Faculty of Behavioural, Management and Social Sciences

SILICON SHIELDING

HOW THE TAIWANESE SEMICONDUCTOR INDUSTRY CO-EVOLVED WITH TAIWAN

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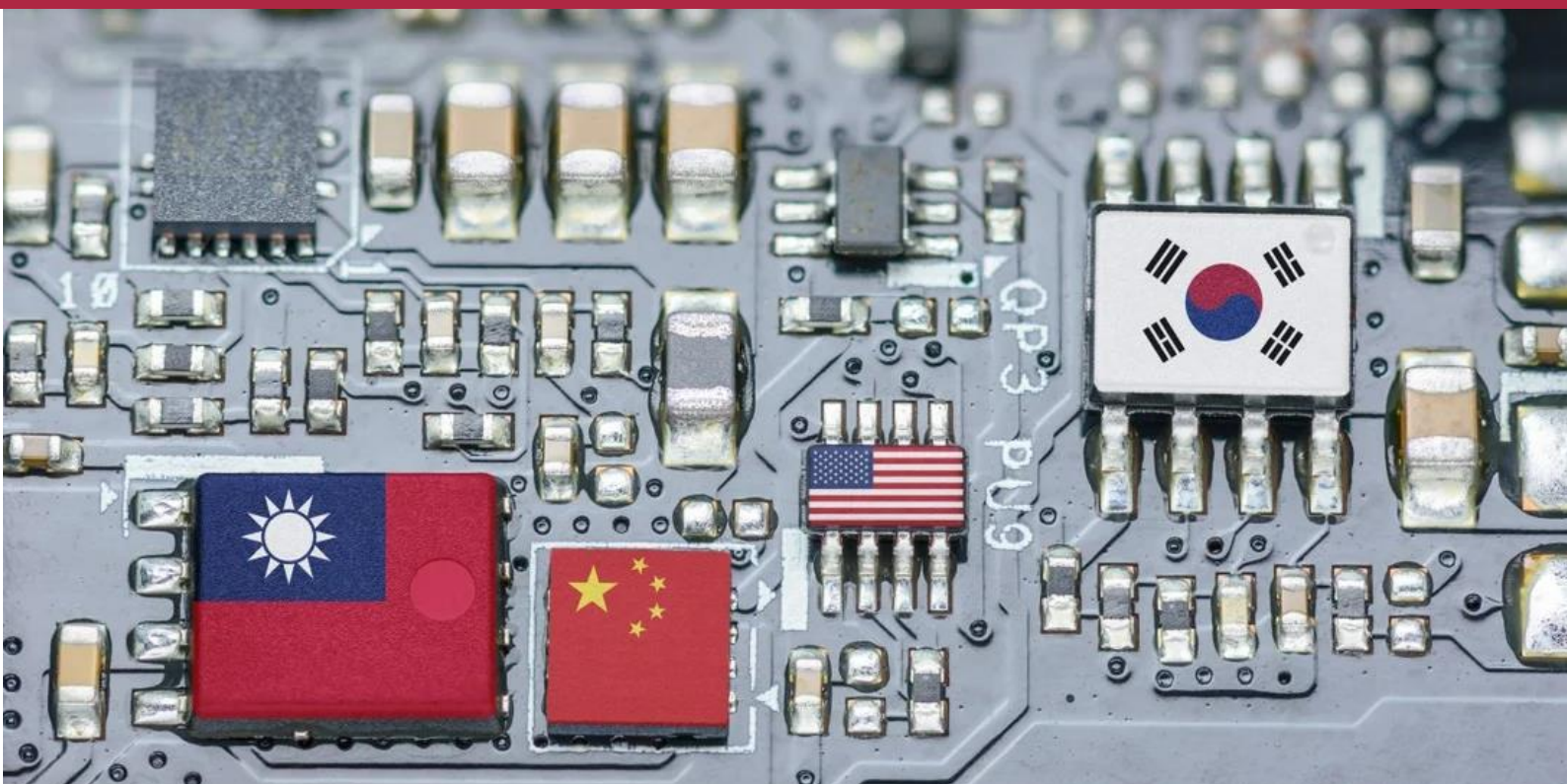

ABSTRACT

This thesis offers a historical analysis of how the Taiwanese semiconductor industry was adopted by and co-evolved with Taiwan's politics. It contributes to the field of history of technology by studying how technology, upon its adoption by society, shapes, impacts and co-evolves with society and vice versa. I argue that this embedded approach is crucial for a comprehensive understanding of any history of technology, because technology is always embedded in society: there is always a societal context that enables and motivates decisions, and in which the technology develops and molds itself with society. This research analyzes this process for the case of the Taiwanese semiconductor industry and in what ways it intentionally and unintentionally impacted Taiwan's politics.

This thesis is divided into three chapters. The first chapter focuses on UN resolution 2758 and argues that Taiwan changed its vision for the future upon being faced with potentially becoming politically isolated and losing its sovereignty. In turn, Taiwan shifted its focus from reunification with the mainland to remaining politically present and relevant in the international sphere. One of the ways in which Taiwan chose to do so was by making the decision to adopt the semiconductor industry. This chapter analyzes how these events led to this decision.

The second chapter is about the various strategies Taiwan employed in pursuing its political ambition to maintain its sovereignty and remain involved in the international sphere. Growing and developing the semiconductor industry was one such strategy, as was transforming Taiwan's economy and becoming a democracy. I argue that these strategies show that Taiwan pursued its political ambition by not just tackling politics, but other areas of society as well. Developments in these separate areas would in turn spill-over to other areas, showcasing how they ultimately change, develop and co-evolve with society together.

The third and final chapter illustrates that it is the combination of Taiwan's strategies to maintain its sovereignty, which included adopting the semiconductor industry, and the unresolved tensions from the past have resulted in the current day situation in which Taiwan is caught in the middle of the US-China trade conflict. I argue that Taiwan is stuck in the middle, not only for its technological expertise, but also for its geopolitically complicated position. Both are the outcomes of Taiwanese society and politics' co-evolution with its semiconductor industry, and Taiwan has rooted itself so firmly in this place that it will be challenging to change. Nevertheless, Taiwan's history has also shown that although options are constrained by the decisions of the past, the agency to act and pursue a wish for the future remains.

"[N]o government less deserved what was about to happen to it than that of Taiwan."[1]

[1] Henry Kissinger in his memoir White House Years from 1979 (as cited in Spence, 2013, p. 567)

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ABBREVIATIONS

BIS:	Bureau of industry and security (US)
CCP:	Chinese communist party
DOD:	Department of defense (US)
EPZ:	Export processing zone
ERSO:	Electronics research and service organization
GDI:	Gross domestic income
HSIP:	Hsinchu science based industrial park
IC:	Integrated circuit
ITRI:	Industrial technology research institute
KMT:	Kuomintang
NDS:	National defense strategy
OSD:	Office of the secretary of defense
PRC:	People's Republic of China
RCA:	Radio corporation of America
SIA:	Semiconductor industry association
TAC:	Technical Advisory Committee
TRA:	Taiwan Relations Act
TSMC:	Taiwan semiconductor manufacturing corporation
UMC:	United Microelectronics Corporation
UN:	United Nations
US:	United States

INTRODUCTION

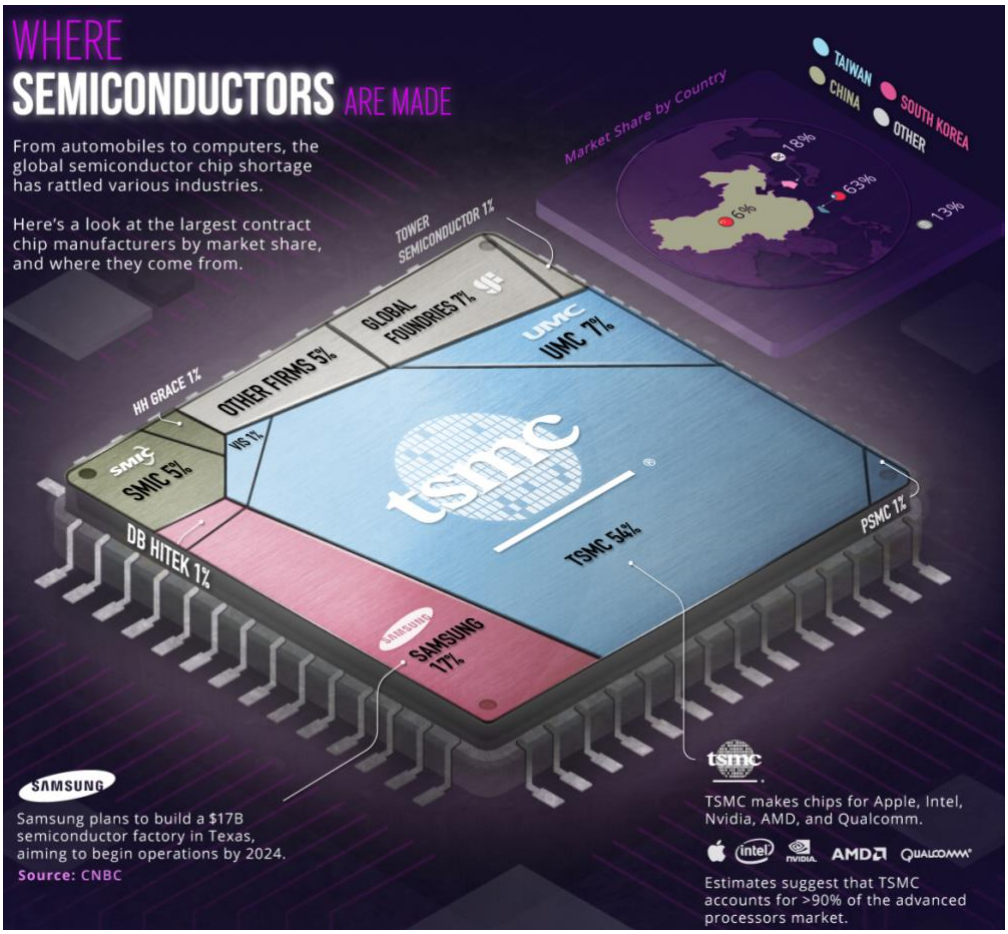


Figure 1. A visual representation of various companies' and countries' market shares in the semiconductor industry (Visual Capitalist, 2021).

The COVID-19 pandemic (2020-present) brought with it a remarkable consequence in the electronics industry: it caused major disruptions in the global supply chain of microchips, which resulted in global shortages on many electronics, most notably cars (Wu & Du, 2021, p. 2). This event, which has been labeled the global chip shortage, has been a wakeup call for not only many actors within the industry, but also consumers who were suddenly faced with both low stock and high prices on electronics. This disruption revealed two important things; firstly, it became clear how important microchips are to societies that make regular use of electronic devices; and secondly, it revealed the fragility of the global supply chain.

This fragility can in part be explained by figure 1, which shows how the semiconductor industry's market share was distributed in 2020 by country and various dominant companies. TSMC and Taiwan's dominance in the industry is particularly remarkable when considering the ongoing political struggle that Taiwan is facing as it is in

conflict with China, mostly unrecognized as a country and largely excluded from intergovernmental organizations[2]. How Taiwan's semiconductor industry and political struggle come together is hinted at by Taiwan's current President Tsai Ing-wen[3], who in 2021 wrote an article in which she referred to the Taiwanese semiconductor industry as Taiwan's "silicon shield" (Tsai, 2021, section "Changing the rules").

This choice of words implies much about the role of the semiconductor industry in Taiwan. The fact that it can function as a shield implies that it is strong and resilient, but also that there is a threat that the semiconductor can shield Taiwan from. We know that both implications are true, as Taiwan dominates the global semiconductor market and has been faced with a dispute over its sovereignty since the Republic of China government took refuge on the island. What the semiconductor industry means to Taiwan and what its role is in Taiwanese politics and society, will be the topic of this thesis. I will conduct a historical analysis on the Taiwanese semiconductor industry, studying how it started, was sustained, developed and became Taiwan's silicon shield. With this approach I aim to shed light on contemporary tensions and conflicts surrounding Taiwan and its semiconductor industry by going back and revealing which decisions, circumstances and unintended consequences have ultimately led to the situation we are facing today. To that end, this thesis will discuss, among other things, the event of Taiwan leaving the UN, how this relates to the decision to pursue a semiconductor industry, Taiwan's democratization and the US-China trade war.

Societal relevance

There are a few aspects of this thesis' topic that makes it currently relevant in society, some of which I have mentioned above. First and foremost, it should be emphasized that microchips are crucial components of any electronic device that has a function beyond turning on and off. This means that they can be found in most consumer electronics as well as in military technologies. This is one of the reasons that the fragile supply chain is a cause for concern for the US and the EU for example. A steady supply of chips is not only important for the availability of consumer electronics, a market that our digital society is so heavily reliant on, but this is also important for these countries' and organizations' (national) security

[2] According to the foreign affairs page on the government portal of the Republic of China, Taiwan currently is an active member with 40 of the 300 intergovernmental organizations (see "Foreign affairs", section International Participation).

[3] The Chinese names in this thesis will be written following the Chinese name format. This means that the last name is written first, followed by the individual's given name. In this case Tsai is the last name, and Ing-wen is the given name.

interests. The global chip shortage has made countries becoming more aware of this fragility, resulting in the US and the EU developing the aspiration to diversify the supply chain and obtaining the capability to manufacture microchips closer to home. In addition to the chip shortage, such an aspiration raises many more complexities for the global semiconductor industry and countries such as Taiwan, to whom the industry means as much as it does. Where these complexities come from and how they are maintained is one of the topics that this thesis will discuss.

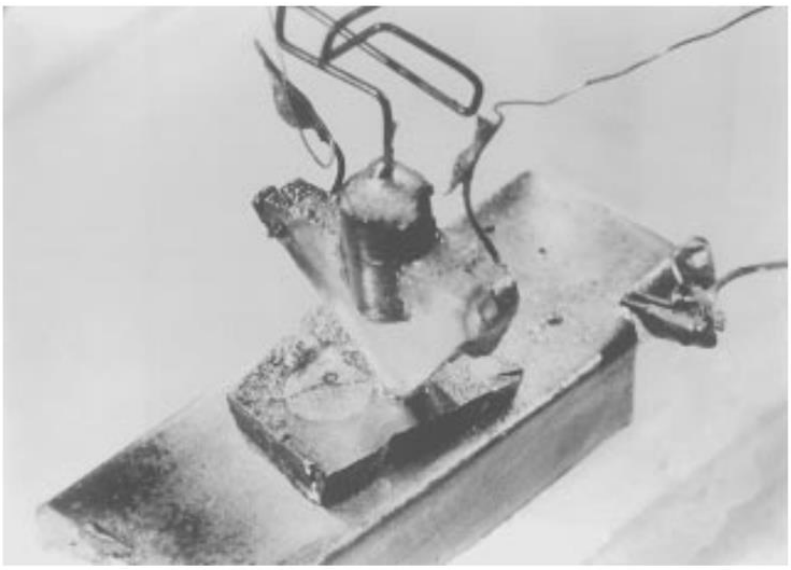
Another contemporary event that this thesis addresses is the US-China trade war, which was unofficially instigated by the 2018 US National Defense Strategy (NDS). The NDS speaks of a "long-term strategic competition" (OSD, 2018, p. 2), but in practice this is played out as a competition for technological superiority and semiconductor autonomy. This is once again due to the importance of microchips to both consumer electronics and military technology. Importantly, the trade war has resulted in rising tensions not only between the US and China, but also between China and Taiwan. There have consequently been concerns that these tensions may eventually escalate into a military conflict. These rising tensions also reveal that despite Taiwan's thriving economy and semiconductor industry, its ongoing dispute with China means that its democracy and general security is nevertheless constantly threatened as long as this conflict remains unresolved. A later stage of this thesis will shed light on why this conflict remains unresolved and how the status-quo is maintained.

