Industrial Technology Research Institute (ITRI), established in 1973, is the important state research agency in acquiring innovative foreign technologies, and then diffusing them through various channels to the private sector. After the emergence of a private industry, they then settle on a new division of labour, with the state starting to assist private industries to conduct their own research and design (R&D) projects. From this point of view, the Taiwan semiconductor industry is a state project with the aim of economic development, and it was the effort of the developmental state which led to the success of its upgrading.

Scholars also described one of the main features of the development of the Taiwan electronics industry as using the means of techno-globalism to achieve the goal of techno-nationalism. Fuller (2005; 2007) summarises the four key features of this model in which three of them are related to the success of the industry: 1) low-cost competency building to create strategic suppliers; 2) the use of multiple technology channels; 3) tolerance of foreign multinational firms in the domestic economy. Fuller contends that it was these three features that explains Taiwan's leveraged international industrial linkages to build up its national economy, particularly in the high-technology sectors. And the hybrid model results in sacrificing the techno-nationalist ambition of higher control over the forefront of technology, because of the contradiction between the two ends of the spectrum. Taiwan's policy makers are willing to accept a level of mutual dependence with the international linkages, in order to enhance domestic firms' performance in global markets. In this sense, the migration and integration to the Chinese market could be seen as a strategy to increase competitiveness of

[1] Integrated Circuits, short for IC or IC chips, are the end products of the semiconductor industry. Sometimes the IC industry is used interchangeably with the semiconductor industry.

the industry in the global market against international firms. However, this explanation is lacking in the implications on wider security issues of the state.

Other scholars try to explore the transformation of the developmental state of Taiwan under the age of globalisation, and examine the adaptive reactions of the developmental state. Dent (2003a; 2003b) argues that globalisation and democratisation had undermined the developmental state paradigm, but the state was able to adapt and evolve a new approach to face new challenges. He contends that the East Asian states are able to form “adaptive partnership" with transnational capitals (TNCs) to meet various foreign economic objectives. In the case of Taiwan, policy makers are willing to embrace neoliberal ideas as long as they could help Taiwanese firms to exploit the growing commercial opportunities offered by globalisation. For example, integration to the global market might help reach economic security objectives, specifically supply security, market access security, and techno-industry capacity security. Apart from the objectives, the Taiwanese state tends to liberalise under a strong institutional and regulatory framework, to counterbalance border economic and other security imperatives. In this sense, economic integration with China is the strategy to enhance firms' competitiveness and access to the Chinese markets. In other words, the semiconductor industry migrates to China to take advantage of the labour market and talent pool, and help restructuring and upgrading in the trade-industry nexus. Following a similar view, Chu (2021) also contends that while the East Asian developmental states are under pressure from a wide range of factors, including neoliberal ideology, global production networks, the maturation of domestic enterprises, and democratisation of political regimes, focusing South Korea and Taiwan as the examples, they have been able to undergo reconfiguration and reconstitution, and form developmental alliances to advance states’ practices of defensive globalisation. In other words, the semiconductor industry, under the reconstituted state-business relations and with state’s financial and regulatory resources, expands transnationally to capture lower wages, inexpensive resources, gain access to market, in order to maintain their position in the global value chain. This thesis will follow the views from these statist approaches. From the study of developmental state’s transformation

under globalisation, we could analyse the role and reactions of the state under the period of regional economic integration. Furthermore, this thesis will try to contextualise this transformation on a broader geopolitical background in the Asian Pacific, and the dynamic relationships among Taiwan, China, and the US. Following the statist tradition of thought, the ideas of neomercantilism will be introduced in the next section. As a concept covering broader economic and political implications on security, it would offer more nuances on the political economy of the Taiwan semiconductor industry in the global value chain.

3. Theory and Methodology

Mercantilism, dating back to 16th to 18th century in European history, is often described as the oldest and earliest theory or school of thought in the study of Global Political Economy (GPE) (Cohen 2016). It focuses on the pursuit of national power in the international relations of open national rivalry (Gomes 1987), and also pursuit of stateness as an active economic actor, and the strengthening of state power (Hettne 1993). Mercantilism is also often compared as the realism in GPE terms, as it emphasises the power of states in the international system, and its demands on security; while realists focus more on the military power while mercantilists focus more on the economic part of the power (Cohen 2016, 86). The terms mercantilism and neomercantilism are highly associated, with the former usually used to describe the school of thought and state strategies in 16th to 18th century, the latter to describe its counterpart in the contemporary world, which would be the theoretical framework guiding the analysis in this thesis.

Similar to its older predecessor, neomercantilism also focuses on the national security and economic security of the state in the global market. Sharing a similar world view on the international arena, because there is no central authority governing above states, they should pursue their own national interests and strive to preserve national sovereignties, amidst the threats of war and conflict. States who take actions aiming to enhance their

security, might become sources of insecurity and fear of other states. In the neomercantilist's perspective, states would therefore emphasise relative gains in power vis-à-vis other states within the capitalist system (Cohen 2016). Accumulation of wealth is one way states could utilise and translate to relative power positions in political terms, which is of primary importance (Gilpin 1975). Therefore, in the global market, the pure logic of market is to jump political boundaries and locate economic activities in the most efficient and profitable geographical location, while the logic of the state is to "capture and control the process of economic growth and capital accumulation in order to increase the power and economic welfare of the nation" (Gilpin 2001, 81). In this sense, the relationship of economic affairs and national security is reciprocal. The International political and security system provides the essential framework for the global market to function. Meanwhile, international and domestic economic activities generate wealth as the foundation of this international political system. Economic growths are not evenly distributed within the system. That results in transformations of international balance of power, and leads to states redefining their national interests and foreign policies (Gilpin 2001, 22-3).

Another key feature of the relations between states and the global market is the hegemonic stability theory. The theory is related to our discussion in which it contends that the international economic system is more likely to be open and stable when a hegemonic state is able and willing to provide leadership to the system, and other states are willing to follow. From a neomercantilist perspective, a hegemon is defined as an extremely unequal distribution of power, and a single powerful state could control or dominate the lesser state in the system (Gilpin 1981). Liberals might view the hegemon providing public goods as an act of benevolence. But neomercantilists are more inclined into believing that the hegemon is aiming to further its own national interests, as an open international system contributes to its economic growth and political power (Cohn 2016, 95-7).

Haggard (1983) categorised three strands of mercantilisms: power mercantilism, development mercantilism, and welfare mercantilism. He argues that the first and third are the economic doctrines of developed countries, while the second being the one of the

"dependent and backward". However, in the contemporary world, states usually deploy a mixture of the three strands to achieve their political and economic goals. A wide range of policies are observed for states to pursue their security. The pursuit of power could mean not only national wealth and sovereignty, but also industrial development and employment. For example, foreign exchange reserve and control were common fiscal policy for developed and Newly Industrialised Countries, so as tariff and non-tariff barriers, export-led policies. Developmental strategies like investment encouragements, setting up industrial parks, and increase on public investment are some of the core policies for developmental states; but protections on agricultural sector and sunset industries through the means of tariff are also evident in developed countries (Shiau 1989). The varieties of mercantilist policies and strategies are therefore dubbed *neomercantilism* as an umbrella term.