A short note on the semiconductor industry

The semiconductor industry is not an industry that manufactures, trades, and distributes semiconductors in and of itself. Instead, the term semiconductor industry refers to the microchips and microelectronics industry. The reason for this misleading terminology lies in the fact that these components are made using semiconductor materials. On their own, these materials have the unique property that they have a varying conductivity: it is almost a perfect insulator at zero degrees Kelvin (-273.15 degrees Celcius) and its conductivity increases as the temperature increases (Crecraft & Gergely, 2002, p. 109). A pure semiconductor material with no impurities is known as an intrinsic semiconductor. Common semiconductor materials that have been used for electronics are germanium (in the past), and silicon (in the present). In contrast to conductors, a semiconductor can conduct electricity in two ways: either through the displacement of positive charges (known as the p-type semiconductor) or negative charges (known as the n-type semiconductor). A semiconductor can be made into a p-type or n-type by adding an impurity into the intrinsic semiconductor

through a process known as doping (Crecraft & Gergely, 2002, p. 109-110). Today the most commonly used semiconductor material is silicon, and it is usually laced with either phosphorus (n-type) or boron (p-type) Crecraft & Gergely, 2002, p. 110).

The invention of the first transistor exploited this unique quality of the semiconductor. The first working transistor was invented in 1947 and is usually credited to have been invented by W. Shockley, J. Bardeen and W. H. Brattain[4], three physicists who were employed at Bell Laboratories at the time. It was originally intended to perform the basic functionality of the vacuum tube, also known as a thermionic valve, which is to amplify an input signal (Riordan et al., 1999, p. 337), while also being more reliable, durable and resilient than the thermionic valves' glass tube construction. Also, since transistors do not require the glass tube construction of a vacuum tube, there was also much more potential for miniaturization in electronic applications. This became abundantly clear as time passed and transistors today have become as small as 3 nanometers in 2022, and billions of them can be packed onto a logic processing chip (in a smart phone for example). Note that the core functionality of transistors have remained the same: it can amplify and manipulate input signals in order to achieve a certain alternative output. By putting many of them together on a chip, much more complex outputs and tasks can be achieved. Hence, the semiconductor industry is in reality a microchip industry, but the semiconductor is the crucial component that makes it all possible. For the rest of this thesis, I will use the terms semiconductor and semiconductor industry as they are used colloquially, by which I am referring to microchips and the microelectronics industry respectively.



[4] The first publication on the first working transistor was published by its inventors J. Bardeen and W. H. Brattain and published in 1948.

Figure 2. The first transistor, using a block of germanium (the metal looking slab on the bottom) as the semiconductor material (Reproduced in Ross, 1998, p. 11).

History of technology and the Taiwanese semiconductor industry

At the time of writing, the histories of Taiwan and its semiconductor industry are largely fragmented in academic literature. Detailed historiographies and historical analyses have been done on Taiwan's semiconductor industry specifically (Mathews & Cho, 2000; Davids, 2021)[5]. While these works have provided adequate overviews of the way the Taiwanese semiconductor industry was started, developed and grew, they lack the broader societal context surrounding this industry. Taiwan's semiconductor industry did not start and grow independently from society, yet how society impacted the developments in the industry and vice versa is a topic that is largely missing from these works. Besides the semiconductor industry, another popular topic in Taiwan's history has been its tumultuous political history (Ko, 2004; Shiao, 1999)[6], largely focuses on the many political challenges and developments that the Republic of China has gone through since being founded in 1912. One major development for example has been Taiwan's democratization in the late 1980s and 1990s, marking Taiwan as the first Chinese society that democratized. The democratization process occurred at the same time the semiconductor industry in Taiwan started to flourish, yet these two narratives have never been brought together in a single historical analysis that studies the link between Taiwan's semiconductor industry and society. Finally, another area that has received much attention in the field of history has been Taiwan's rapid economic growth since the 1950s, which is colloquially referred to as the Taiwan miracle[7]. Though these histories certainly acknowledged the role the semiconductor industry has played in Taiwan's economic transformation, the link between Taiwan's economy, technology and how they relate to politics is mostly missing.

[5] Davids (2021) has offered a very recent analysis of the Taiwanese semiconductor industry. Mathews & Cho's (2000) extensive research in *Tiger Technology: The Creation of a Semiconductor Industry in East Asia* is to this day considered as one of the most extensive records of the strategies various East Asian countries have employed to start and grow their semiconductor industries. More specific aspects of this history will be supplemented by the works of Hsu (2016), Saxenian & Hsu (2001) and Lin & Rasiah (2013) for example on the Taiwanese expat returnees, as well as So's (2006) highly detailed analysis of the events surrounding the construction of Hsinchu Science-based Industrial Parts.

[6] See Ko (2004) and Shiao (1999) for detailed analyses of Taiwan's democratization. Tucker (2005) has offered a unique and extensive analysis of how the normalization of the US's relationship with China has affected Taiwan. See Spencer (2013) for a highly detailed historiography on the history of China (both the Republic of China and the People's Republic of China) since the Ming-dynasty.

[7] See White (1999) for a historical analysis on Taiwan and globalization, in which economy plays an important role. Mao & Schive's (1995) and Van Hoesel (1996) have both worked on Taiwan's trade and economy in the first decades after the Second World War.

Considering the uniqueness of Taiwan's case: its political history, leading semiconductor industry, disputed status and role in contemporary geopolitical tensions, I contend that a historical analysis that embeds Taiwan's semiconductor industry in society is an important omission in the field of history of technology that should be addressed. For this purpose, I have found that Thomas Misa's conceptual history of technology framework is particularly suitable, as it focuses specifically on the conjunction between technology and society, and how the two impact and shape each other. In his book *Leonardo to the Internet* (2011), Thomas Misa offers the following description of what he believes a history of technology can shed light on:

> Societies with distinct goals and aspirations have chosen and sustained certain technologies, and these technologies have powerfully molded the economic, social, and cultural capabilities of the societies that have adopted them. What type of society we wish for the future is at once an open question and a constrained choice. While our societal debate must be an open one, accessible by all members, our options for society tomorrow will be framed by the choices we make about our technologies today. (Misa, 2011, xx)

Misa argues that societies are able to choose to adopt technologies, given that there are distinct goals and aspirations that they aim to achieve with them. These technologies will "mold" themselves into various levels of these societies, which means that they will noticeably shape and form these societies' capabilities in more realms than just technology or industry. Importantly, this makes any society's choice regarding adopting a technology something that will constrain its possible futures: the choices they make will leave some paths for the future open, while others are closed.

This approach to history of technology acknowledges that there is a sense of human agency and control in the futures that we envision and the technologies we may choose to pursue. Importantly, this embeds technology within society, as it is society that adopts the technology and does so with a societal (which may have a technological) aspiration. Also beyond the initial adoption phase, the decisions that are consequently made regarding this technology are made by and for society. Hence, the way technology develops can only be truly studied in conjunction with this societal context. Another important aspect that Misa emphasizes but has been left unexplored in the case of the Taiwanese semiconductor industry is how this technology-society coupling does not go in one direction, but instead that technology will simultaneously also mold this society, changing it, its opportunities, possible futures and aspirations.

The way Misa treats technology as something that is embedded in society and co-shapes and co-evolves with it, is what I find particularly valuable for a historical analysis of Taiwan's semiconductor industry. It allows me to study where the motivation and opportunities for a semiconductor industry came from, why this industry was chosen over others, how Taiwan managed to become the global leader in semiconductor manufacturing and where the current-day tensions surrounding this industry and Taiwan come from. Another reason behind choosing specifically this approach to history of technology lies in the fact that Misa's work so far has largely focused on western societies and technologies, meaning that an analysis using his approach on a non-western case is currently lacking. As I do consider Misa's approach highly valuable to the field, my contribution thus not only aims to broaden our understanding of the history of Taiwan's semiconductor industry, but it will also contribute to a larger and more recent trend in the history of technology that calls for the inclusion of non-western perspectives[8].

In sum, the historiography of Taiwan is currently a fragmented one. Elements of Taiwan's history, such as the history of Taiwan's semiconductor industry, are written separately from each other and as such they do not tell the whole story. This thesis aims to take the first step towards addressing this historiographic blind spot. As it is beyond the scope of this thesis to write an exhaustive embedded history of the Taiwanese semiconductor industry, I will focus specifically on the political context in which the semiconductor industry was adopted by Taiwan and how this decision has co-shaped and co-evolved with Taiwan, with a special focus on its political capabilities. Accordingly, my research question is:

How did the Taiwanese semiconductor industry co-evolve with Taiwan's politics from the 1970s to the 21st century?

The aim and structure of this thesis

By answering this research question, this thesis aims to offer an embedded historical analysis of the Taiwanese semiconductor industry that clearly situates it in Taiwanese society. I have chosen to focus primarily on the intersection between the Taiwanese semiconductor industry

[8] For example, Kobiljski (2022) calls for a greater awareness and knowledge of industrialization in non-western countries, since the global supply chain and countries in the "postindustrial world" (p. 309) are heavily dependent on them for products such as electronics. See Schäfer & Valeriani (2021) and Abraham (2022) for critiques on the how western perspectives have dominated the fields of history of science and technology and science and technology studies respectively: namely how they leave no room for other modes or forms of knowledge, industries and connections that are much more prominent in non-western societies (Schäfer & Valeriani, 2021, p. 327-328; Abraham, 2022, p. 2).

and the political dimension behind the decision to pursue it and in analyzing how the industry shaped society, as an analysis of how the industry has co-evolved with all of society is unfortunately beyond the scope of this research. My study still sheds light on the connections, interactions and dynamics between technology and society, but it does so through a specific focus on politics. Politics in this sense refers primarily to Taiwan's national and international political capabilities, but this thesis will also discuss Taiwan's political aspirations, crises, influence and geopolitics.

This thesis is divided in three chapters, each of which will be situated in a different period in the history of Taiwan's semiconductor industry. Chapter 1 will depart from UN resolution 2758, which saw Taiwan leave the UN and grant membership to the People's Republic of China (PRC) instead. I argue that the potential political isolation Taiwan faced following this event has motivated Taiwan to form a new vision for its future, in which it aims to remain politically relevant and present in the international sphere. Developing a Taiwanese semiconductor industry was a key strategy in pursuing this goal. This chapter thus studies the context in which a new vision for the future is formed, and how a society can come to the decision to adopt a technology in its pursuit of this future.

Chapter 2 is situated in the 1960s to 1990s. To showcase the process Taiwan went through to start, sustain and grow the industry, I focus on three areas that Taiwan needed to develop at the time: economy, knowledge, and politics. I argue that each of these areas have impacted each other through spillover effects, which shows how these various areas of Taiwanese society at the time co-shaped each other and co-evolved together. This chapter thus also aims to show how these aspects transformed certain areas of Taiwanese society and Taiwan's political capabilities at the time.

The third and final chapter is situated in the twenty-first century and focuses on the ongoing US-China trade conflict, which was initiated through a wave of policies following the 2018 US National Defense Strategy. This chapter not only serves to reflect on contemporary events, but also analyzes how Taiwan's past choices have manifested in current-day Taiwan, its political capabilities and geopolitical place in the world.

For this research, I will thus use Thomas Misa's approach to history of technology as my theoretical framework. For the historical side of my analysis, I will make use of the various historical analyses on different aspects of Taiwan's history that I mentioned earlier, and combine their perspectives to offer a more embedded analysis of the history of Taiwan's semiconductor industry and the political dimension surrounding it. Primary sources, such as original memoranda and government documentation, will be used to close-read and analyze

the motivations behind the events and decisions that followed. Finally, especially in the sections about more recent events, news articles and some other electronic sources will be used to complement and add to these narratives wherever necessary.

To conclude, this thesis aims to offer two main takeaways. Firstly and conceptually, this thesis argues that a history of technology cannot be studied or written without embedding the technology in society, as the societal dimension is the context in which decisions about technologies were made. Society shapes technology and in part determines how technology becomes part of it, while in turn it is simultaneously shaped and molded by technology as well. A deeper understanding of this process can only be reached when separate historical lenses (such as history of technology, politics and economy) are combined and studied together, acknowledging how they were all part of the same greater historical narrative.

Secondly, with regards to the case of Taiwan and its semiconductor industry, it argues that since the industry's adoption it has shaped and evolved with society in both intentional and unintentional ways. I will argue that it was intended for the semiconductor industry to impact Taiwan's political capabilities, but that the exact ramifications of the decisions towards this ambition were not foreseen, though where they come from can be traced back through a historical analysis. I contend that nevertheless, technology and society in Taiwan have molded together in such powerful ways that the question of what Taiwan's identity is, cannot be adequately answered without mentioning the role of its semiconductor industry.

CHAPTER 1

Leaving the United Nations and technology in Taiwan's new vision for the future

This chapter is about the event that marked a radical change in Taiwan's history and set them on a path towards a new future: the Republic of China (ROC, colloquially known as Taiwan) withdrawing its UN membership in 1971. This decision was prompted by UN resolution 2758, which states that the "lawful rights of the People's Republic of China in the United Nations" will be restored. In other words, with this resolution the People's Republic of China became an official member of the United Nations, replacing the ROC. I will argue that following this event, Taiwan was prompted to envision a new wish for the future in which it could remain present and relevant in the international sphere despite having lost its status as a legitimate country.

The analysis will be carried out in two steps. In the first section, I will offer the historical and geopolitical context of the US, China and Taiwan in the 1970s, which I will present through an analysis of the events surrounding resolution 2758. I argue that this event has been a major catalyst in Taiwan's envisioning of a new future. In the second section I will shift my focus to the semiconductor industry, which I contend was the technology Taiwan chose to obtain its political and economic ambitions. Conceptually, this chapter illustrates the first stage in Thomas Misa's theory on how societies can adopt technologies: envisioning the future that the society wishes for and choosing a technology that can help achieve it.

I will be using the original memoranda of the conversations between Henry Kissinger and Zhou Enlai in 1971, which allows me to analyze how the contents of these conversations eventually led to Taiwan losing its UN membership. As Tucker (2005, p. 122) argues, the US and Kissinger have not been transparent about the contents of these conversations (especially regarding the topic of Taiwan), which have only become declassified in 2001 (Burr, 2002). Hence I have decided to include these original documents in this chapter to analyze how Kissinger and Zhou actually talked about Taiwan during Kissinger's visit. Additionally, I will also use Tucker's (2005) highly detailed analysis of Kissinger's visit to China in 1971 to supplement my own analysis of this event. However, where Tucker has used her analysis to express criticism on the decisions surrounding the US-China normalization process, I aim to focus more on how these decisions have impacted the various actors involved and how they set the events that followed in motion.