Jones (1986, 150-223) concludes a range of primary and secondary neomercantilist policies and practices: tariffs, non-tariffs barriers, quotas, bilateralism, export promotion, trade control, economic aid, military aid, educational and cultural policy, and military-industrial complex activity, in the international sphere. Domestically, there are economic, monetary, fiscal, and exchange rate policy; industrial and development policy, including planning, public investment, selective intervention and sectoral support, small business support; science, technology, education and training; acquisition and retention of technology.

While developing countries used neomercantilist strategies to pursue economic development and security, and some of them, especially the Asian Tigers including Taiwan, were successful in transforming themselves as Newly Industrialised Economies (NIEs), the neomercantilist states have been under pressure in the last couple decades in the trend of globalisation. Transnational activities may challenge and undermine state control in certain areas. They may reduce the state's ability to tax citizens and corporations, for example, and force the state to take action in order to protect its own interests. On the other hand, some neomercantilist theorists argue that globalisation has both enabling and constraining effects on the state (Cohn 2016). This thesis would be structured around these perspectives of

neomercantilism as the analytic tool, with a focus on the development aspects of the school of thought. It examines the semiconductor industry in Taiwan, particularly on how it was born in the neomercantilist context, how it became what it is today as a means to achieve neomercantilist objectives of the Taiwan state, and how the industry started to following the globalising trend and eroding these very objectives and policies which once fostered the industry.

In terms of methodology, this thesis would adopt congruence method of the within case study, in order to examine and analyse the application of neomercantilist strategies the Taiwan state used for economic development and political security, and how they created and fostered the semiconductor industry of Taiwan. Meanwhile, when it successfully occupied a critical node in the global value chain, the industry seemed to be migrating to China driven by the force of globalisation, and defying the neomercantilist roots of itself. Congruence method allows investigators to examine links between a theory and its ability to explain or predict the outcome within a single or small number of cases (Geroge and Bennett 2005). The study would utilise both primary and secondary sources. Primary sources include official documents, speeches and news reports. Secondary sources include academic articles and books.

In response to my research question, the thesis would be structured regarding the following organisational plan. In the following section 4.1, I will first examine the current global value chain of the semiconductor industry, and Taiwan's position within the value chain, to serve as background of the Taiwanese semiconductor industry and show the critical position which it is holding. Sectoral migration of the industry from Taiwan to China will also be examined in the subsequent section 4.2. Section 4.3 will examine the neomercantilist origin of the semiconductor industry for the state's pursuit of national and economic security. Section 4.4 will discuss the reasons which caused the change of the neomercantilist policies and the transformation of state's role under globalisation. Section 4.5 will discuss the geopolitical shift under US-China trade and technology war which put Taiwan semiconductor industry in the middle of crossfire, and how the state and the industry react accordingly.

4.Content

4.1 Overview of Taiwan in the Global Semiconductor Value Chain

The semiconductor industry is a highly globalised industry, with various production nodes along the value chain spread out around the world. Semiconductors are truly the ultimate product of globalisation. Different parts of the production process are interconnected with each other and not a single country in the world could potentially produce chips on its own without foreign inputs. It could be said to be the first industry where the label “global factory” could be applied, with spatial hierarchy of production and a clear geographical separation at the global scale (Dicken 2007, 317). With that in mind, three basic segments could be identified along the supply chain: 1) IC design, 2) fabrication, and 3) packaging and testing. Bown (2020) contends that availabilities of venture capital, policy environment that is more supportive to intellectual property protection, reducing trade barriers on the global market, policies encouraging foreign direct investment (FDI), and differences in skill intensity across the supply chain are the main reasons underpinning the fragmentation of the global semiconductor industry since the 1980s. This section will provide an overview to the industry global value chain, and then it will be followed by the positions of Taiwanese firms along the value chain.

The IC design segment consists of fabless and design houses which specialise in designing electronic circuit layouts (the fabless model would be further discussed below). In the modern semiconductor industry, designer engineers rely on electronic design automation (EDA) software to design IC chips. EDA tools are essential due to the compact components in a single chip. Three US-based companies Synopsys, Cadence Design Systems, and Mentor Graphics sell or licence software services to over 85% of the global EDA market to both US and foreign chipmakers (Varas et al. 2020, 6).

After design houses have designed the IC chips, they are then brought into the real world in the process of IC chip fabrication. In chip production factories, which are called

foundries or fabs, the designs are transferred through mask making and then manufactured through the process of extreme ultraviolet (EUV) lithography. To this date, it is one of the world's most complex manufacturing processes. IC fabrication is also skill-intensive as well as capital-intensive. Apart from the highly skilled engineers and technicians required in monitoring and controlling the process, a larger proportion of fabrication costs are allocated to the chip manufacturing machines and equipment (Chu 2013). The Dutch company ASML has an effective monopoly in providing EUV lithography machines as it is the only one holding this crucial technology (Das 2023).

After being manufactured by foundries, they are then shipped for assembling, testing and packaging before ready to ship to downstream consumers. Package and testing the low-end of the value chain and it is a labour-intensive process and less skill- and technology-intensive than the other parts of the supply chain. This segment only generates 6% of the global industry revenue (Bown 2020). However, because of its labour-intensive nature, it was the first segment of the whole semiconductor value chain sought for outsourcing and has been globalised since the 1960s. Since the 1980s, about 85% packaging and testing capacity has been concentrated in Southeast Asia (Chu 2013). It was also the segment in the global semiconductor value chain where Taiwan first set foot in, when Texas Instruments (TI) first approved assembling facilities in the island in 1968 (Miller 2022, 65).

In the modern semiconductor industry, there are two main models for production. The more conventional one is integrated device manufacturers (IDMs), who design, manufacture, and market their own chips, and sell to downstream companies who use them in their products. The other model is fabless-foundry model. “Fabless” is referring to design companies who lack their own manufacturing factory (“fab”). They fabless companies only design and market their chips, but require foundry service from a foundry company. Foundry is referring to the manufacturing facilities which fabricate the semiconductor chips. Examples of fabless companies are Nvidia, Qualcomm. TSMC is an example of a foundry company. The foundry-fabless model allows design companies to focus on the inputs into R&D aspect

of the value chain, while foundry companies focus on the capital intensive investment of fab facilities.

In the semiconductor industry value chain, designing firms including both fabless and IDMs account for 74.6% of the total revenues worldwide, and is the highest proportion and the most valuable of the sector. IDMs, because they control the whole process of design, fabrication and packaging and testing, hold 51.7% in it, while fabless hold 22.9%. Next to it is the fabrication segment of foundries, which accounts 11.1% of the total market share in revenue. As discussed above, packaging and testing is the lowest value in the supply chain and accounts only 6% of the revenues. Apart from that, the equipment segment holds 8.2% (Grimes and Du 2022).

Taiwan has the most success in the IC fabrication segment of the industry. As of 2022, there were 15 foundry companies in Taiwan, the biggest ones include TSMC, UMC, PSMC, Vanguard etc. In total they hold a revenue of NT$2,920.3 billion, about 77.6% of the market share of the industry worldwide. Among that, TSMC alone generated NT$2,263.9 billion, being the single largest player in this sector. Apart from that, TSMC also holds the manufacturing capacity of 92% of most advanced chips under 10nm (Industrial Technology Research Institute 2022).

In the IC design sector, Taiwan played the second largest role in this segment, following the first position of the US. There were 262 design firms in Taiwan specialising in chip design such as 5G mobile phones and WiFi. Notable firms from top of market share include Mediatek, Realtek, Novatek, PHISON, Himax. Together this sector generated revenue of NT$1,232 billion in 2022, and held a worldwide market share of 20.8%.

In the packaging and testing sector, Taiwan also played the largest role, followed by China and the US. There were 37 packaging and testing companies in Taiwan in 2022. Some of them include ASE technology, PTI, KYEX, and Chipbond. Together they generated NT$ 684.7 billion, and held a market share of 53.9% (TSIA 2023).

4.2 Sectoral Migration to China

Although Taiwan has occupied a role in every vertical distribution along the value chain, and particularly secured a crucial role in fabrication of the most advanced chips, there have been significant sectoral migration from Taiwan to mainland China in the past two decades. In one sense, it has helped fostering and nurturing the development of the Chinese semiconductor industry, which became competitors to Taiwan; and in another sense, it created security concerns for Taiwan in national security and economic security. This section will be an overview of the sectoral migration.

Since the early 2000s, there has been steady and growing sectoral migration from Taiwan to China. Some of them even did so by evading Taiwanese regulation and restriction on investment to China, or even by deliberately disobeying the laws. As examined by Chu (2013), the sectoral shift was extensive and the scope covered along the supply chain, from chip design sector, fabrication sector, and packaging and testing sector. By the end of 2006, four out of the top five fabrication firms in Taiwan had invested in setting facilities in mainland China (Taiwan Semiconductor Industry Association 2007). Several types of migration could be identified: Taiwanese firms founding subsidiaries in China, Taiwanese owned newly founded enterprises, newly founded MNCs with Taiwanese participation, and existing or newly founded joint ventures. Based on interviews and secondary data, Chu (2013) analysed the flow patterns in technology flow, talent flow, and investment flow along the three segments of the supply chain.

Technology

For technology flow, four patterns were identified in the fabrication segment and/or packaging and testing segment, while three patterns were identified in the chip design segment. For fabrication and/or packaging and testing, the first pattern was the most common one, involving firms directly transferring mature and lower end technologies from Taiwan to China. Taiwanese firms got official approval from the government to build older

process technology fabs in China, and transferred the mature technologies to its own subsidiaries in the mainland. The second pattern was manufacturing operations which relied on Taiwanese investment or talent getting second-hand equipment from the international market. Through the process, they acquired technological know-how from Taiwanese engineers. The third pattern was that firms in China initially got technology, investment, or talent transferred from Taiwan, and grew mature enough to obtain high-end technologies from other foreign partners. SMIC and HeJain are the examples of this pattern, which their Taiwanese inputs would be discussed in the later part of this section. The fourth pattern was that Taiwanese firms initially got approval from Taiwan to move low-end technologies to the mainland, later involved in higher-end production activities which were forbidden by Taiwanese authority.

In the chip design segment, the first pattern of technology flow was Taiwanese subsidiaries in China involving in sales activities unrelated to chip design. It was a limited flow because only technology and know-how not directly related to chip designs was involved. The second pattern was the most common in the chip design segment, which involved Taiwanese subsidiaries in China engaging in lower-end and fragmentary tasks of the design flow. The main reason was to utilise the software engineering talent pool in China for software work, labour-intensive tasks. Firms usually kept the high-end specification, design layout and synthesis works in Taiwan. The third pattern was senior Taiwanese engineers opening chip design firms in China, directly transferring technological expertise and training to local junior engineers.

Investment

Following the liberalisation in early 2000s, influx of Taiwanese investment had been another important input to the Chinese semiconductor industry development. In 2005, it was the largest bulk of total foreign investment in the Chinese semiconductor industry, followed by the US, South Korean, European and Japanese capital. Substantial growth in approved Taiwanese investment in the electronic parts and components manufacturing industry, of

which semiconductor industry was part of this category (MOEAIC 2007; 2008). It had grown from around US$ 500 million in 2000 to US$ 2 billion in 2007. According to interviews conducted by Chu, the official number was underestimating the actual investment amount because many Taiwanese investments went to China “through many hands and places to skirt Taipei’s regulations” (Chu 2013, 124).

Talent

A lot of Taiwanese engineers were attracted by the opportunities in mainland China, and this generated a massive talent flow from the island to the mainland. Some industry insiders considered this as the most important component of the migration (Leng 2002). As of 2005, more than 1,200 Taiwanese engineers and executives were working in China-based semiconductor firms, about 650 working in SMIC, 200 in HeJian, 100 in TSMC Shanghai, 100 in GSMC, 50 in NSSI and 20 in CSMS.. These Taiwanese talents brought with them expertise and know-how, and helped train about 13,000 local engineers and technicians in the above mentioned fabrication firms. Apart from that, they also brought business connections with them to China (Chu 2013).

Through the sectoral migration, Taiwanese semiconductor firms had helped foster the development of their counterpart in mainland China. The China semiconductor benefited from the shift from the technology, investment, and talent flows from the island. First of all, Taiwanese firms helped train a substantial amount of local designers in China. According to interviews conducted by Fuller (2008), at least seven of the top ten largest Taiwanese design firms had subsidiaries or design centres in China, with two might have design centres in China but hiding from the authority to evade restrictions. For the fabrication segment, direct contribution by Taiwanese firms in training engineers was only moderate, because TSMC and UMC have only 4 fabs in China as of 2022. In contrast, China benefited the most from experienced Taiwanese engineers leaving the two leading firms and setting up new foundries in China, like Grace Semiconductor Manufacturing Corporation (GSMC) and

SMIC. They grew substantially over time and became some of the most competitive semiconductor firms in the China market. Apart from that, Taiwanese firms in China contributed to R&D on IT products. As of 2006, of the 939 corporate IT US utility patents from firms originating from China and created by foreign MNCs, large Chinese firms or Taiwanese firms, 689 patents were from Taiwanese associated firms, including GSMC and SMIC (Fuller 2008).

Below will be a brief example of three Chinese semiconductor firms which had significant Taiwanese inputs. One is chip design firms, and two are fabrication firms. They are selected because they are some of the most successful firms in the industry in China.