1.1 The events surrounding resolution 2758

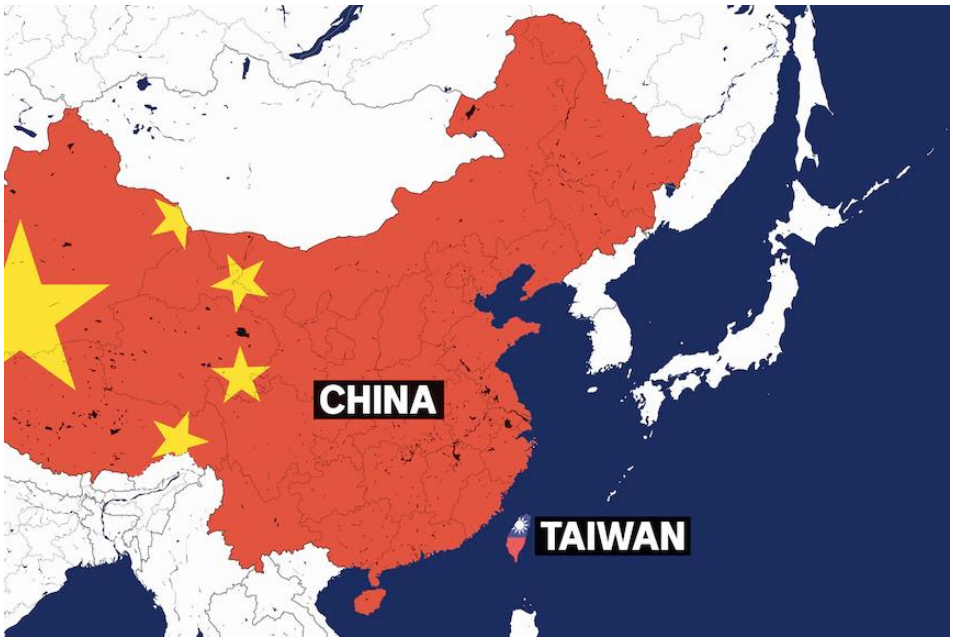


Figure 3. China and Taiwan on the map (Fankhauser, 2022).

When it comes to Taiwanese politics, various terms and government parties should be distinguished first. Today, in the twenty-first century, neither "China" nor "Taiwan" are official terms. Instead, they are colloquial names that are often used to refer to the People's Republic of China (PRC) and the Republic of China (ROC) respectively.

These two separate "Chinas" originated from the time where China's dynasties came to an end. Following the fall of the Ming dynasty, the former China officially declared itself as the Republic of China in January, 1912 (Spence, 2013, p. 254). In 1949 the relationship between the two largest political parties at the time, the Kuomintang (KMT) and the Chinese Communist Party (CCP), grew so strained that the KMT fled the mainland and took refuge on the island of Taiwan (Ko 2004, p. 142), where they upheld that the ROC was China. On the mainland, the CCP founded an alternative China under the leadership of Mao Ze-dong: the People's Republic of China. Both the ROC and the PRC claimed to be the sole, legitimate China, which encompasses both the mainland and Taiwan combined. This conflict is still a core aspect to the ongoing dispute between the PRC and the ROC. Although it should be noted that the ROC has undergone many changes in all aspects of society, including politics, which has resulted in the ROC adopting a much more nuanced perspective towards the one-China ideology[9].

[9] Today, questioning the Taiwanese people regarding their perspective on one-China, two-Chinas or Taiwanese independence will yield various different opinions and beliefs depending on who you ask

Figure 4. Chiang Kai-shek and Mao Zedong side by side (Reproduced in The China Project, n.d.).

This was one of the key issues that resolution 2758 addressed. In 1971, the United Nations only had one member seat for China, which belonged to the ROC from 1949 till 1971. Hence, the ROC was considered the one and only China, while the PRC was not. The world recognized the ROC as the legitimate China for it being considered the 'Free China" alternative to Mao Zedong's "Communist China" (Ko, 2004, p. 146). This was particularly important in the context of the Cold War (1947-1991), during which democracies shunned the communist regime. The ROC was founded on a US inspired democratic ideology, which meant that it was the West's preferred China of the two. In practice, the KMT had imposed martial law and a "Temporary Provisions" policy on Taiwan since leaving the mainland, which suspended sections of the constitution and significantly restricted the people's freedom. They were justified as a necessary means in Taiwan's ambition to take the mainland back from the CCP (Ko, 2004, p. 141).

Something changed under Richard Nixon's presidency (1969-1974): the Cold War drew the US and communist China together. Both countries grew increasingly concerned over the Soviet Union (Tucker 2005, p. 117). Despite the ongoing American alliance with the ROC, a desire for a relationship with the PRC grew and was actively, but secretly pursued during Richard Nixon's presidency.

(White, 1999, p. 122), which shows that the Taiwanese are divided about whether or not they still want to reunite with the mainland or not.

The diplomatic, but secretive strategy that Richard Nixon and Henry Kissinger employed to establish the first ever relationship between the US and the PRC is commonly referred to as ping-pong diplomacy (Tucker, 2005, p. 120). However, the full version of the story was only revealed when formerly classified documents from the US government archive became declassified, which showed how the US and the PRC dealt with the "Taiwan issue" during Kissinger's secret trip to China in July 1971. Despite Kissinger claiming in his memoir that they did not discuss the matter of Taiwan extensively (Tucker, 2005, p. 122), records of his first conversation with Prime Minister Zhou Enlai show that Taiwan was literally on their list of topics to discuss (Lord, 1971a, p. 5). The recorded conversation clearly shows the Chinese's eagerness to discuss this topic and to receive clarity on the US' stance on Taiwan's status. The secrecy of this endeavor meant that Taiwan itself was actively kept from knowing about Kissinger's visits (Tucker, 2005, p. 125). Although these conversations would ultimately initiate a radical change for the island nation, it was never given the opportunity to intervene.

Records show that the Americans had a rather forthcoming attitude to the Chinese regarding this topic (see Lord 1971a and 1971b). Though formal recognition was withheld, Kissinger did state that the US would "not stand in the way of basic evolution", with which he is referring to the natural course of "political evolution" he had mentioned earlier (Lord, 1971a, p. 13).

The following day, Zhou pressed Kissinger on the Taiwan question again. It needed to be clarified that Taiwan was not an "isolated issue" and they had to come to an agreement on their views regarding this matter before they could move forward with the normalization process (Tucker, 2005, p. 123). Kissinger stressed that the United States "will not support one China, one Taiwan" (Lord, 1971b, p. 16) and Zhou does not go into this any further, implying that he is pleased with Kissinger's statements, and instead moves on to the question of international recognition by countries and international organizations. He asked of Kissinger what Washington would do about this, to which Kissinger replied:

> What has occurred to us with respect to the international organizations issue is the following formula: we would be willing to agree that the admission of the People's Republic of China can be by a majority vote, and we would withdraw our view that it should be an important question. We would say that the expulsion of other countries now in the U.N., with seats now in the U.N., should be by a two-thirds vote.

> In this manner, you would be able to take the Security Council's seat allocated to China, and as soon as you can get the two-thirds vote for expulsion, you would be the only representative of China in the U.N. Indeed, you would get the China seat now.
>
> In other words, we would solve the contradiction before our public by withdrawing our opposition to entry of the People's Republic of China. But we have not yet announced this because as a sign of our goodwill, the President wanted to me to discuss this matter with you before we adopted a position. (Lord, 1971b, p. 17)

This quote yields two important observations. Firstly, though Taiwan is not explicitly mentioned by name, when Kissinger says that China "would be the only representative of China in the U.N.", it is clearly implied that Taiwan will thus receive expulsion. Secondly, these words are exchanged in a secret conversation between Kissinger and Zhou with the purpose of improving US-China relations. However, these plans involve altering the future of Taiwan, a third key party that is excluded from this conversation. In other words, China and the US think they are discussing their future, but (and China is well aware of this) simultaneously this conversation is just as much about Taiwan's future as it is about theirs.

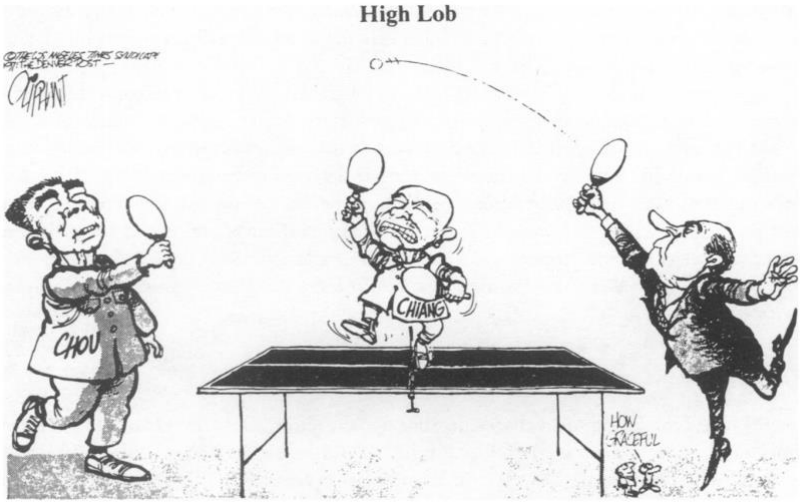


Figure 5. A cartoon of the Chinese Premier Zhou En-lai and US President Richard Nixon engaging in a friendly game of table tennis while excluding Taiwanese President Chiang Kai Shek from participation. (*Los Angeles Times*, 1971, Reproduced in Tucker, 2005, p. 122).

By the time that the vote for resolution 2758 was about to happen, Taiwan had already vouched that it would leave the UN if the PRC was awarded a seat at the Security Council (Tucker, 2005, p. 128). There was an attempt at making a dual representation in the UN possible, but Tucker claims that any chance at success of this policy was thrown out the

window when Kissinger proceeded with his October trip to Beijing in 1971, only months before the vote, signaling to the world where Washington's priorities were (2005, p. 130). Also, with both China and Taiwan adamantly claiming that there was only one China, dual representation was not an option. Already knowing what the outcome of the General Assembly vote would be in 1971, Taiwan left the UN before the final vote had been cast (Shiao, 1999, p. 110; Ko, 2004, p. 146). At the time, the US was partially blamed for this outcome. Chiang Kai-shek had stated before that if the ROC were to leave the UN, this would have been the US's doing rather than the Communists (Tucker, 2005, p. 129). George H. W. Bush considered Kissinger to be an "instrument of Taiwan's shameful ouster" (Tucker, 2005, p. 131).

Figure 6. Chairman Mao Ze-Dong and former US President Richard Nixon shaking hands on Nixon's first official visit to China in 1972 (Reproduced in China Daily, 2012).

Taiwan was harshly met with the consequences of leaving the UN. First, it lost most of its diplomatic ties with other countries (Ko, 2004, p. 146; Davids, 2021, p. 6), which had economic consequences as well, since it limited Taiwanese travel and business opportunities (Ko, 2004, p. 147). In 1973 Taiwan was also faced with the world-wide oil crisis. These political and economic crises marked the 1970s as a difficult period in Taiwan's post-war history as the Taiwanese government tried to prevent political isolation (Shiao, 1999, p. 105; Ko, 2004, p. 146). The PRC had expected that it was only a matter of time before Taiwan would collapse (Tucker, 2005, p. 124). Kissinger's statement on the natural course of "political evolution" implied that he perhaps thought the same (Lord, 1971a, p. 13).

Contrary to China's expectations, Taiwan did not collapse. This was surprising considering the ROC's former reliance on US support for economic and military aid ever since it fled the mainland. With diplomatic ties ending between the ROC and the US, the PRC had expected the US to withdraw both forms of aid and step aside in any case of conflict between the two Chinas. In practice the US indeed severed its diplomatic ties with Taiwan in 1979, but they have remained ambiguous on their view regarding the PRC's one-China principle. While not recognizing Taiwan as its own independent sovereignty, the US has also never firmly stated that Taiwan is "merely" a region of China. This ambiguous stance allowed the US to enact Taiwan Relations Act (TRA) in 1979 despite their lack of diplomatic ties[10]. The TRA ensured a continued military protection against mainland China and limited arms sales, so that Taiwan could still protect itself if necessary (Ko, 2004, p. 147). The TRA remains active to this day.

1.2 Technology and Taiwan's response to the crises of the 1970s

With former ambitions to take back the mainland shelved, the KMT shifted its focus and efforts onto growing the economy. By shifting the government's focus, Chiang Ching-kuo, son of President Chiang Kai-shek and premier of the ROC since 1972, hoped that this would help maintain economic relations with countries in lieu of the lost diplomatic ones (Shiao, 1999, p. 105). Seeing the electronics industry bloom in Japan, Hong Kong and South Korea in the 1970s, the state developed a desire for Taiwan to also enter the electronics industry to boost this economic competitiveness (So, 2006, p. 67). However, the KMT also realized that Taiwan did not have the time nor funds to indigenously grow a profitable semiconductor industry fast enough out of basic research. Hence, the government established the Industrial Technology Research Institute (ITRI) in 1973, which was founded specifically to do applied research and become a driving force in Taiwan's industrial upgrading (Hsu, 2016, p. 169). I will further discuss Taiwan's industrial upgrading in the next chapter.

[10] The original Taiwan Relations Act (1979) can be found in the US Congress archive: https://www.congress.gov/96/statute/STATUTE-93/STATUTE-93-Pg14.pdf

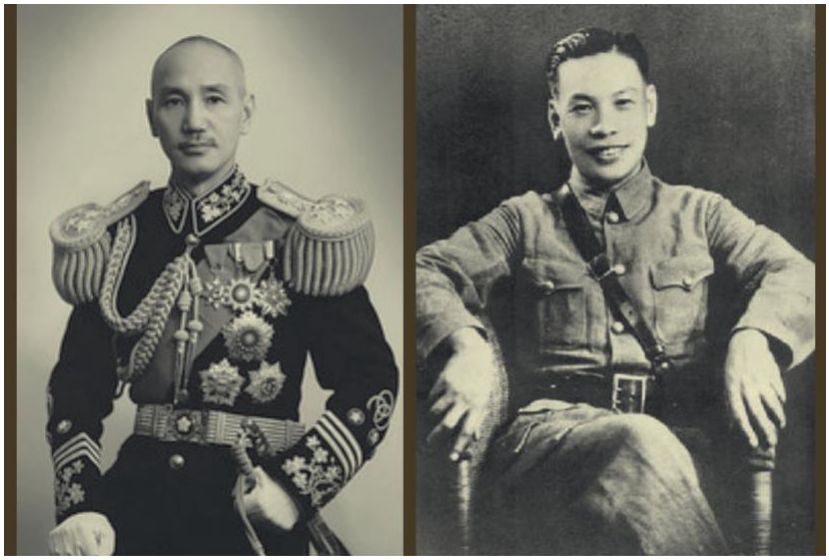


Figure 7. Chiang Kai-shek (left) and his son and successor as President of the ROC Chiang Ching-kuo (right) (Fairbank Center for Chinese Studies, n.d.).