The first example is the leading Taiwanese chip design firm Realtek, which was the second largest design firm in Taiwan and eighth largest globally in 2022 (SIPO 2023). Since the lift on semiconductor investment ban, Realtek had been expanding to China, establishing two fully-owned subsidiaries in Suzhou and Shenzhen in 2002, which were approved by Taipei,. The operations involved “R&D and information service” and “design, research, development, selling, and marketing”. Apart from that, co-founders of Realtek also informally invested to start up a new design firm Actions Semiconductor in Zhuhai, China. The connection was framed by the vice-president of Realtek as investment in “personal capacity” by Realtek’s major shareholders, and they had withdrawn the investment fearing government inquiry after Taiwan’s authority took investigation into UMC’s problematic investment in the Chinese firm HeJian in 2005. Nevertheless, Realtek and Actions kept close business relations (Chu 2013). Director of Realtek Nan-Horng Yeh became CEO of Actions at the same time from 2005 to 2009. Nan-Horng Ye became Chairman of Realtek in 2009 until 2021. In the same year, when Actions Technology (successor of Actions Semiconductor) was listed on the Shanghai stock exchange, it was revealed on prospectus that Actions’ controlling shareholders were a company related to the Yeh family (Wang 2021).

Hua Hong Semiconductor ranked fifth on chip fabrication revenue globally in 2022 (SIPO 2023). It was merged by Hua Hong Semiconductor and GSMC in 2011. GSMC was co-founded by Winston Wong, son of Taiwanese corporation Formosa Group Chairman Wung-ching Wang, and Jiang Mianheng, son of the then Chinese President Jiang Zemin. The company was incorporated in the Cayman Islands in 2000, presumably to avoid Taipei's investment restriction. Multinational capital involved in GSMC, including foreign private inequity, Hong Kong, Chinese bank loans and government subsidies. GSMC Technology transfers relied on foreign sources like US and Japanese companies, but the key input from Taiwan was Winston Wong's recruitment of several experienced Taiwanese engineers and managers (Chu 2013; Miller 2022).

SMIC was the biggest chip manufacturer and fourth in the world in 2022 (SIPO 2023). Sharing a similar background with GSMC, SMIC was incorporated in 2000 in Cayman Islands, by Richard Chang who was born in China but moved to Taiwan in 1949. He grew up and educated in the island, and went to the US for further education and worked in Texas Instrument before coming back to Taiwan to start his own semiconductor business. Later when he established SMIC in Shanghai, he consolidate multinational sources of capital, talent and technology, including investment from private investors from Taiwan and the US, quasi-public investments from China and Singapore; engineers from the US, Taiwan, Singapore, South Korea etc.; technologies transferred from several MNCs from Germany, Japan, Singapore, and the US, in exchange of stocks or manufacturing capacity. Chang emphasised his US citizenship as an excuse to not follow Taipei's investment restriction (Chu 2013). At least 100 Taiwanese engineers were recruited from TSMC to SMIC (Chase *et al* 2004, 116). TSMC accused SMIC of violating its patents and took action in American courts. Eventually the two firms settled in 2009 with SMIC to compensate TSMC for US$ 200 million, and TSMC got 10% of SMIC's share (Reuters 2009).

After a brief introduction of the current positions of the Taiwanese semiconductor industry in the global value chain, and the sectoral migration to China. The following sections will try to

examine the dynamics of development of the semiconductor industry in Taiwan and the changes which led to the sectoral migration.

4.3 Neomercantilist Origins of the Semiconductor Industry in Taiwan

In the previous section, the key positions of Taiwanese firms in the global semiconductor value chain is evident in the huge market share they are occupying, of which TSMC in the IC fabrication segment is one of the most important players in the industry. This section will provide the historical background of the development of the semiconductor industry. There have been plentiful academic discussions on the relation between the success of the industry and the developmental state in Taiwan. This section will try to contextualise the relations on the geopolitics that political leaders were facing at the time, and examine the neomercantailist origins of the semiconductor industry in Taiwan. This section contends that the development of semiconductor industry is rooted in Taiwan's strategies for national-building, securing diplomatic alliance with its biggest allies the US, and providing economic and political securities in the geopolitics in the region.

Early in the mid 1960, there were three major incidents which happened around the same time, kicking off Taiwan's developmental state which focused on achievements on economic developments through state-sponsored science and technology research institutions and programmes. In 1964, China succeeded in testing its first atomic bomb. Two years later, it tested guided missiles and hydrogen bombs in October and December respectively. This created an immediate threat to Taiwan's national security. Quickly responding to that, President Chiang Kai-shek and Premier C. K. Yen addressed the importance of training more scientific personnel, improving and strengthening research on science and technology, in order to suit Taiwan's nation-building and military development needs (Greene 2008, 74-5). Another factor is the cessation of US aid. Around 1957 to 1958, because of the growing financial pressure from its involvement in the war in Vietnam, the US re-elevated its foreign aid policy and decided to gradually cut out aid to its Asian allies

(Chang 1965; Jacoby 1966). The strategy of foreign aid changed from military-oriented to development-oriented (Shiau 1989, 54, 59-60). On this background, the US initiated an accelerated development programme for Taiwan, to make it an “attractive showcase” of the achievements of a “free society” and maximise sound economic growth in the next 4-5 years. Subsequently, USAID, the agency for US aid programmes, changed its goals on science education programmes to promote expansion of industry and agriculture towards economic self-sufficiency (Greene 2008, 55-6). The aim is to reduce Taiwan’s dependence on US aid. Apart from that, Taiwan was transforming from an import substitution industrialisation (ISI) to an export-led industrialization strategy. Early goals of rebuilding basic infrastructures, improving agricultural output, and encouraging growth in essential industry had been largely fulfilled. Taiwan had to find alternative sources of foreign income to replace US aid, economic planners identified new opportunities to invite foreign investment into Taiwan to develop new industries. That made them realise Taiwan needed to strengthen science and technology (S&T) education and increase its talent pool in order to attract multinational corporations (MNCs) and to take advantage of technology transfer and spin-off from those new industries (Greene 2008, 72-3).

By late 1960s, As political leaders were putting more emphasis on S&T to fulfil the demand from economic development, Minister of Economic Affair Li Kwoh-ting (K.T. Li) addressed the connection between S & T and economic growth. He stated that, “It is clear… that we will have to step up our efforts in the field of science and technology if we are to sustain our economic growth, or ever hope to narrow the income gap” (Li 1967, 2). And he observed that the next economic plan would promote developments on electronics, petrochemicals, machinery and export processing. With that in mind, political leaders were trying to adapt new strategies for economic as well as political security. In 1968, K.T. Li met with Mark Shepherd and Morris Chang, two Texas Instruments (TI) executives visiting Taiwan on a tour to select locations for a new overseas semiconductor chip assembly facility. Li wanted to secure more ties with the US and one of his strategies was through the semiconductor industry. He believed that the US would be more willing to defend Taiwan

should a TI facility was on the island. The more semiconductor plants there were, the safer Taiwan would be. Not only would Taiwan have better military strategic values, it would also transform Taiwan's economy, catalyse other investments and help Taiwan produce more higher-value goods (Miller 2022, 63-5). It was the beginning of Taiwan getting its hand on the global semiconductor value chain. It is evident that since the very beginning, a semiconductor industry in Taiwan was a product of a broader strategic need for the state.

In the 1970s, political leaders were facing another set of economic and political crises, and they pushed the Taiwan state to put greater investment and efforts on S&T and to further advance the economic development of Taiwan.

In 1971, ROC left the United Nations when the People's Republic of China joined the organisation. In 1972, US President Richard Nixon visited Beijing, and this and the Shanghai Communiqué kicked off a decade of normalisation of relations between China and the US. Quickly after that, ROC lost diplomatic relations with many other countries, and eventually with the US in 1978. In this series of diplomatic crises, Taiwan became more and more isolated in the international arena. It was in this context that political leaders decided to use economic ties as an alternative to political ties. They were now committed to an aggressive strategy for promoting economic growth and expanding the export economy. In this way, fully integrating Taiwan's economy into the global economy could maintain Taiwan's relations with its former political allies, and keep itself in part of their political interests. At the same time, the 2 oil crises in the 1970s also impacted Taiwan's industry which relied heavily on energy import. Political leadership aimed to promote more technologically advanced industry which would be less energy-intensive. For example, capital- and technological- intensive industries in steel, electronics, and precision machinery were encouraged (Shiau 1989, 76-8; Greene 2008, 118-9).

In 1973, the Ministry of Economic Affairs established the Industrial Technology Research Institute (ITRI). Its main job was to provide Research and Design (R&D) services for the industry sector, development and then transfer technologies to domestic firms, serve

as a bridge between industry and academia, promote ventures between locally and foreign owned industries to universities. ITRI sent a delegation of 38 scientists to the US for short-term semiconductor training in the mid-1970. After their return, the Electronics Research and Service Organisation (ERSO) was formed under ITRI, specialising in research in information technology (Greene 2008, 120-2). In 1976, ITRI and ERSO partnered with the US semiconductor firm RCA, and reached agreement for technology transfer and setting up a fabrication facility in Taiwan. Insisted by senior government officials like Premier Sun, it would be a Taiwan-owned spinoff instead of owned by RCA. The state had to establish the new spinoff firm because no private domestic firms were taking up as the major shareholder. It set the first ITRI project on semiconductor fabrication and brought technological and industrial upgrading to the island's economy. United Microelectronics Corporation (UMC) was hence born. By 1982, the initial investment had already broken even (Fuller 2020, 629). However, UMC still lagged behind the cutting edge technologies, and captured only a small portion of the profits in the chip industry. Economic planners like Minister K.T. Li knew that Taiwan needed another breakthrough in the semiconductor industry in order to capture a more advanced role in the global economy (Miller 2022, 164).

A new initiative was launched. Another ERSO project was the very large-scale integration (VLSI) project from 1983-1988. K.T. Li invited Morris Chang from the US and took the job as the director of ITRI, placing him in the centre of the semiconductor development of Taiwan. K.T. Li offered Morris Chang generous terms on financial backing from the government, and gave him bigger flexibility and freedom (Miller 2022, 163-7). Morris Chang had been crystallising the idea of a new pureplay foundry model, focusing only on fabricating chips for chip designers without their own fabrication capacity. At this time, some small design companies in Silicon Valley were trying to focus only on designing chips, and rely on bigger IDM companies to spare their fabrication capacity sometimes. They were subjected to the willingness of the bigger companies, and feared the designs would get stolen because they were competitors with the IDMs after all. Secondly, digitalisation and modularisation were also mature enough for design houses in the US to send their design to Taiwan for

fabrication. It was the right timing for the new model to take off. TSMC was therefore established as a spinoff from ITRI, with Morris Chang being the head of the new company, and 48.3% of investment was provided by the government. The Dutch company Philips was convinced by Morris Chang to transfer technologies and licence its intellectual property in return of holding 27.5% share of the TSMC. Some domestic Taiwan firms were also asked by the government to provide some investment (Miller 2022, 167-8; Fuller 2020, 629-30).

With the setup of the Hsinchu Science Park in 1979, it became a crucial cluster for R&D efforts and linkage among academia (science-oriented Qinghua and Jiaotong universities around the area), state's institutions like (ITRI), and the industry. It was envisioned to be a melting pot that "utilised Taiwan's indigenous state-sponsored S&T resources in combination with returning scholars and entrepreneurs and the know-how imported by foreign companies" (Greene 2008, 136). UMC and TSMC, and many other firms in chip design and assembly and testing, forming one semiconductor cluster supporting and exchanging with one another. The semiconductor industry in Taiwan is clearly a state project, on one hand serves the economic need of upgrading and diversifying its economy, promoting economic growth and technology advancement; on the other hand serves the political and strategic needs of forming closer ties with political allies internationally amidst diplomatic setbacks and political crisis throughout the 1960s and 1970s. However, while it being crucial for the economic and political security of Taiwan, we could observe that the industry was gradually migrating and integrating to China, creating significant concerns for political leaders and scholars alike. Next section will be discussing yet more changes in the global economy and geopolitics which set the foundation for the period of semiconductor migration.

4.4 Transformation of the Neomercantilist State

4.4.1 Liberalisation and Globalisation

The semiconductor industry of Taiwan has its root in the neomercantilist policies from 1960s and 1970s onwards to serve the purposes of economic stability and political security, deliberately to form closer ties with political allies amidst political crises in the changing geopolitical environment. However, yet again significant changes in global political economy and geopolitics from the 1980s and 1990s onwards greatly impact the developmental state and the neomercantilist policies. Although the semiconductor industry was crucial to the economic and political security of Taiwan, there have been substantial cross-strait migration and integration to China, prompting security concerns for Taiwan. This section will analyse the external and internal pressures Taiwan was facing at the time which led to the transformation of the neomercantilist state, trade globalisation and liberalisation, and the subsequent migration and integration of the semiconductor industry to China.

As Gray (2011, 588) put it, Taiwanese industrialisation was a product of US grand strategy, and “Taiwan’s importance was always secondary to the wider dynamics of US-China relations”. On top of that, while Taiwan was utilising an export-led model as a development strategy, so were other NIEs, and it sparked protectionism in the developed countries (Shiau 1989, 77). From the 1960s onwards when Taiwan started integrating itself to the global production network, trade with the US had been increasing substantially. Taiwan’s export to the US grew from US$ 18.9 million in 1960 to US$ 66.3 billion in 1989, with a huge trade surplus to the US of US$ 16 billion in 1987 figures. At the same time, 43% of Taiwan's total export was to the US between 1979 to 1987 (Huang 2009, 42). Taiwan’s export economy had long been dependent to the US, and with addition to political and military reassurance[2] from the US as strategies for national security, it was facing asymmetrical power relations with its biggest trading partner. Trade negotiations intensified during the 1980s, with 22 rounds of trade talks conducted. Because of the pressure, Taiwan had to make concessions on tariff rates, market access, exchange rate systems, labour rights, intellectual property protection, public procurement and other non-tariff barriers

[2] The Sino-American Mutual Defense Treaty from 1954, later replaced by Taiwan Relations Act in 1979 when the US established formal diplomatic relations with China.