This ambition took on a more concrete form at the hands of the Taiwanese Minister of Economic affairs Sun Yun-suan and Dr. Pan Wen-yuan, a Chinese American electrical engineer in the US (Mathews & Cho, 1999, p. 158)[11]. The latter was at the time employed at David Sarnoff Laboratories, a lab focusing on semiconductors among other electronics at Radio Corporation of America (RCA). He also had an extensive network among both the overseas Chinese and the Taiwanese (Leonard, 2017). As such, the story goes that Minister Sun and Dr. Pan came together in 1974 to discuss how Taiwan could enter more knowledge-intensive industries: once in Taipei in February and once at Princeton in August ("The start of Taiwan's IC industry," n.d.; Mathews & Cho, 1999, p. 138). Following this meeting, Dr. Pan formed an advisory group at Princeton, which became known as the Technical Advisory Committee (TAC). With their expertise in this field in the US, the TAC developed a report with a concrete plan and specific recommendations for Taiwan to kickstart its semiconductor industry, which was presented to the Taiwanese cabinet (Leonard, 2017; Mathews & Cho, 1999, p. 158). Based on this report, the government agreed in 1974 to form a specialized laboratory through ITRI that focused on finding and leveraging foreign technologies for Taiwan's semiconductor industry: the Electronics Research Service Organisation (ERSO).

[11] Note that Dr. Pan was born in 1912 in the Republic of China, which is several decades before the ROC took refuge in Taiwan and the PRC was founded in Beijing. Chinese in this sense refers to Dr. Pan's heritage in the Republic of China, when it was still the one and only China that existed in the world. When the ROC fled to Taiwan, Dr. Pan had already moved to the United States.

It was through ERSO and Dr. Pan's influence at RCA that Taiwan finally obtained its first 7-micron integrated circuit technology from RCA in 1976 (Mathews & Cho, 1999, p. 158), which marked the beginning of Taiwan's semiconductor industry. Taiwan's first integrated circuit firm United Corporation Microelectronics (UMC), one of the largest semiconductor firms in the world today, was a direct result of this first IC technology transfer. I will go in more detail about this technology transfer and how it helped Taiwan develop its technological capabilities in the next chapter.

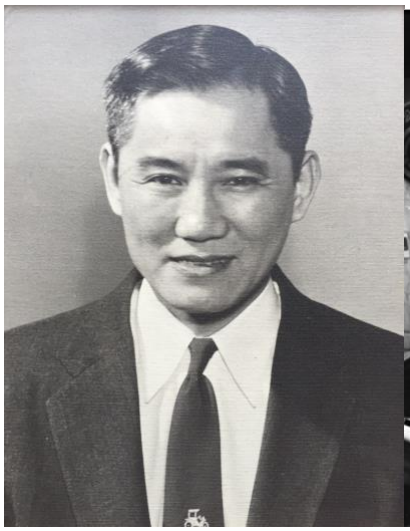


Figure 8 (on the left). Dr. Pan Wen-yuan (n.d.), often called "the father of Taiwan's semiconductor industry" (Leonard, 2017, parag. 4).
Figure 9 (on the right). Sun Yun-suan (in the gray suit) at the 1982 Taiwan Electronics Show (Sun Yun-suan Foundation, 1982).

Another important aspect in Taiwan's pursuit of becoming a competitive player in the semiconductor industry was the decision to build Taiwan's first science park: Hsinchu Science-based Industrial Park (HSIP). The inspiration for building HSIP can be traced back to Taiwanese officials visiting science parks in other countries. In 1968 for example, the Minister of Economic Affairs at the time Li Kuo-ting proposed setting up a research park after seeing similar initiatives in South Korea and India, supposedly to attract student returnees who had gone abroad to pursue their studies (So, 2006, p. 67). This was not viable for Taiwan at the time, as its technological sector remained less advanced in the 1960s, but by the 1970s things had changed. As I will discuss in the next chapter, a combination of economic policies of the past had resulted in a more fruitful environment in which to invest in the electronics and semiconductor industry. This, in combination with the political and

economic crises Taiwan faced in the 1970s, led to the idea of constructing a research park to resurface (So, 2006, p. 67).

Figure 10. The administration building in Hsinchu Science-based Industrial Park (ETToday, n.d.).

For the construction of HSIP, the KMT had a relatively clear vision for what it hoped HSIP would do for Taiwan. This vision can be divided into four dimensions: “political, economic, educational and national defense” (So, 2006, p. 71). The breakdown of these dimensions is as follows:

> Politically, HSP was to strengthen the national power by developing advanced industries and to lure overseas' Chinese talents back to Taiwan to engage into the national development; economically, as noted above, the government expected HSP could help upgrade Taiwan's products to enhance their competitiveness in the global market; educationally, it is an attempt to foster collaboration between industries, and universities and research institutes; in national defense, HSP should be able to enhance the level of national defense by transferring outputs of high-tech industrial research into military purposes. (So, 2006, p. 71)

So (2006) traced these visions from the development plan of HSIP, which shows that the Taiwanese were highly conscious of the societal impacts that they hoped this technological project would have. The plan mentions how HSIP was envisioned to help develop Taiwan,

which would be beneficial to Taiwan's national power. Unclear is whether this is referring to power as international influence, or power as the capability to act, decide and make more radical changes within the country. Nevertheless, politics is defined as a goal, which showcases Taiwan's political motivation behind technological projects. Additionally, a dedicated industrial research zone was also meant to boost Taiwan's ability to manufacture electronics, which is beneficial for learning and developing more capabilities in this sector, as well as for Taiwan's economy. The goals in these plans thus show that while they focus on technology in its execution, they were carefully laid out with a political motivation in mind.

1.3 Conclusion

This chapter serves as a starting point to this thesis, both chronologically and in Thomas Misa's understanding of how societies co-evolve with technologies upon adopting them. As such, this first chapter has addressed two separate aspects: the first was to offer the reader a political and historical context of Taiwan, China and the US in the 1970s. I used resolution 2758 as the central event, since it radically changed the geopolitical relationship between these three countries and has been a determining event for both China and Taiwan's geopolitical futures, both as separate countries or one. The US changing its diplomatic ties but remaining ambiguous on the one-China issue has resulted in Taiwan being able to continue as a separate entity, but one with hardly any official diplomatic ties due to its unofficial status as a country. This remains an ongoing issue to this day.

The second aspect was to show that the outcomes of Taiwan's withdrawal from the UN have forced Taiwan to envision a new future: one that would address the crises Taiwan came to face. Though resolution 2758 has been detrimental to Taiwan's diplomatic relations, it has also changed Taiwan's circumstance to such a degree where the government knew the future would look radically different after the event. Despite not having had much control in how external factors may suddenly sweep over the country, it did confront Taiwan with a freedom and agency to consciously develop a new vision for the future with new aims and strategies to achieve it. Though the crises of the 1970s were political and economic in nature, I have reconstructed how the KMT developed a technological vision to address these political and economic struggles. This serves to illustrate that technological decisions were not made for the sake of technology alone, but that they were made with clear visions for society, culture, and politics in mind. It should be emphasized however, that these choices were not always self-evident or even possible. The crises that followed resolution 2758 changed

Taiwan's needs and priorities, and as I will discuss in the next chapter, other developments were also required to create an environment in which any of these decisions were even viable. For Taiwan, the circumstances turned out to be just right for the adoption of these industries, even if the KMT government may not have consciously realized this. I do contend that Taiwan's decisions regarding the semiconductor industry and HSIP indicate that Taiwan recognized that technology can nevertheless be a powerful means to what is a societal end.

To bring this all back to the part of Thomas Misa's approach this chapter was about: a society's ability to adopt a technology that is believed to match its wishes for the future (Misa, 2011, p. xx). Taiwan altering its wish for the future based on events at the time shows that there is some freedom with regards to what future a society may wish for, or how. This freedom is constrained by the society's historical context, however, as Taiwan's case illustrates. Nevertheless, Taiwan's case has allowed me to showcase how this abstract concept can look in practice. Taiwan's example has been one of mostly careful planning, subject to external forces but still maintaining its own agency to formulate a new future, and a carefully formed plan of adopting and sustaining the semiconductor industry to help achieve this future. While this chapter focused on the envisioning and adopting processes, the next chapter will focus on the strategies Taiwan employed to sustain the semiconductor industry and how the decisions Taiwan made in the 1950s-1990s incrementally molded Taiwan's society and future.

CHAPTER 2

Strategizing through economy, the semiconductor industry and politics

This chapter is situated in the 1950s to 1990s, and about three areas in which Taiwan developed itself to come closer to achieving its ambition to win back international recognition and relations. While this thesis as a whole focuses more on the semiconductor industry, the political dimension behind Taiwan's decision to pursue this industry will be an important theme in this chapter, since it serves as an important motivation behind Taiwan's developments at the time. In the larger scope of this thesis, this chapter illustrates the steps that Taiwan has taken since the events of the previous chapter that ultimately led to what has become of Taiwan in the 21st century.

Each section focuses on one of the areas in which Taiwan pushed for developments that would be beneficial to its international recognition: economy, the semiconductor industry and politics. The first section will be about Taiwan transforming its previously mostly agricultural economy into a trade-based economy, and I will argue that this was an important precondition for Taiwan to be able to pursue the semiconductor industry in the first place. It represents the economic side of Taiwan's strategy to improve its international relations. The second section will discuss Taiwan's strategy of obtaining knowledge and expertise about the semiconductor industry that it was lacking. While the previous chapter focused on how the early decisions surrounding adopting the semiconductor industry were made, this section will instead focus on how Taiwan obtained its technological capabilities through these decisions. The third section will shortly discuss the political dimension that has been present since leaving the UN. One part of this section will be about Taiwan's democratization process, and how this can be seen as a political side to Taiwan's strategy. The other part of this section argues that despite all of Taiwan's efforts within its borders to improve its relations with other countries, the events of the previous chapter and China's continuous meddling are factors that nevertheless maintain this ongoing struggle. The fourth section will link the previous three sections together and discuss how Taiwan's transformed economy and semiconductor industry have respectively contributed to Taiwan's goal of improving its international relations as well as national security.

For this chapter I will be building on existing historical work on Taiwan's economy, semiconductor industry and politics. Both Van Hoesel's (1996) and Mao & Schive's (1995)

works have analyzed how Taiwan transformed its economy in the first decades after the Second World War. While this has been helpful for my own understanding of how Taiwan transformed its economy, their focus on highly specific aspects of economy (such as foreign direct investment or the export of agricultural goods) does mean that their analyses do not encompass developments in other areas of Taiwan's society, which I do aim to do in this chapter. Another historical analysis I would like to mention is Mathews & Cho's book *Tiger Technology: The Creation of a Semiconductor Industry in East Asia* (1999), which has offered one of the most extensive historiographies on Asian semiconductor industries to this day. This has been immensely influential in history of technology work on the Asian semiconductor industries, as well as valuable to my own knowledge of how Taiwan's industry started and grew. Though very extensive when it comes to the semiconductor industry, their work on Taiwan has largely ignored the societal dimension of Taiwan's history. Hence, in this chapter I will combine the different historical perspectives that focused on individual areas of society to analyze how they impacted each other and co-shaped Taiwan's society in these decades together.

2.1 Transforming the economy

For the best chance at success in a more knowledge-intensive industry such as electronics, it was important that there was an economic and industrial environment in Taiwan that would be able to nurture such an industry in the first place. This means an economy that is strong enough to not only finance the beginning of an expensive industry such as semiconductors, but also an economy that is strong enough to sustain and grow this industry. This section will detail the steps that Taiwan took to transform its economy. Some of the policies the KMT adopted while working on transforming the economy, also provided Taiwan with valuable trade experience that inspired its approach to growing the semiconductor industry as well. As such, this section mostly serves to provide a historical background to Taiwan's economy that aided the rest of the developments I will discuss in later sections.

In the first decades after the Second World War, Taiwan was a relatively poor country. In 1960 Taiwan only had a per capita gross national income (GNI) of US$141, which pales in comparison to its per capita GNI of US$ 10.556 a mere three decades later (Van Hoesel, 1996, p. 220). It was only from 1952 onwards that Taiwan commenced a transition from an agricultural economy to one that would eventually become dependent on the import and export of manufactured goods (Mao & Schive, 1995, p. 23; White, 1999, p.

100). One of the first steps that the KMT government took, was the implementation of an import substitution policy in the early 1950s (Van Hoesel, 1996, p. 221; Davids, 2021, p. 6). This type of policy blocks the import of products from other countries in order to protect domestic entrepreneurs and boost local production. The growth potential of the import substitution policy was short lived however, as Taiwan was quickly faced with balance of payment problems and a saturated domestic market (Mao & Schive, 1995, p. 46). This prompted the government to look for an alternative strategy, one that focused on promoting exports as opposed to blocking imports (Mao & Schive, 1995, p. 46; Van Hoesel, 1996, p. 221). Examining how the patterns of trade and types of products were exported in the period from the 1950s to the 1970s clearly showcases how Taiwan consequently transformed its economic structure. Exports in the 1950s mostly consisted of processed foods, in the 1960s there was an increase in the export of industrial products such as textiles, and by the 1970s electronics and equipment had become important exported products (Mao & Schive, 1995, p. 42).

The transition from primarily exporting foods to electronics within a few decades is explained through Taiwan's careful planning and awareness of its workforce's own strengths and weaknesses. Policy reforms that shifted focus to give manufacturers more incentives to increase their exports were very successful. Even foreign firms were attracted by the improved trade environment in Taiwan, since the KMT government offered relatively cheap, but well-trained labor due to a relatively large and well-educated labor force, which was a comparative advantage that Taiwan made use of (Mao & Schive, 1995, p. 40). At the same time, foreign firms that invested in facilities in Taiwan were guaranteed by the KMT government that they would retain full ownership and management over their companies without the need to join ventures with local firms (Van Hoesel, 1996, p. 222). This notably resulted in a number of foreign electronics firms opening manufacturing facilities in Taiwan (Mao & Schive, 1995, p. 41), which aided Taiwan in building and maintaining foreign relationships (Davids, 2021, p. 11).

A major step forward in Taiwan's export promotion was the establishment of the first export processing zone (EPZ) in 1966 (Van Hoesel, 1996, p. 223; Davids, 2021, p. 6). The idea of the EPZ, the first of which was established in Kaohsiung, was to create very attractive conditions for companies that focused on producing goods for export, which included foreign firms. One barrier for entry that foreign companies had prior to the opening of the first EPZ was an unfamiliarity with the government's procedures. The establishment of EPZs were specifically targeted at simplifying this process and making it easier for foreign companies to

reap the benefits of Taiwan's favorable trade environment of the 1960s (Mao & Schive, 1995, p. 48). EPZs provided buildings and facilities at reasonable prices, as well as tax incentives and no import duties on products or equipment (Van Hoesel, 1996, p. 223).

Shifting focus to export promotion as well as attracting foreign investments not only greatly boosted Taiwan's economy, but there was also a spillover effect from the foreign firms to local managers and workers who were employed and trained at these foreign firms (Mao & Schive, 1995, p. 47). They became familiar with the manufacturing of electronics and built relationships with these foreign companies. Both factors would be helpful for setting up Taiwan's electronics industry in the near future (Davids, 2021, p. 6).

This section has offered a short overview of some of the economic policies Taiwan employed in the 1950s to the 1960s. These events took place prior to the crises of the 1970s, meaning that Taiwan had already started transforming its economy prior to Taiwan's withdrawal from the UN, as I described in the previous chapter. Importantly, this nuances the view that Taiwan had carefully planned every step for the purpose of building a semiconductor industry. Nevertheless, the earlier ambition to transform the economy did prove advantageous to the technological ambitions Taiwan would come to adopt in the 1970s, meaning that an understanding of this economic context contributes to the idea that part of adopting the semiconductor industry also had to do with the right timing. Prior to the economic growth and industrial experience Taiwan gained from these developments, the semiconductor industry may not have had the same potential for growth and success.