(Huang 2009, 44). At the same time, Taiwan sent special procurement missions to the US to balance the trade surplus. 18 missions were sent from 1978 to 1992 (Yang 2003). As a response to the growing pressure, in 1984 newly appointed Premier Yu Kuo-hwa quickly announced the government's objectives of "Liberalisation, Internationalisation, Institutionalisation". The next year, the Economic Reform Committee was formed with state officials, industry and academic representatives, formulating directions on liberalisation on trade, finance, investment, and industry privatisation. For example, average tariffs decreased from 20% before 1987 to 12.1% in 1988. Finance liberalisation led to opening of private banks and more competition. In 1991, 15 new banks were established. It allowed industrial sectors to obtain flexible and abundant capital financing. On the other hand, privatisation led to a bigger role and growing influences of the private sectors in the economy and economic policies (Chen 2013). In 1990, Taiwan applied for the membership for the General Agreement on Tariffs and Trade (GATT) in the name of "Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu". Although initially facing pressure from China for political reasons, Taiwan eventually joined the World Trade Organization (WTO) in 2002 after a lengthy accession process of 12 years (Huang 2009).

Domestically, the Taiwan state faced new social forces that arose from the very authoritarian developmental regime the state had deployed for earlier economic development. The new social forces contested on the specific geopolitical context of Taiwan's industrialisation, namely the dominance of the industrialisation agenda over social well-being and equity, ethnic basis of the KMT state and its suppression of the local non-mainlander ethnic group, the party-state corporatism and political authoritarianism. Movements involved include consumer protection, anti-pollution and conservation, minorities' language and cultural rights, labour and social movement from key sectors such as farmers, teachers, women etc., sensitive political issues such as human rights and ban on private contact between Taiwan and mainland (Gray 2011, 589-90). Eventually, it led to

democratisation in the political aspect. Martial law ended in 1987, and visiting mainland China was allowed in the same year.

As noted by Dent (2003b), democratisation in East Asia has led to the emergence of a more pluralistic society and polycentric distribution of powers, and they challenged the authoritarian basis of the developmental state. In other words, not only the civil society are having greater participation in public affairs and influences on government policies, so are the business and industrial sectors. It is what some call the “gravedigger” hypothesis. While the state nurtured a growing business sector as a developmental strategy, it “creates an increasingly empowered bourgeoisie that in turn seeks greater political power and a more liberal policy agenda” (Dent 2003b, 467). On one hand, with the maturation of firms that have spun off from state’s developmental programmes and gained industrial success in the global value chain, industry leaders were starting to act on their own interests. For example, In the development of the semiconductor industry, when ITRI initially kicked off the VLSI project which eventually led to TSMC, UMC opposed it because the resources should go to them instead of starting a new project. The next ERSO-led research project in 1990-1994 the Sub-micron Project to acquire DRAM technology also faced opposition from Acer, because it had already established a joint venture with TI and entered the market of this sector. Nevertheless, the Sub-micron Project led to another spinoff from ITRI, Vanguard, which was the last major spinoff project of ITRI. By late 1990s, ITRI tried to initiate a new research project Advanced Semiconductor Technology Research Organization (ASTRO) on future generations of process technology. TSMC and UMC both opposed the project. Without the support of the two successful industrial leaders, the project failed (Fuller 2020; Fuller 2007). Another example is that in march 2009, amidst the global financial crisis, the Taiwanese government proposed to use the National Development Fund to merge the small local DRAM firms, which were in a “life-and-death” struggle during the crisis, into a single firm Taiwan Innovation Memory Corporation (TIMC), and to partner up with foreign firms such as Elpida and Micron for technology transfer. However, the largest players among them, Nanya and Powerchip, showed reluctance in participating in the project. The

Legislative Yuan voted against the use of the National Development Fund as they deemed the project as futile because of this (Fuller 2017; Fuller 2020). These examples show that domestic firms gained growing influences in the industry and could alter government's industrial policies regarding new development in the semiconductor industry.

On the other hand, the private sector as a whole became powerful enough to alter the political environment and facilitate cross-strait economic integration. Starting from the late 1980s, with the end of martial law domestically and approaching the end of the Cold War globally, Taiwan relaxed restrictions on trade and investment to mainland China. Indirect investment to China was permitted in 1991. With the deepening economic reform strategy pushed forward by Deng Xiaoping in 1992, more and more Taiwanese firms were attracted by the opportunities and lower production cost in the mainland, regardless of their firm sizes. By 1996, China became the biggest export market of Taiwan, with average trade value reaching US$ 37 to 45 billion (Shiau 2004). The state initially tried to restrain the trend and to stop the cross-strait capital flow. President Lee Teng-Hua announced the "no haste, go slow" policy in 1996, and released new guidelines banning high-tech investment, infrastructure projects, and capping singular project investment to a US$ 50 million ceiling in 1997. But because of the financial liberalisation and deepening globalisation, Taiwanese firms were able to find workarounds by rerouting capital via a third country, such as Hong Kong or offshore banking locations in the Caribbean (Dent 2003a, Fuller 2008). Despite the initial success of the restrictions, the state quickly faced growing resistance from the business and industrial sectors. Beckershoff (2018) analysed the new social forces emerging from the privatisation and deregulation with a state-funded upgrading into high-tech industries. An alliance of pure-play foundries in semiconductor industry, electronics assemblers, and finance bourgeoisie took the window of opportunities of Chen Shui-bian from the Democratic Progress Party (DPP) becoming the president in 2000, and the burst of the "dot-com bubble" which led to an economic crisis in Taiwan. Leading by Wang Yung-ching of Formosa Plastics, other business tycoons like Barry Lam of Quanta Computer and Morris Chang from TSMC were mobilised for their share interest with a stable relations with China, framing a

rapprochement with the mainland as the only way out of this economic crisis, and Wang urged the government to focus on economy, not politics (Dobson 2000, Beckershoff 2018). Chen convened the Economic Development Advisory Committee (EDAC) in August 2001 as the crisis persisted. The EDAC consisted of bipartisan representatives, scholars, business leaders and workers. The business sector successfully channelled its structural power “to achieve the first steps towards a normalisation of economic cross-Strait relations” (Beckershoff 2018, 234). The EDAC reached the consensus of replacing the “no haste, be patient” principle to a new motto “active opening, effective management”. A total of 322 action items were made, including relaxing capital investment restrictions to China, setting up a regulating task force to review easing of investment restrictions on selected industries and products, allowing enterprises to make direct investment (Yang and Hung 2003). They were all convinced that if Taiwan did not ease the investment restrictions, Taiwan companies, especially the high-tech sectors would lose their competitiveness. Morris Chang even said that “not going to China would risk TSMC losing its competitive edge to companies that do go” (Dobson 2001).

This revealed the global competition the Taiwan semiconductor industry faced. As China opened up its economy for foreign investment, leading chip firms in the industry all took advantage of the low production costs in China. Taiwanese firms had to follow the trend in order to stay competitive in the international market. This was the main argument in the heated debate in the subsequent year, when the government was deciding whether to lift the ban on semiconductor investment across the Strait. Construction cost of building a fab in Shanghai was 35% cheaper than in Taiwan, on top of that water supply is 60% cheaper and bulk gas cost 30% lower. There was a huge cost advantage in both constructing and operating a fab in China over Taiwan. Secondly, as China also joined WTO in 2002, original equipment manufacturers (OEMs) were expected to grow, creating enormous demands on IC chips for manufacturing electronics products. In April 2002, the Taiwanese government decided to lift the ban on semiconductor investment in China for “small scale” and "low level” investment under the principle of effective management. Mature technology of 8 inches

wafer was allowed, while cutting edge 12 inches wafer fabrication had to remain in Taiwan (Yang and Hung 2003).

4.4.2 Transforming State Role in the Global Economy

In the above discussion, we could see that the developmental state and the neomercantilist strategies were under external and internal pressures, which led to the liberalisation and globalisation of the economy, and economic integration to mainland China. However, it did not imply the end or retreat of the developmental state. This thesis agrees with the camp of debate that while the Taiwanese state has to adapt and transform itself in the new political economy, it has managed to reorganised state institutions and deploy new policy tools, and to reconstitute new “developmental alliances" (Chu 2021) or “adaptive partnership” (Dent 2003a) in the new state-business relations.

First of all, though pressured by the new geopolitical situation and new domestic social forces, the state’s decision to further liberalise cross-Strait capital flow can be interpreted as a means to achieve certain foreign economic policy objectives. Using the macro-framework of foreign economic policy analysis proposed by Dent (2003a), growing economic integration with Taiwanese capital in mainland China could help realise economic security objectives on Taiwan’s foreign economic policy. For supply security, it diversified the range of resources and products available to Taiwanese firms at competitive costs. For market accessing security, access to the Chinese market contributed to the annual trade surpluses approaching US$ 20 billion in the Taiwan-China bilateral trade alone, which in turn helped accumulating foreign exchange reserves and fulfilling the finance-credit security objective. Cross-Strait linkage also helped advance techno-industrial upgrading of key industries such as electronics, maintaining Taiwan’s techno-industrial capacity security. In this sense, lifting the ban on semiconductor investment is an example of what Dent called the “Liberalisation Plus” model. It was a controlled and gradual approach for liberalisation with strong state mediation. It set a firm institutional and regulatory framework with attention

to gradualistic sequencing. It was the state's cautious attempt to mediate liberalisation driven by market logic and anxieties over potential developments in cross-Strait economic relations and dependency to mainland China which would undermine Taiwan's security (Dent 2003b). Lifting the ban allowed the state to put regulation and management on the capital flow, and maintain the technology edge and competitiveness of Taiwanese firms. For example, firms could apply for permission to build 8 inch fabs in mainland China, only when they had produced 12 inch wafers in Taiwan for more than 6 months, and only process technology bigger than 0.25 μm was permitted. In that way, Taiwan could secure the technological edge. In 2006, when the restrictions were reviewed by the Investment Commission under the Ministry of Economic Affairs (MOEAIC), similar concerns were considered. Because fabs in Taiwan had advanced the process technology 4 to 5 generations ahead to 90 and 65 nm, and local Chinese firms had already acquired 0.18 to 0.13 μm process technology from foreign firms, the MOEAIC once again relaxed the restrictions for building 0.18 μm 8 inch wafer fabrication fabs in mainland China, so that Taiwanese could maintain competitiveness, and the Taiwan state could "assist upgrading in semiconductor industry", "leverage the niche of an expanded global presence", and "further consolidate Taiwan's critical position and competitive advantage in the global semiconductor market" (MOEAIC 2007). In 2015, a similar pattern occurred again. TSMC's major competitor in the foundry sector Samsung had already built two 12 inch fabs in Xi'an, China. MOEAIC again relaxed regulation, allowing TSMC to build 12 inch wafer fabs to serve the growing Chinese market. Again there was a clause that process technology for 10nm below had to remain in Taiwan, in order to protect a technological edge (Patterson 2016) .

Another feature of the new developmental alliance was the state's practices of defensive globalisation. The state mobilises financial and regulatory resources to facilitate and channel its corporations' global expansion, to sustain economic growth but also to preserve economic security, in the sense that to seek to maintain or advance their positions in the global value chain (Chu 2021). For the semiconductor industry, the Taiwan state shifted its role from leading to promoting the industry, but continued supporting R&D

investment as the strategy to keep the leading position on fabrication in the global value chain. Although it underwent regime transitions, state developmental institutions did not go through significant reorganisation. Lower-level state institutions such as ITRI and other government institutions like the Ministry of Science and Technology remained in their function of providing crucial support to the industry. Taiwan's R&D was one of the highest in terms of GDP globally, from NT$ 395.9 billion in 2010 it grew to NT$ 660.8 billion in 2019, an increase of over 66.9%. Because of their maturity and global success, the private sector provided 81% while the public sector provided 18.2% (Ministry of Science and Technology 2021). Despite sectoral migration to China, the state's policy has managed to keep the most valuable asset in the global value chain -- cutting edge technology in the hands of leading Taiwanese firms.

All in all, despite sectoral globalisation and trade liberalisation, the Taiwanese state has adapted new state-business relations to form a developmental alliance. State institutions continue with their support to the semiconductor industry through promotions, providing a favourable business environment and policy such as tax incentives in a way of what Dent (2003b) "residual neomercantilism". With state's support and their success in the global value chain, leading fabrication firms, particularly TSMC, have been able to keep advancing on cutting edge process technologies, holding a critical position in the value chain and the manufacturing capacities for the most advanced chips for its foreign partners. At the same time, Taiwan has been able to keep the complete ecosystem of the industry clustered domestically, continue to perform and contribute to the Taiwanese economy.

4.5 Another Geopolitical Shift

As analysed in the previous sections, geopolitical shifts in US-China and cross-Strait relations and economic globalisation from the early 2000s allowed the semiconductor industry of Taiwan to follow its market logic, and substantially migrated to mainland China, mainly attracted by the growing semiconductor market, talent pools and lower production

costs, bringing technologies, talents and capital from the island to the mainland. However, another geopolitical shift in the later half of the 2010s, namely the US-China trade war and the subsequent confrontation of the two countries on technology development, has once again changed the landscape of the semiconductor global value chain, causing global restructuring, and changed the strategies for both the Taiwanese state and the industry.

Semiconductor was in the centre of the US-China trade war very early on. In 2017, the US government started an investigation on China's unfair trade practices under US Law Section 301. In 2018, reports were issued accusing China for forcible and below-market transfer of technology, as well as state-sponsored industrial espionage and theft of intellectual property. The US imposed 25% tariffs on semiconductor imported from China. Concerning national security on its involvement on 5G communication equipment, the US put the Chinese tech giant Huawei to a "Entity List" in August 2019, barring it from receiving goods or services from American companies without licences from the government. In 2020, the chip manufacturer SMIC was also added into the export control list, with the export control expanded to any goods made with US-produced technologies to be sold to the mentioned Chinese entities (Bown 2020). Not only Huawei cannot design chips using US softwares, SMIC cannot manufacture chips with US tools, TSMC also cannot manufacture chips designed by Huawei because TSMC relies on US equipment. Despite Huawei being TSMC's biggest customer, TSMC decided to abide by the rules according to "the intention of the US government" (Stacey and Hille 2020). As both were navigating the restructuring supply chain, TSMC's Chairman and government official ensured that it would not hurt the firm's or Taiwan's economy (Fuller 2021). The confrontation continued by the Biden administration. On 7 October 2022, US Department of Commerce extended export controls on advanced computing and semiconductor manufacturing items to China, effectively restricting China from obtaining advanced computer chips and the ability to manufacture advanced semiconductors, in order to "protect US national security and foreign policy interests", and to counter China's attempt in developing supercomputing capabilities and becoming "a world leader in artificial intelligence by 2030" (BIS 2022). The US also

persuaded allies to take similar actions. Japan and the Netherlands both announced export controls on critical semiconductor equipment and tools to China in 2023 (CNA 2023a; CNA 2023b) .