Figure 11. Hundreds of women leaving the export processing zone at the end of a shift (Reproduced in Crook, 2011).

2.2 Obtaining the required knowledge and expertise

By the time the 1970s arrived, Taiwan had thus already worked on transforming its economy for a few decades. As a result, Taiwan had three export processing zones at this time, some relationships with foreign (electronics) firms and were manufacturing and exporting electronics and related equipment that were labor intensive, but not highly complex. Taiwan's new-found ambition to adopt the semiconductor industry following the events described in the previous chapter, was obstructed by a lack of knowledge of complex technologies such as microchips and ICs. This section will discuss the struggle for knowledge and expertise in the beginning of Taiwan's semiconductor journey, what strategies it employed to overcome these struggles, and how these consequently enabled Taiwan to sustain and grow the industry. First I will elaborate on how founding ITRI and ERSO as well as securing its first IC technology transfer has helped Taiwan to obtain the knowledge and industrial capabilities for the semiconductor industry that the Taiwanese were still lacking at the time. Then I will shift my focus to the matter of Taiwanese expat returnees, how they were attracted to move back to Taiwan, and what their role was in the growth of the semiconductor industry.

One of the first questions to answer was whether Taiwan's limited time and resources, considering the political and economic crises at the time, should be spent on basic or applied research. Some believed that investing in basic research would allow the Taiwanese to "root" the industry in Taiwan and grow it indigenously (Hsu, 2016, p. 165). However, since Taiwan was already several decades behind countries such as the US, which was the global leader in semiconductor research and manufacturing in the 1970s, the Premier at the time Chiang Ching-kuo argued that Taiwan's limited resources would be better spent on diving immediately into "applied research for industrial purposes" (Hsu, 2016, p. 169). In other words, an alternative method of adopting the technology was required in order to grow hard and fast. The KMT government therefore took efforts to set up a knowledge infrastructure that focused on finding technologies that would be beneficial for the Taiwanese semiconductor industry and suitable to pursue, as well as find strategies to obtain them (Davids, 2021, p. 6).

This is the purpose for which the Industrial Technology Research Institute (ITRI) was founded in 1973, an institute that to this day is still operational as an institute for applied

technology research (“ITRI Overview”, n.d.). In 1973 its primary goal was applied research into technologies to drive Taiwan’s industrial upgrading forward (Hsu, 2016, p. 165). Many of the first initiatives in the Taiwanese semiconductor industry, such as Taiwan’s first IC technology transfer, the establishment of the first Taiwanese semiconductor firm and Taiwan’s largest semiconductor firms, all find their roots in ITRI. The decision to focus on semiconductors came quickly after founding ITRI. The story of Minister Sun Yun-suan and his friend and colleague Dr. Pan Wen-yuan deciding on what technology Taiwan should pursue to become a competitive player in the electronics industry, has been told in the previous chapter. Important to reiterate is that it was Dr. Pan and his Technology Advisory Committee (TAC) that wrote a report that advised Taiwan to invest $10 million in the semiconductor industry and detailed a plan using technology transfers to obtain knowledge of semiconductor technologies from abroad (Mathews & Cho, 1999, p. 158). The government agreed with this plan. Following this decision, the Electronics Research and Service Organization (ERSO) was founded from ITRI to specifically focus on the semiconductor industry and specialize in scouting and organizing potential technology transfers in this field. ERSO in combination with Dr. Pan, who was employed at a research lab under Radio Corporation of America (RCA), managed to secure Taiwan’s first IC technology transfer: RCA’s 7-micron IC technology (Mathews & Cho, 1999, p. 158).

Figure 12. President Chiang Ching-kuo (the man in front wearing glasses) at the opening ceremony of Hsinchu Science-based Industrial Park on December 12, 1980 (Reproduced in “Hsinchu Science Park celebrates its 40th birthday today!”, 2020).

This transfer was immensely valuable to Taiwan, because it marked the true beginning of Taiwan’s semiconductor industry. This transfer gave the Taiwanese engineers their first look

into “the secret world of advanced technology” (Mathews & Cho, 1999, p. 158). For RCA, the 7 micron IC technology had already become obsolete in its own American market, so it saw no harm in transferring it to Taiwan and receiving royalty payment in return (Mathews & Cho, 1999, p. 158). The technology transfer not only included the technology itself, but also the required knowledge and training for Taiwanese engineers to be able to make ICs by themselves. Accordingly, a small group of Taiwanese engineers were invited to spend almost a year in the US to learn about IC fabrication (Mathews & Cho, 1999, p. 158). With this knowledge, these engineers were able to build the first pilot IC fabrication plant in Taiwan and establish Taiwan’s first semiconductor firm in 1980: United Microelectronics Corporation (UMC) (So, 2006, p. 72; Davids, 2021, p. 6).

Though Taiwan’s economy had already experienced growth, the 1973 economic crisis and the fact that semiconductors was a new industry in Taiwan meant that private investors were initially not interested to invest in the industry. As a result, the government officially provided 45 to 49 percent of the funds that were needed to establish UMC, but indirectly the government invested another 25 percent on top of that (So, 2006, p. 72; Mathews & Cho, 1999, p. 160). This exemplifies how much the government wanted to get the semiconductor industry off the ground and for it to be run as a private company to encourage the founding of more private semiconductor and IC firms. The division of official and unofficial government funding meant that UMC could still be considered a private company even if in reality the government invested more than that (So, 2008, p. 74). Noteworthy is that this technology transfer again showcases Taiwan’s awareness of what capabilities and connections the island had and did not have, and how the government consequently planned to obtain something that was immensely valuable to them.

At the same time Taiwan obtained its first semiconductor technology, another major project to boost the industry was also taking place: the construction of Taiwan’s first research and science park Hsinchu Science-based Industrial Park (HSIP). Building HSIP was a strategic move in three important ways. Firstly, economically Taiwan hoped that by offering a similarly attractive trade environment as the EPZs, it would be able to attract many foreign investments from big multinational electronics firms (So, 2006, p. 74). Secondly, there was the hope that the close proximity of the park with two universities would enhance the cooperation between science and business, as well as attract university graduates to the park (Davids, 2021, p. 7). Finally, HSIP was also supposed to attract Taiwanese diaspora to come back to Taiwan and help further develop the semiconductor industry (Davids, 2021, p. 7).

Many of the Taiwanese diaspora that HSIP was supposed to attract to come back were students that had moved to the US to pursue their studies at prestigious universities and start their careers in US industries. This was the result of the United States' Immigration Act of 1965, which led to a major brain-drain effect from Asia to the US (Saxenian & Hsu, 2001, p. 901). This brain-drain also resulted in there not being many people with this profile left in the countries they left behind. Taiwan was one such region, meaning that there were many high-educated Taiwanese engineers that the KMT government could try to lure back to Taiwan (Saxenian & Hsu, 2001, p. 904). As such, HSIP provided close proximity to ITRI and universities, fiscal incentives, high-quality housing and the only Chinese-American school in Taiwan (Saxenian & Hsu, 2001, p. 908), which were all set up to specifically target and attract this group of engineers and entrepreneurs.

The conscious effort behind attracting these expat returnees suggests that they were considered an important part of Taiwan's strategy to developing a successful semiconductor industry, but the significance of their role in the industry's development is disputed. Following Saxenian & Hsu (2001), the "US-educated Taiwanese engineers" are often believed to have been a critical factor in the Taiwanese catch-up strategy in the semiconductor industry, as Lin & Rasiah (2013) argue for example. This version downplays the state role in achieving success in the semiconductor industry by highlighting alternative factors that have contributed to the rate of growth and development of this industry: that of knowledge flows through human capital, and the reversal of a brain-drain effect into brain-gain (Saxenian & Hsu, 2001, p. 908; Lin & Rasiah, 2013, p. 66).

Possibly the most well-known example of a returning engineer is Morris Chang, the founder of one of the largest and most advanced IC manufacturers today: Taiwan Semiconductor Manufacturing Corporation (TSMC). A doctorate from Stanford University and having held high positions at both Texas Instruments and General Instruments, he returned to Taiwan in 1985 to become the new President of ITRI and established TSMC the following year (Mathews & Cho, 1999, p. 160). It has been noted that the return of individuals such as Morris Chang, who contributed greatly to Taiwan's catch-up activities in the sector, gave others who were still abroad more incentive to return to Taiwan (Lin & Rasiah, 2013, p. 72). Lin & Rasiah go on to claim that "[t]he support and sense of belongingness developed by the Taiwan government acted as a more powerful tool to attract the diaspora than immediate monetary benefits" (2013, p. 76).

Figure 13. Morris Chang is awarded the Order of Propitious Clouds for his outstanding services as a civilian to Taiwan September 14, 2018 ("Decorations of the Republic of China (Taiwan)", n.d.) (Presidential Office, 2018, Reproduced in Teng, 2018).

Kenney et al. (2013) argue however that a case such as Morris Chang's is the exception, rather than the rule. Instead, they show that when one examines some of the larger companies in HSIP, the majority of them were actually established by domestic engineers (Kenney et al., 2013, p. 5). Hence, Kenney et al. emphasize that firstly, these returnees were not "determinative" of the semiconductor industry in Taiwan and that most of them only returned after the industry had "achieved international success" (2013, p. 2). Secondly, they claim that the consequence of focussing on the returnee rhetoric, not enough attention is paid to the importance of the ecosystem that needed to be created first in order to sustain a semiconductor industry and attract the returnees to come back in the first place (Chen, 2008, p. 82; Kenney et al., 2013, p. 6). The following figure shows the number of expats who returned to Taiwan between 1970 and 1998.

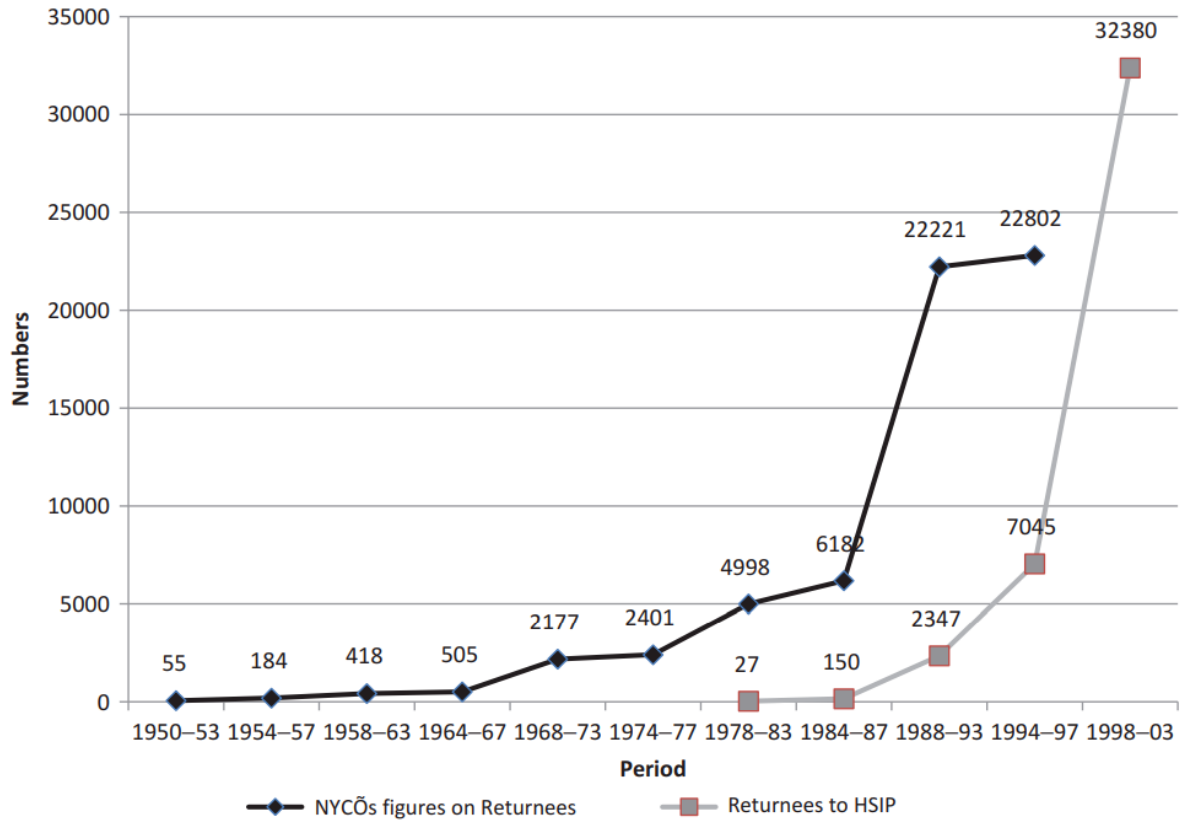


Figure 14. A graph depicting the number of returnees to HSIP from 1978 to 1998 (Lin & Rasiah, 2013, p. 68).

The peak clearly occurred in the 1990s, which is after HSIP was established in 1980 and after consumer electronics firms' stocks had gone public and greatly boosted the value of these companies (Chen, 2008, p. 78). Accordingly, Chen suggests that "the engineers-turned-entrepreneurs became billionaires overnight" after their stocks went public, and that "it is this [HSIP] dream that induced the repatriation of seasoned engineers from Silicon Valley" (2008, p. 78).

While I have briefly presented both sides of the debate, one can assume that it was likely a combination of both and many additional factors that led to the Taiwanese semiconductor industry becoming what it is today. The government strategically planned to attract expats back to Taiwan, but this was not its only strategy. Taiwan tackled the issues of lacking knowledge and funds from multiple angles, which included attempts at attracting foreign investments from multinational corporations, attracting the return of US-educated Taiwanese engineers, knowledge and technology transfer agreements and constructing a science park. These strategies never existed separately and they each contributed in their own way to Taiwan's semiconductor industry. HSIP is an example of this conglomeration: it

required careful planning, inspiration from other countries (mentioned in the previous chapter) and a leap of faith to construct it. HSIP alone may not have been able to attract expats to return to Taiwan if the KMT government had not already worked towards industrializing Taiwan and transforming its economy. With this favorable environment in place for both foreign investors and returnees, HSIP offered just the right incentives at the right moment to attract the first expats to return with knowledge, experience and connections with an overseas community. Figure 14 shows how this resulted in a snowball effect. The first returnees showed others that Taiwan had become a place where engineers and entrepreneurs could seek successful careers as well as a sense of Taiwanese belongingness.

2.3 The ongoing political struggle

While the previous sections have focused on the economic and industrial developments that have enabled the start of a Taiwanese semiconductor industry, it should not be forgotten that behind the decisions to pursue these projects lies a political motivation that was brought on by leaving the UN in 1971. As much as Taiwan has tried to address the political mess that followed this event through economic and technological development, it should be noted that Taiwan's diplomatic relations with other countries nevertheless remained a struggle. This section will take a step back and look more specifically at the political context at this time and discuss why this has remained a struggle despite Taiwan's efforts in all three areas I have so far discussed. As such, this section also adds to this thesis' overarching narrative of Taiwan's political struggle that started with resolution 2758 in the previous chapter and will continue with the geopolitical ramifications in the 21st century of its dispute with China and lack of UN membership in the next. This entry will in part be about Taiwan's democratization in the 1980s and 1990s, for Taiwan's democratic ideology will become one of the relevant elements in the geopolitical tensions I will focus on in the next chapter. Taiwan's democratization was also a way for it to improve its international image. This section will end with Taiwan's ongoing strained relationship with China, and how this external factor nevertheless maintains the political struggle, regardless of Taiwan's efforts within its borders.

One of the most noteworthy political developments in Taiwan's history has been its rapid democratization, in which the KMT government again played a large role. While in the 1960s to 1970s the government had been occupied by plans to boost Taiwan's economy and kickstart its semiconductor industry, by the 1980s the Taiwanese government also started

taking steps towards democratizing Taiwan[12]. An important event that marked the beginning of reforms was President Chiang Ching-kuo's interview with the Washington post in 1986 (Southeri, 1986), in which he announced that he would lift martial law from Taiwan and allow the formation of new political parties as long as they supported the KMT's one-China policy and opposed communism (Ko, 2004, p. 153). President Chiang kept his word and lifted martial law in 1987, which resulted in significantly more political and media freedom in the island-nation (Ko, 2004, p. 153). What is remarkable about President Chiang's statements in this interview is that he spoke them in front of an international audience, as opposed to his own people. Ko (2004) has suggested that President Chiang's promised reforms did not come from a belief in democracy, but rather as an attempt to consolidate his power by improving Taiwan and the KMT's image on an international platform (p. 154). Though initiating the democratization process would lead to much more political and media freedom in Taiwan, it was importantly also a way in which Taiwanese presidents attempted to regain US support, or in the very least improve their diplomatic relations with the US in some way (Ko, 2004, p. 170).

This is another indication of Taiwan's preoccupation with international politics, and shows another way in which the government tried to improve Taiwan's image for the purpose of developing or maintaining its international relations. Note how developing a semiconductor industry and a strong economy have been projects with the same overall aim in mind: to develop Taiwan in such a way that it maintains an international presence. The combination of strategies that I have discussed in this chapter so far thus shows the various approaches a country can take to achieve that one vision.

[12] There were incidents and a general political unrest that preceded the democratization process. The people were critical of the KMT party's votebuying, flawed bureaucratic processes that allowed the same senior parliamentarians keep the same position for decades and the ongoing martial law and Temporary Provisions Policy. The way the government responded to a rally held by an opposition movement in 1979 (arresting the entire leadership of this rally) led to much international attention and criticism as well. Scalapino (1999) suggests that the KMT was sensitive to such incidents, criticism and negative international attention. As Taiwan's only government party at the time, the KMT was familiar with major setbacks and failures, which the government was determined to learn from and adapt (Scalapino, 1999, p. xiv OF p. 14). This was conducive for an environment where the KMT's leaders and President Chiang were more open to the idea of reforms, especially if these reforms allowed them to keep the people happy and themselves in power (Ko, 2004, p. 153).

Figure 15. President Chiang Ching-kuo at the 1986 interview with Katherine Graham from the Washington Post, in which he declared he would lift Martial Law. (Reproduced in China Change, 2016).

Nevertheless, international relations remained an ongoing struggle despite the alternative ways Taiwan found to maintain its international relations. As I have mentioned in the previous chapter, both China and the US were skeptical about Taiwan's ability to retain sovereignty. Taiwan never toppled over, however, which meant the two Chinas had to learn to live alongside each other. While this relationship has been fruitful at times, especially when it comes to trade, it has also been a constant cause for worry over a potential military conflict with China over their ideological differences and Taiwan's disputed status. Importantly, the strained relationship between the two has also impacted Taiwan's relationship with other countries. Despite Taiwan's efforts to develop itself on multiple fronts to remain present and relevant on the international sphere, it became increasingly more difficult to uphold international relations as less and less countries wanted a diplomatic relationship with Taiwan as time went on (White, 1999, p. 123). There have been records of China's efforts to prevent countries from forming close relationships with Taiwan through threats and bullying tactics, but also by using its veto card in international organizations to actively exclude Taiwan from participating as much as possible[13]. China's actions and Taiwan's struggle in this regard are a direct consequence of resolution 2758. China was given a highly valuable UN membership, which it has used to exert its influence over Taiwan's possibilities in the international arena. Taiwan has since worked hard to develop itself within its own borders. However, Taiwan's relatively small presence in international organizations

[13] See these Drun & Glaser (2022) and Englund (2022) for more elaborate analyses of the various tactics China has utilized to exclude Taiwan from as much as possible.

indicate that outside of Taiwan's borders it nevertheless remains disadvantaged when it comes to building diplomatic relationships. At the time of writing, Taiwan has a membership with 40 out of 300 intergovernmental organizations ("Foreign affairs", International Participation), and has applied multiple times for its own UN membership since 1993 (Winkler, 2012, section "Taiwan's UN drive since 1993"), but all of its applications have so far been denied for its "undetermined" status[14].

This section has in short illustrated Taiwan's ongoing struggle for international recognition and relationships. This is the struggle that Taiwan has attempted to tackle since leaving the UN through the realms of technology and economy. Besides the strategies in these other areas, Taiwan has of course also taken efforts towards their political ambition within the realm of politics itself. Part of the initial motivation behind Taiwan's democratization was that it could potentially improve Taiwan's international image, but it has since become an ideology that is highly valuable to the Taiwanese people and that they wish to protect at all cost. Importantly, this democratic ideology has made a potential reunion with China even more complicated, as both Chinas' political systems appear incompatible with each other in their eyes.

This chapter has so far shown that while Taiwan has undergone many developments within its borders, the circumstances outside of Taiwan's borders remain a struggle. In the final section I will take some time to discuss how the three aspects I have looked at in this chapter have impacted each other in various ways, and finally discuss how they have contributed to Taiwan's ambition to remain active and relevant on the international sphere.

2.4 Discussing some links between Taiwan's economy, technology and politics

I would like to use this final section to offer some observations on how the separate areas I have presented in this chapter can be brought together. These observations are by no means exhaustive, but serve to indicate that none of the developments I have discussed in this chapter happened isolated from the others, and that developments in one area inevitably had spillover effects in other areas as well. This section will first discuss the political dimension of Taiwan's economy and how developing it has given Taiwan political capabilities it did not have before. After that I will discuss how the semiconductor industry has been conducive for

[14] Note how Taiwan's "undetermined" status was determined in another one of Henry Kissinger and Zhou En-lai's conversations in 1971 (Lord, 1971c), this one taking place mere days prior to the official adoption of UN resolution 2758. The undetermined status, a result of the compromise between the US and China in their pursuit of a diplomatic relationship, has been adopted since the resolution as most countries' remain ambiguous on the matter: neither accepting nor denying that Taiwan is a region of China.

economic growth, which contributes to the political benefits from a strong economy, as well as the political dimension of semiconductors in the first place.

2.4.1 The political dimension of Taiwan's economy

Taiwan's economic growth in the 1960s and 1970s were important in shaping an economic environment that could support developing an electronics and semiconductor industry in the 1970s and 1980s. On top of that, attracting foreign firms to invest in manufacturing facilities in Taiwan also provided Taiwanese workers and managers with important learning opportunities that made them familiar with (managing) industrial manufacturing processes of basic electronics for example (Mao & Schive, 1995, p. 47). Having trade and investment relations with foreign firms also meant that Taiwan maintained links with other countries through these companies, which kept Taiwan in a position where it could still benefit from an increasingly globalizing and technological world, even if Taiwan was politically severely limited in this regard (Davids, 2021, p. 6). These economic developments thus not only contributed to the Taiwanese semiconductor industry economically, but they came with additional spillover effects that improved knowledge and skill while keeping Taiwan involved in the global sphere as well. The latter was difficult to achieve diplomatically, but by remaining competitive in the global market Taiwan at least managed to achieve it economically instead.

Besides it being beneficial to the semiconductor industry, a strong economy has also served a much more political role for Taiwan. Former Minister of Economy Sun has mentioned that Taiwan's approach to economy is relatively conservative, preferring to keep a budget surplus and keeping foreign borrowing to a minimum if possible (White, 1999, p. 101). White (1999) suggests that this careful approach to the economy serves as a protective measure against a potential escalation of a conflict with China, insuring Taiwan of a financial defense. The vast financial reserves Taiwan has built up as a result have also allowed Taiwan to become a major foreign investor, which the Taiwanese government has used strategically to further confirm and strengthen Taiwan's global networks (White, 1999, p. 113). These examples show that the Taiwanese economy, after Taiwan had worked hard to develop and grow it, has become something that the Taiwanese government uses for political means as well. It serves as both a form of defense in case conflict arises, but also as a tool to secure and maintain relationships with other countries. In this sense, developing the economy has helped

Taiwan to not only set the stage to start and grow a semiconductor industry, but it has also allowed Taiwan to maintain a presence in the international sphere.

2.4.2 The semiconductor industry's impact on economy and politics

The electronics industry, semiconductor industry and HSIP were important for the further transformation of Taiwan's economy and society. Besides becoming a trade economy, obtaining the technological knowledge and expertise from the initial technology transfer agreements eventually led to Taiwan experiencing a brain-gain effect and developing the capability of domestically educating and training engineers at the highest levels (Lin & Rasiah, 2013, p. 79). So (2006) claims that this was due to foreign companies not paying sufficient attention to the bustling potential of the Taiwanese industry, leaving it room to grow natively as a result (p. 75). The growing economy and technological sector also led to a growing middle class that "fed the opposition's push for reform" (Ko, 2004, p. 172).

Important to mention here as well is that the products of the semiconductor industry, integrated circuits, are often considered and treated as a highly political technology. This started in history as the first transistor and integrated circuits were created in the US during the Cold War for military purposes (Mody, 2021, p. 35). As with many military technologies, ICs quickly found their way onto the consumer market in consumer products as well. In the 21st century, ICs can be found in nearly all electronic devices and come in a wide array of technological complexity. ICs are hence important in the political sense not only for their military applications, but also because they have become such an integral part of humans' technological and digital lives. In other words, being a dominant player in this industry offers economic and political leverage due to its immense importance to modern life. Whether Taiwan intended to become the world leader in the manufacturing of the most advanced ICs on the globe is debatable, but the Taiwanese have always been aware of the importance and value of this technology and the security implications of adopting it. As cross-strait trade with mainland China picked up again in the 1980s and 1990s, Taiwan has shown itself to be particularly protective over its semiconductor industry and rules regarding opening IC manufacturing facilities in mainland China (Hsu, 2016, p. 173). Interestingly, it was also the higher executives of these semiconductor firms that eventually managed to pressure the government into adopting a more lenient policy regarding IC manufacturing in mainland China (Hsu, 2016, p. 173), which at the very least indicates that the semiconductor industry brings together technological, economical and political concerns into one industry.

2.5 Conclusion

This chapter took a deep dive into some of the struggles that Taiwan faced in the 1950s to the 1990s. The first section focused on Taiwan's economic transformation from an agricultural economy to a trade economy in the 1950s to 1960s. This section serves as an economic and historical context on one hand, but some of the policies that Taiwan employed in its transformation of the economy have also contributed to valuable knowledge for when Taiwan entered the semiconductor industry. This period contributed to a stronger economy that enabled stepping into the semiconductor industry in the first place, as well as Taiwan becoming more experienced as a trade economy with international trade relations.

The second section shifted focus to the semiconductor industry itself. It highlighted how some of the events mentioned in the previous chapter contributed to Taiwan's growing technological capability in the semiconductor field. The examples in this section show the way Taiwan addressed the hurdle of lacking the knowledge and expertise required to enter such a knowledge-intensive industry. It not only illustrated the catch-up technology transfer strategy Taiwan employed to learn and grow quickly, but also presented how each decision that Taiwan made in these examples contributed to growing Taiwan's technological capabilities.

The third section of this chapter zooms in on the political struggle Taiwan has faced since leaving the UN from two perspectives. First I elaborated on Taiwan's democratization process and argued that it was another way in which Taiwan attempted to improve its international image. Though the democratization process would be successful, by the end of this section I contend that international politics nevertheless remains an ongoing struggle.

The fourth and final section discussed how Taiwan's economic, industrial and political developments did not occur separately, but in conjunction with each other instead. There were important spillover effects from one area to the other that opened up new possibilities and projects to pursue. This section also highlighted how politics was always a major consideration. Even when Taiwan was tackling the realms of economy and industry, these projects had an underlying political motivation.

In conclusion, this chapter has studied how Taiwan strategized its pursuit of a new future, a vision that was brought on by resolution 2758 as I have described in the previous chapter. The desire to remain present in the international sphere and maintain Taiwan's sovereignty despite this major setback motivated developments in multiple areas of society, not just in the political sphere. Developing a semiconductor industry was only one of the

ways in which Taiwan did so. While the previous chapter showed that the desire to develop a semiconductor industry had a political motivation, this chapter has argued that developments in other areas of society, such as economy, were required in order to sustain such an industry. In turn, sustaining this industry and growing Taiwan's economy have indeed also contributed to Taiwan's political goals, as Taiwan had envisioned. The way the different areas discussed in this chapter have come together and impacted one another therefore shows that history told through separate lenses (technology, economy, politics) does not tell the full story. Instead, technology, economy and politics co-evolve with each other and co-shape society as it moves towards its envisioned future. The next chapter will zoom in on the political and geopolitical tensions of contemporary Taiwan, together with the US and China. It represents a culmination of the decisions I have analyzed in the first two chapters, showcasing how they have shaped the very specific scenario of the US-China trade war and Taiwan's role herein.

CHAPTER 3

The US-China trade war and Taiwan's semiconductor industry

Figure 16. From left to right: Chinese President Xi Jin-ping, Taiwanese President Tsai Ing-wen and former US President Donald Trump (Financial Times, 2018).

This chapter serves as a third and final chapter to this thesis by showing how Taiwan's political history and decision to adopt the semiconductor industry come together in the current-day tensions and rivalries on a global scale. As such, this chapter analyzes how the semiconductor industry became Taiwan's "silicon shield" (Tsai, 2021, section "Changing the rules"), how this relates to current-day tensions and complexities and how these are maintained given Taiwan's history and geopolitical place in the world today. Since the US-China trade war is an ongoing event and regularly sees new developments, there is relatively little academic literature on the intersection of the US-China trade war with a specific focus on Taiwan. Previous work that has been done on the US-China trade war and current state of the Taiwanese semiconductor industry have (Momoko, 2022; Shattuck, 2021; Klinger-Vidra & Kuo, 2021) mostly focused on analyzing contemporary events, with some historical elements of the industry added to provide context. I aim to add to this by more explicitly and intentionally analyzing how the various decisions and developments in Taiwan's history have ultimately led to Taiwan being in the position it is in today. Additionally, policy

recommendations have also been written to address the rising tensions amidst the US-China trade war (Dekker, 2021; Nordin & Stünkel, 2022), which have aided my understanding of the more diplomatic side of this conflict. My analysis in this chapter will provide some of the historical context and depth that these papers have only addressed shortly, which will allow me to shed light on the feasibility of these recommendations how the situation has become so complex to resolve.

The chapter will be structured as follows. The first section will discuss Taiwan and TSMC's global importance through their semiconductor industry and how they have grown as important as they are. This will provide the necessary context to understand Taiwan's and TSMC's roles in the geopolitical competition I will discuss in the rest of the chapter. The second section will shift the focus to the conflict that has been plaguing the semiconductor industry in recent years: the US-China trade war. After presenting the American incentive to instigate this competition during the Trump administration, I will focus more specifically on how Taiwan and TSMC are situated in the middle of this conflict. This section will also illustrate why the semiconductor industry in particular, has become the area in which the US-China rivalry is being played out. The third and final section will touch on the current responses with regards to the semiconductor industry to the rising tensions in the Taiwan-strait and between the US and China. As such it will illustrate the complexities that these actors are facing due to Taiwan's geopolitical position and the resulting conflicting interests.