As Miller put it, the globalisation of the semiconductor supply chain is making countries more intertwined than ever before, that networks knit together have become a domain of conflict. In the semiconductor industry, globalisation has led to monopolisation of chip “choke points” , where a handful of actors have control over certain nodes along the supply chain. The asymmetric networks allow the US to weaponise this interdependence to exert coercion and control (Miller 2022; Farrell and Newman 2019). Choke point on chip fabrication of advanced logic chips lies in TSMC of Taiwan and Samsung of South Korea, where both countries rely on US military protection.

Both the state and the semiconductor industry in Taiwan need to respond to the reorganisation of the global supply chain in order to survive. On state level, Premier Su expressed on several occasions that Taiwan would partner with the US and allies, strengthen economic relations between the two and work jointly to advance supply chain realignment (DIS 2020). And the government would continue its comprehensive support to the industry through tax incentives, encouraging investment and easing restrictions on talent recruitment, in order to maintain Taiwan’s edge on advanced technology and competitive advantage (DIS 2022). On 7 Jan 2023, MOEA’s amendments on the Statute for Industrial Innovation Article 10-2 and 72 (“Taiwan Chips Act”) were passed by the Legislative Yuan. The new policies were to formalise the tax incentives to R&D expenditure for high-tech industries including semiconductor firms. TSMC was considered benefiting from the amendments the most as the firm was spending 8% annual revenue to R&D for its next generation 2 nm process technology, which was expected to be commercially available by 2025 (Wang 2023). At the same time, Taiwan joined the “Chip 4 Alliance” initiated by the US, along with Japan and South Korea to coordinate a stable supply chain, and the Alliance held the first senior official level meeting in February 2023 (Kaur 2023).

On the industry level, TSMC abided by US export control closely as discussed above. TSMC announced in May 2020 that it would build a new fab in Arizona, US. It would use 5 nm process technology and be operational by 2024. A second fab in Arizona was announced in December 2022, using even more advanced 3 nm process technology. Similar plans to build facilities for advanced chips in Japan and Germany were also announced. To respond to concerns that the trend would hollow out Taiwan's semiconductor industry and talents, MOEA, TSMC Chair Mark Liu and CEO C.C. Wei all assured that cutting edge process production would remain in Taiwan, and Arizona plant manufacturing capacity would only be 0.9% of total TSMC capacity. Apart from that, only 500 TSMC engineers went to support the building of the plant, while TSMC hired in total 50,000 Taiwanese engineers. MOEA emphasised the clusters of a complete semiconductor ecosystem developed over 40 years in Taiwan that remained irreplaceable (CNA 2022a). TSMC also held a grand ceremony for the expansion of a 3 nm fab in the Southern Taiwan Science Park on 29 December 2022 to boost confidence. In the ceremony, Mark Liu expressed gratitude to the government's assistance (CNA 2022b).

Once again, we could see the new developmental alliance as previously discussed are working closely together in the changing international economy and geopolitics. Supported by the state ,the semiconductor industry is strengthening its business ties with foreign partner firms and Taiwan's political allies, while the state is forming political ties in the realignment of the global supply chain. Retired TSMC Chair Morris Chang described globalisation in the chip sector as dead (Wu 2023). Although the semiconductor value chain would still be positioned globally, it is true that the dominant actor, namely the US, wants to cut it off from China, concerning the US's own national security and diplomatic interests. The globalisation of the sector was only possible when the hegemonic power allowed it, and when it was beneficial to the dominant power. The trend has been reversed when a major confrontation in geopolitics occurred between the two biggest economies in the world.

5.Conclusion

This thesis has addressed the following research question: "**Why is Taiwan successful in holding a key position in the global value chain in the semiconductor industry, but at the same time the industry in Taiwan has been collaborating with China, its potential competitor and rivalry?"** By conducting a case study, focusing on the congruence method for analysing the event development and decision making from first and second hand sources, this thesis showed the dynamic of neomercantilist strategy in the changing geopolitics of globalisation.

Literature review investigated available literature on the two rival camps of thoughts on the globalisation of the semiconductor value chain, and how it led to the integration and migration to China. This thesis tries to put the statist approach on a wider theoretical framework on neomercantilism, and examine the relations between the development of Taiwan semiconductor industry and the state's concerns over national and economic security. Subsequently in the next section on theory, the history of the theoretical tradition of neomercantilism in global political economy was discussed. Not only the needs for national and economic security of states were explored, the essence of the global market in the perspective of neomercantilism was also analysed. It contends that an open and stable international economic system is only possible when the hegemonic power is willing as well as able to provide leadership and support, if the hegemon deems the system is beneficial to its own interests. In another sense, Globalisation could also have both enabling or constraining effects on states (Cohn 2016).

After an overview of the global semiconductor value chain and the key positions which Taiwan is able to hold along the value chain, the sectoral migration to China was also discussed. During the era of economic liberalisation and trade globalisation, substantial flows of technology, capital and talents were observed from Taiwan to mainland China, fostering and benefiting the semiconductor sector in China, and saw the rise of some of the major competitors to Taiwanese firms.

Tracing back to the initial development of the Taiwan semiconductor industry, this thesis showed its root on the neomercantilist strategy from early on in the 1960s to 1980s. Taiwan semiconductor industry was a state project for economic security in upgrading its industry, and political security in developing ties and former diplomatic allies. However, certain changes on domestic and international sphere have pressured the developmental state to adapt a new state-business relations, the a shift on the geopolitics, namely normalisation of US-China relations and the globalisation of international economy, allowed the regional economic integration as well as sectoral migration of the semiconductor industry from Taiwan to mainland China. However, when another major geopolitical shift happens, the trend of globalisation of the chip industry has to be reverted as the hegemonic power deemed it threatening its national security and interests, and weaponised the interdependent production network to exert control and coercions.

This thesis contends that the globalisation of the semiconductor industry, with the particular case of Taiwan, only happened when the geopolitics environment allowed it. As it was from the beginning a state project for securing Taiwan's need for economic and political stability. This thesis can aid in the understanding of how states' pursuit of national and economic security intertwined with the trend of globalisation of production networks in the past decades. As concluded, in the changing and reorganising of global supply chains amidst geopolitical confrontation between the US and China, future study could focus on the changing political economy of the semiconductor industry in the new geopolitics in the Asia-Pacific region or on a global scale.

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