3.1 TSMC's importance to the world and Taiwan

3.1.1 The trajectory to becoming the global leader in the semiconductor industry

Since its establishment in 1987, TSMC has grown into one of the most important semiconductor manufacturers in the global supply chain. When it was founded, it was the first pure-play foundry in the world (Mathews & Cho, 2000, p. 160), meaning that TSMC does not design ICs themselves, but instead only manufactures them for other companies. For the first time, companies were able to design their own chips, but outsource the manufacturing of them, consequently lowered the bar for entering this industry since companies were no longer required to have their own foundries (Shattuck, 2021, p. 104; Davids, 2021, p. 9), which are expensive and time-consuming to construct. At the time, this greatly benefited the semiconductor industry in Taiwan, and the number of Taiwanese IC design houses greatly escalated in the first decade since TSMC's establishment (Davids, 2021, p. 9).

Following TSMC's example, Taiwan's first semiconductor firm United

Microelectronics Corporation (UMC) also transitioned its business model to become a pure-play foundry, while letting its IC design department be diverted into another company (Davids, 2021, p. 9). Being the first two pure-play foundries, TSMC and UMC became highly important to the Taiwanese semiconductor industry, as they greatly lowered the threshold for new IC design houses in HSIP to enter the industry, which contributed to making HSIP into a highly competitive environment where a lot of knowledge was shared and exchanged, all pushing the domestic semiconductor industry forward (Mathews & Cho, 2000, p. 178). The benefits of pure-play foundries were not limited to Taiwan's borders. To the contrary: this business model allows these companies to serve companies that design ICs around the world without competing with them (Shattuck, 2021, p. 104). Instead, the relationships that pure-play foundries such as TSMC built with other companies were mutually beneficial.

Their fast growth as companies can be attributed to a combined strategy of investments, mergers and acquisitions (Chen, 2008, p. 81-82; Davids, 2021, p. 9), but it was their pure-play foundry business model that allowed them to focus specifically on improving the quality, production capacity and efficiency of the manufacturing process of chips (Shattuck, 2021, p. 104). This meant that by the end of the 1990s, a mere decade after TSMC's establishment, Taiwan had achieved world leader status in the manufacturing of semiconductors (Klingler-Vidra & Kuo, 2021, p. 185) and both TSMC and UMC had managed to achieve firm global positions in the semiconductor industries (Davids, 2021, p. 10).

At this stage, with Taiwan's semiconductor industry approaching the cutting edge of microchip technology, the industry's previous strategy of technology transfer had become less viable (Van Hoesel, 1996, p. 226). The growth of HSIP and the industry also resulted in all IC firms in Taiwan becoming privately owned by the year 2000, which was also the same year in which government planning and coordination for the semiconductor industry ended (Lin & Rasiah, 2013, p. 75-76). Planning, diversifying and expanding activities have since been entirely taken over by private firms.

3.1.2 The factors that make TSMC unique

Taiwan, as well as TSMC in particular, have managed to maintain their leadership positions in the industry since the 1990s. Currently, TSMC produces the most advanced chips in the world while also being the biggest pure-play foundry firm on the globe (Klingler-Vidra &

Kuo, 2021, p. 186; Shattuck, 2021, p. 104). This is due to the fact that TSMC is not only constantly at the technological frontier of chip manufacturing, but has also been a major investor in joint research and development activities with the Dutch firm ASML for next generation lithography machines (Klingler-Vidra & Kuo, 2021, p. 189). This construct ensures that TSMC is usually one of the first, if not the first, to obtain these machines (Hijink, 2021 p. 12), which also means that TSMC is usually one of the first manufacturers to be able to start production on larger volumes of next generation chips, which in turn safeguards its position in the industry. In addition to its advanced capabilities, TSMC has also developed the reputation of being one of the most reliable foundries in the industry (Shattuck, 2021, p. 104). Consequently, some of the world's largest tech companies rely on TSMC to produce their designs: examples include Apple, Nvidia, Google and Huawei (Shattuck, 2021, p. 104).

Combining TSMC's massive production capacity and advanced chip manufacturing capabilities with the world's reliance on semiconductors makes TSMC one of Taiwan's most important companies (Shattuck, 2021, p. 104). TSMC manufactured chips are not only abundantly present in consumer electronics, but its chips are also used in military technologies such as missiles and radars, which makes TSMC an important company from a security perspective as well. A reliable foundry that can produce secure and cutting edge chips is therefore considered an advantageous security asset as well. Hence, TSMC is not only important for Taiwan's economy and the global semiconductor industry, but its importance with regards to international politics has also become increasingly clear in the wake of the US-China trade war (Shattuck, 2021, p. 101).

In sum, factors that contribute to TSMC's success are its scale of operation, advanced manufacturing capabilities, reliability and security, which makes TSMC unique in the industry and valuable in the global sphere. TSMC achieved this position through a combination of various aspects that were conducive to their growth. It was founded in a time where through careful government planning, an environment and infrastructure had been created for the semiconductor industry to seed and grow (Mathews & Cho, 2000). The local industry benefited from TSMC's establishment, which again benefited from all the local business. The Taiwanese cluster became something that nurtured itself as it carved out its own niche in the global market (So, 2006, p. 75).

Figure 17. TSMC's latest 5nm fab: Fab 18 in Tainan Science Park, Taiwan (WCCFTech, n.d.).

3.1.3 TSMC's importance for Taiwan

As I have shown in the previous chapter, Taiwan went through major societal changes as its semiconductor industry matured. All the while, the semiconductor industry remained an important asset to Taiwan that needed to be nourished and protected. It is in the interest of both Taiwan and TSMC to keep TSMC's most advanced technologies within Taiwan's borders. The headquarters, all the innovation and manufacturing of its most advanced and security sensitive chips all remain on the small, mountainous island of Taiwan. Of TSMC's sixteen operational fabs, only three are currently operational outside of Taiwan (TSMC fabs, n.d.). This is not without reason. Part of TSMC's business strategy that enables it to remain the leading semiconductor manufacturer is to keep the most advanced technologies within Taiwan's borders, where also a large number of TSMC's engineers and most experienced managers are (Momoko, 2022, p. 9), while production costs in Asia are also comparably lower than in the West.

Keeping the most advanced operations in Taiwan is also beneficial for the Taiwanese government. Amidst talks between TSMC and the West about the construction of fabs on the European and American continent, the Taiwanese Minister of Economic Affairs Wang Mei-hua has assured that "Taiwan will remain the homebase for its most advanced technologies"

(Oung, 2021). Clearly then, it is the government's intention to keep one of the most valuable aspects of its semiconductor industry within Taiwan. Motivations behind this intent are not only the industry's indispensability to the Taiwanese economy, but President Tsai has also noted that the industry has become Taiwan's "silicon shield" that protects Taiwan from aggression that may target the industry's global value chain through Taiwan (Tsai, 2021, section "Changing the rules"). Discourses surrounding the semiconductor industry largely still focus on protecting the economy and diversifying global supply chains, but as I will discuss in the next section, from a defense perspective the industry is also considered to be a major security concern. As such, the "silicon shield" and Taiwan's strong economy, are both essential to Taiwan's national security as a whole (Nordin & Stünkel, 2022, p. 5)

The Taiwanese semiconductor industry and its tech giants such as TSMC are thus considered highly important to both Taiwan and the rest of the world. With regards to the latter: the Taiwanese chip industry has managed to earn the reputation of being reliable while also being able to generally meet global demands for chips for the most advanced chips in the world. The way Taiwan managed to develop and grow its indigenous industry has allowed Taiwan to obtain a unique set of qualities that is highly desirable in today's technological societies. This unique position has led to the world being largely dependent on the island, particularly TSMC, to supply chips for both widely used consumer market technologies as well as highly sensitive military technologies. This dependence as well as the fragility of this supply chain was made abundantly clear when supply was disrupted by the COVID-19 pandemic, geological happenings in Taiwan that disturb operations, or disruptive policies that influence semiconductor trade, to name a few examples (Nordin & Stünkel, 2022, p. 1).

Then, with regards to Taiwan, this technological dependence has affected Taiwan's position in the world as well. Not only did the semiconductor industry help Taiwan achieve a strong and thriving economy, but the highly important and security sensitive nature of semiconductors in combination with the world's reliance on Taiwanese manufactured chips has provided Taiwan with a security blanket that serves as an additional incentive to maintain peace in the Taiwan strait. As such, at this stage the Taiwanese semiconductor industry has become an important, political asset to Taiwan, both to its advantage and sometimes disadvantages, as I will discuss later in this chapter.

3.2 TSMC and Taiwan's geopolitical position in the US-China trade war

Having discussed the Taiwanese semiconductor industry's importance in the global sphere,

the ongoing trade conflict between the US and China exposes the complexities of being in this position. Also colloquially known as the US-China trade war or US-China tech war, it is commonly perceived to have started with the Trump administration when in 2018 the National Security Strategy announced the "great power competition" with (primarily) China and Russia (Shattuck, 2021, p. 106). This section will focus on discussing the US-China trade war and its implications for TSMC and Taiwan's geopolitical position in the world. I will take the publicly available summary of the 2018 National Defense Strategy (NDS), published by the Office of the Secretary of Defense (OSD) as a point of departure to illustrate technology's role in the conflict. From here I will discuss how the US consequently acted on the NDS and targeted the Chinese company Huawei. These actions had ramifications for the industry across the globe, and thus for TSMC and Taiwan as well, putting them in an awkward geopolitical position between the two global superpowers. The section will conclude with a reflection on the ideological component of the trade war.

3.2.1 The role of technology in the great power competition

The 2018 National Defense Strategy states that "the central challenge to U.S. prosperity and security *is the re-emergence of long-term, strategic competition*" (OSD, 2018, p. 2). The term "re-emergence" supposedly refers to the re-emergence of certain actors as well as the return to a time in which they partook in "long-term, strategic competition" with the US: the Cold War and the former Soviet Union. This time the NDS states explicitly that China and Russia are the US' priority due to the "magnitude of the threats they pose to U.S. security and prosperity today, and the potential for those threats to increase in the future" (OSD, 2018, p. 4). The US Department of Defense (DOD) highlights technology as a sensitive area, specifically because of how the rapid advancements of technology and who possesses it will likely determine the wars of the future, as well as who can fight these wars and win them (OSD, 2018, p. 4). The specific technologies that are mentioned include robotics, artificial intelligence, big data and biotechnology among others. Importantly, all of these technologies require semiconductors of varying degrees of complexity to be able to function in the first place. The DOD acknowledges this by stating that it will likely be the commercial technologies that will continue to change society, but also drive technological advancements in both the commercial and military sector (OSD, 2018, p. 3). It is emphasized that the security concern lies in "state competitors and non-state actors" also having access to these technologies, hence risking that these competitors will use them for their own advancements

and potentially use those against the US (OSD, 2018, p. 3). On one hand it is therefore determined that technology employed against the US should be perceived as a major threat. The DOD is not only referring to military technologies, but also ways in which commercial technologies are used to disrupt or influence democratic processes (OSD, 2018, p. 2). On the other hand, it is believed that maintaining a technological advantage is an important aspect of the defense strategy so that the US will be prepared to fight the war of the future, however it may look like. It is stated that this "will require changes to industry culture, investment sources, and protection across the National Security Innovation Base" (OSD, 2018, p. 3). It should be noted that the NSIB as it is described in the NDS encompasses not only academia or the military, but also the private sector (Lewis, 2021, parag. 1).

There are thus three important observations that can be made from this. Firstly, the Trump administration very strongly perceived the other, in this case primarily Russia and China, as a threat to their own technological advantage and the international order that was established after World War II (OSD, 2018, p. 2). This erosion is blamed on the countries just mentioned for the way they influence this international order through coercion, "predatory economics", and seeking influence over international organizations to further their own agenda (OSD, 2018, p. 2), which does not align with the US' agenda nor its ideologies. This creates an "us versus them" discourse that creates competition and paints the other as a threat that must be contained. The great power competition is announced to do exactly this: contain and minimize the threat while asserting their own power.

The second observation shows that technology is considered a crucial way in which this power is to be asserted. The DOD's main concern lies in technologies for military applications, since they assure a country's warfare capabilities. This is especially important to the DOD in light of future warfare, about which it is unknown how it will exactly differ from wars of the past, but the DOD is certain that it will involve advanced technologies. Securing these technologies and their technological advantage over the perceived threat is therefore a key aspect in a competition for power.

The way the US chose to do so is also the third observation: the NDS prioritizes a change and protection strategy of the technological industry to the perceived threats and re-asserting the US' power. Since technologies such as semiconductors are currently largely a commercial technology both in application and manufacture, this poses a security concern to national security. There is much less control in terms of who has access to these technologies and how they will use them, which the 2018 NDS aimed to change, as will be discussed later in this section. The security concern also has two important facets that require protection: the

risks that come with using commercial technologies in military technologies, and the industry itself that can provide economic prosperity and thus economic security when successful.

3.2.2 The great power competition in practice: targeting Huawei

After publishing the 2018 NDS, a strict US policy stance was taken towards China and its high tech industry. One of the most notable cases is how the US targeted the Chinese technology giant Huawei. Huawei was first targeted in May 2019 when the Department of Commerce added Huawei to the Entity List due to a reasonable cause to believe that it poses a national security and foreign policy threat to the US (Addition of Entities to the Entity List, 2019; Momoko, 2021, p. 8). Being added to the list meant that there would be more license[15] requirements imposed on the company, since it exports products that are based on US technologies and designs while also being considered a risk to the US (Addition of Entities to the Entity List, 2019; Shattuck, 2021, p. 107). Since Huawei continued using US technologies, the Bureau of Industry and Security (BIS) implemented additional rules in 2020 to restrict Huawei's ability to acquire semiconductors. Semiconductor designs made by Huawei and items that are produced from its designs that are considered a product of the US Commerce Control List, would now also be subject to the Export Administration Regulations (Commerce Addresses Huawei's Efforts to Undermine Entity List, 2020, points ii and iii). This meant that companies such as TSMC that manufactured Huawei designed chips for Huawei now needed an additional license to continue to do so (Shattuck, 2021, p. 107). Nevertheless, Huawei found a loophole: it could still buy chips that were designed and sold by other companies (Shattuck, 2021, p. 7). This did prevent Huawei from continuing its business with TSMC, since TSMC does not produce in-house designs, but Huawei could still purchase chips from Mediatek, another Taiwanese semiconductor firm (Shattuck, 2021, p. 7). Realizing this, the US imposed further restrictions in August 2020: all items produced from US technology and software now required an additional license to sell to Huawei (Commerce Department Further Restricts Huawei Access to U.S. Technology, 2020, parag. 1). This was considered the final nail in the coffin. It did not matter that these were not US companies, since this set of restrictions allowed the US to control the export and trade of semiconductors

[15] This license needs to be acquired from the US Bureau of Industry and Security (BIS). Applications for such a license are subject to a license review. However, the BIS license review policy operates on a presumption of denial, meaning in practice that most license applications are denied (Giancarlo et al., 2019, parag. 2).

purely based on them containing or using US software or technologies. As most semiconductor firms make use of these, Huawei was left with no way to acquire chips from an external company. This was highly problematic to the Chinese firm, since outsourcing the manufacturing of its highly advanced chip designs was how Huawei managed to grow into the technology giant it has become (Momoko, 2022, p. 8).

3.2.3 How the US restrictions affect TSMC and Taiwan

The US' decision to implement the restrictions on Huawei had implications for all companies that had dealings with the Chinese firm. These restrictions were met with disapproval from the industry. The Semiconductor Industry Association's (SIA) represents the majority of the US semiconductor industry as well as international members such as TSMC, Mediatek and Samsung (Shattuck, 2021, p. 108). In its response, the SIA claimed that these restrictions on commercial chips will cause "significant disruption to the U.S. semiconductor industry" and emphasize that selling "non-sensitive, commercial products to China drive[s] semiconductor research and innovation" (SIA, 2020). In practice, it has resulted in companies being forced to carefully consider how to do so (Klingler-Vidra & Kuo, 2021, p. 191).

Figure 18. A cartoon of former US President Donald Trump burning a bridge, while Chinese President Xi Jin-ping appears to be learning how to build one instead (Stephens, 2018). Note how this picture was drawn in 2018, prior to the restrictions the US placed on Chinese companies.

The restrictions have affected TSMC in multiple ways. After Apple, Huawei was TSMC's

biggest customer for chips in the first half of 2020 and accounted for 10% of TSMC's total sales (Momoko, 2022, p. 8). Nevertheless TSMC announced in May 2020 that it had not taken any new orders from the Chinese firm since the US restrictions (Cheng & Li, 2020), and that it would officially stop doing business with Huawei in September of the same year (Shattuck, 2021, p. 108). TSMC nor Taiwan suffered financially from these restrictions however. Instead, the technological competition between the US and China has been highly profitable for the Taiwanese semiconductor industry, since it resulted in rising demands from both sides. (Klingler-Vidra & Kuo, 2021, p. 194). Additionally, the 2020 to the present global chip shortage also contributed to soaring demands for chips, which greatly benefited the Taiwanese economy (Wang, 2022, p. 66). This positive economic development for Taiwan has prompted Klingler-Vidra & Kuo (2021) to be cautiously optimistic about Taiwan's and TSMC's financial performance, and encourage Taiwan to acknowledge China as both a business partner as well as an upcoming competitor in the semiconductor industry (p. 197).

In practice, however, the situation is not quite as simple. This relative economic optimism is starkly contrasted by the geopolitical concerns of the US-China trade war. Shattuck (2021) showcases in his argument how TSMC is geopolitically stuck in the middle of two global superpowers and why this may cause more harm than good for Taiwan. The cross-strait conflict regarding Taiwan's status hangs over the two Chinas in two very different ways; whereas peaceful unification with Taiwan is one of China's top priorities; Taiwan's priority over the last decades has been to maintain peace in the region, which meant maintaining the status quo. Although this conflict has loomed over the two nations since the KMT fled from the mainland, over the years cross-strait trade has nevertheless grown significantly to a point where China became Taiwan's largest trading partner (Shattuck, 2021, p. 103). At the same time, China has also grown dependent on Taiwanese produced chips to further its own pursuit of semiconductor independence (Klingler-Vidra & Kuo, 2021, p. 186). There has thus been a fine balanced interdependence between the two that most countries are keen on maintaining, because it's one of the aspects that encourages cross-strait peace, which meant for the technology sector that both China and the US had access to Taiwanese-made chips (Shattuck, 2021, p. 109). One of the greatest risks of the US restrictions on semiconductor trade with Chinese companies is the disruption of this interdependence, which could affect cross-strait peace in two ways.

Firstly, the US restrictions pressured companies such as TSMC to pick a side in this trade war. Considering TSMC's dependence on US technologies, its decision to end business relations with Huawei was not surprising. However, considering Taiwan's and TSMC's

geopolitical positions, it would have been most beneficial to both to maintain a balance between both the East and the West and remain neutral to avoid raising tensions within its already tense relationship with China (Shattuck, 2021, p. 108). This has been both TSMC and Taiwan's strategy until the US forced them to pick a side. The rising tensions in turn tend to push Taiwan more towards the US and its allies both politically and ideologically.

Secondly, by disturbing the interdependence, China's technological and economical reasons for maintaining peace with Taiwan are undermined. While this leads to concerns that China will therefore be less inclined to maintain peace, the TRA still offers plenty of incentive to avoid military conflict (Smith, 2022, p. 82. What it does do is give China more incentive to develop its own native semiconductor industry. While China was already pursuing semiconductor independence prior to the great power competition, by taking away the possibility to rely on foreign firms' semiconductors (Grimes & Du, 2022, p. 11), one of China's remaining options to obtain them and pursue semiconductor independence is to grow these capabilities by itself (Klingler-Vidra & Kuo, 2021, p. 196). While this would be highly undesirable for the US and Taiwan, both whom's technological advantages would be challenged in that case, Grimes and Du (2022) have found that this pursuit has been made particularly difficult by the US restrictions, since these also pose restrictions on technology and knowledge transfers, which are a crucial part of a latecomer's catch up strategy (p. 12).

There is also the additional risk that China may turn to illicit means to acquire the necessary knowledge. It has already been determined that China has used tactics such as hacking and stealing blueprints from TSMC, as well as disrupting its operations through cyber attacks (Shattuck, 2021, p. 114). Being pushed into a corner when it comes to legitimately acquiring chips and knowledge may give the Chinese more incentive to use more problematic means. Activities such as hacking would pose additional security risks for not only the companies that are targeted, but also the countries that make use of the technologies that may have been subject to sabotage or theft.

3.2.4 Reflections on the great power competition as an ideological competition

While this section has largely focused on the technological component of the US-China trade war, it should be emphasized that it is ultimately a competition for power. The way the US NDS approaches technology makes it clear that the US views technology as something that will help maintain the current power balances that are favorable to them, namely one that should "safeguard the free and open international order" (OSD, 2018, p. 1). One of the major

problems that the US DOD has with the rivaling countries is that they are instead perceived to be shaping a global order in accordance with their "authoritarian model" (OSD, 2018, p. 2). Note that it is this difference in ideology, where the US favors a "free and open international order" and opposes the other's "authoritarian" model, that drives an underlying, ideological competition between the US and their perceived rivals. In accordance, the othering discourse in the 2018 NDS is highly antagonistic towards these rivaling countries. This set of beliefs is used to justify the great power competition and all the actions that have come from it.

This China policy has led to ripple effects that altered other countries' geopolitical positions, while the policy itself is based on a discourse that was shaped by the US' beliefs and perceived threats. While they are based on real life situations, events and actions, it should be noted that they are interpreted from a "free and open" democratic perspective. Since the Second World War, democracies have formed a strong international order that has been largely successful in maintaining peace among democratic countries. It is therefore also not surprising that these democracies prefer to maintain the current international order, and hence perceive countries with alternative political ideologies gaining power and influence as a threat (see also OSD, 2018, p. 2). The case of the US-China trade war illustrates how an ideological competition can manifest itself in a technological competition.

Shifting our focus back to Taiwan, examining Taiwan's case shows how technology in the past has helped shape today's Taiwan: one with a strong economy, democratic principles, and a world leading semiconductor industry that also serves as its security blanket and political asset in diplomatic talks. Importantly, this journey has incidentally also led to Taiwan's complicated geopolitical position in which technology once again plays a major role for not only Taiwan, but also on the global spectrum as countries currently aim to secure Taiwanese chips in a competition for technological and geopolitical hegemony. Being a "democracy under threat" (Wang, 2022, p. 69), Taiwan is adamant on protecting it despite growing threats from China. This means that ideologically Taiwan will be inclined to favor an alliance with the US as well as the EU, which to a certain degree is reciprocated not only for Taiwan's chips, but also its democratic principles that align with their own (Dekker, 2020, p. 3). As such, Taiwan's chips can help keep countries' like the US stay technologically ahead, whereas Taiwan's democratic principles are appealing to the US and EU in their search for fellow democracies to promote these ideologies in a world where China and Russia are gaining influence. However, because most countries have official diplomatic ties with China and the latter considers Taiwan a rogue province, this means that any officially diplomatic relation with Taiwan is undesirable for fear of souring their relationship with the

Chinese. Although Taiwan has become a democracy and world leader in semiconductor manufacturing, the island nevertheless remains stuck in the middle without being able to go in either direction without risking war or losing its free and open democratic principles. While the Taiwanese are growing accustomed to being in this position, the US-China trade war has stirred this careful balance. Taiwan has to nevertheless maintain it in an increasingly tense, competitive and hostile environment.

3.3 Building towards the future

The 2020 to present global chip shortage has been a wake up call to the entire world how prone the semiconductor supply chain was to disruptions. This was cause for worry across the globe. With semiconductors being one of the most important technologies in our digital life, countries developed ambitions to diversify the supply chain so that global disruptions could be mitigated as much as possible regardless of whatever events may potentially disturb it. This has resulted in both the EU and the US to come up with their own plans for semiconductor autonomy by "on-shoring" fabs in the near future (Nordin & Stünkel, 2022, p. 2; Shattuck, 2021, p. 110), and the Taiwanese TSMC plays a role in both cases.

Conflicting interests about how to move forward can be clearly identified in TSMC's involvement in semiconductor projects with both the EU and the US. The EU seeks to enhance its semiconductor autonomy. In this pursuit Taiwan has been noted as an essential partner to achieve the aims laid out in the 2021 European Chips Act (Nordin & Stünkel, 2022, p. 3). Hence, partially because of Taiwan's semiconductor industry, the EU seeks to enhance its relations with Taiwan within the ambiguous boundaries of the one-China policy (Nordin & Stünkel, 2022, p. 3). Taiwan has shown keen interest to cooperate and improve its relations with the EU, but concerns regarding the EU's lack of an existing semiconductor market, a prospected low profit margin and the absence of assurances for sufficient private investors in the EU have resulted in no concrete plans having been formed yet (Nordin & Stünkel, 2022). As Nordin & Stünkel (2022) have shown in their analysis of this situation, both parties hope to achieve their respective ambitions, but these do not align with each other. Where the EU hopes to achieve semiconductor capabilities across the whole value chain in a relatively short amount of time, Taiwan ultimately seeks to improve its diplomatic relations. Interestingly, neither of them have strong incentives to show interest in each other's ambitions. For Taiwan it is most profitable to keep its technologies and investments closer to home in East Asia, where costs are lower and the industry is already well established. The EU

on the other hand has little desire to act in ways that could affect or change the status quo of the last five decades, since this could provoke undesirable consequences in light of China's unrelenting one-China principle and growing influence, the latter of which is in itself a cause for worry in the West.

Figure 19. The construction site of TSMC's new US fab in Phoenix, Arizona (Financial Times, n.d.).

In contrast to the EU, the US does have plans in place for a TSMC fab in Arizona. This was the result of mounting pressure from Washington on two fronts: on one hand, in late 2019 and early 2020, the US was still actively trying to restrain TSMC from selling chips to Huawei. On the other, since TSMC is a key producer of military chips for the US, Washington wanted to ensure a stable and secure supply chain for its military by insisting on an on-shore fab (Shattuck, 2020, p. 110). The benefits for TSMC in case of constructing a fab in the US are that it would be tied to fewer regulations when it came to manufacturing military-chips and securing other contracts with US contractors (Shattuck, 2021, p. 10). The combination of pressure and incentive resulted in TSMC's announcement in May 2020, amidst the tightening regulations on Huawei, that it would build a factory in Arizona (Klingler-Vidra & Kuo, 2021, p. 193). In the great power competition, this was a victory for the US as they managed to secure their own semiconductor supply chain through a domestic TSMC fab, while simultaneously making it extremely difficult for Huawei to obtain chips

(Shattuck, 2021, p. 111). It should be noted, however, that TSMC made sure that the Arizona factory will not have the same production capabilities as their own fabs in Taiwan. Instead, it will produce 5nm chips by the time it starts production in 2024, while TSMC's Taiwanese fabs aim to have started 2 nm production by then (Shattuck, 2021, p. 111). On top of the generation gap, the Arizona fab will also have a smaller production capacity: 20.000 chips per month compared to TSMC's larger Taiwanese fabs that produce 150.000 chips per month (Shattuck, 2021, p. 111).

This restriction is indicative of Taiwan's reluctance for current generation technology transfer (Nordin & Stünkel, 2022, p. 6). As I mentioned earlier in this chapter, Taiwan is aware of the semiconductor industry's importance to its security, economy and political leverage. Recent events such as the chip shortage and the US-China trade war, in combination with TSMC's global leadership position, expose the ways in which TSMC and Taiwan are currently valuable to various actors in the global sphere. Their importance to this industry can be used in Taiwan's advantage as it seeks to improve relationships with other democracies, the same democracies that now want to cooperate closely with Taiwan over a highly important and security sensitive technology. Taiwan is well aware of these countries' interest in its semiconductor industry, and receptive to proposed cooperations regarding this industry, as long as its own position in the global supply chain is ensured (Nordin & Stünkel, 2022, p. 3).

3.4 Conclusion

This chapter has discussed the US-China trade war, technology's role in a competition for power and what the great power competition has to do with TSMC and Taiwan. To understand the latter, section 3.1 illustrated TSMC's importance to both Taiwan and the world. Section 3.2.1 examined the discourse in the 2018 US National Defense Strategy to distill the importance of technology for a great power competition that encompasses military superiority as well as an ideological competition. The NDS offers a great illustration of motivation from the US' side to understand their consequent actions to protect certain technologies by controlling who has access to semiconductors for example, which was the focus of section 3.2.2. As a global leader in semiconductor production, the Taiwanese TSMC is caught in the middle of this conflict and its policies.

Sections 3.2.3 and 3.2.4 show that both the US and China perceive each other's relationship with Taiwan as a threat. As China is gaining influence and improving its

technological capabilities, in part with the help of Taiwan's chips in Huawei's case for instance, the US views this fruitful relationship as a threat to the established international order and its own technological advantage. The other way around, the US has stood in the way of a potential reunion between China and Taiwan by offering military support in the case of military aggression towards Taiwan and also having remained ambiguous regarding the one-China policy. The democratization of Taiwan has pushed Taiwan ideologically and politically further away from China and towards the US and its preferred international order. China realizes that this makes it ever harder to reunite the two Chinas, and thus perceives the closer relationship between the US and Taiwan as a threat to its own agenda. Considering that both sides of this conflict feel threatened by the other and their relationships with Taiwan, it is not surprising that actions in the US-China trade conflict have resulted in increasing tensions between the two (and their allies) and an increasingly difficult time for Taiwan to maintain its carefully balanced position in the middle.

Importantly, the analysis of how the US-China trade war affected Taiwan and TSMC also makes it clear that Taiwan does not participate in this power competition. Rather, Taiwan's role is more akin to being a pawn in the middle. The preconditions that enabled this role were established through Taiwan's technological and political history: the Taiwanese government adopted the semiconductor industry and democratized in the same decades this industry was taking root in Taiwan. The context of the US-China trade war in combination with Taiwan's past, in which its technology and politics have co-evolved over time, is what has driven Taiwan into its geopolitical place today. Taiwan has been stuck in the middle since its separation from the People's Republic of China. However, complexities have only increased as tensions rise amidst the US-China trade war, in which Taiwan is competed over among the rivaling countries. This disrupts the previously established status quo. Note how this triangle dynamic is strangely reminiscent of their dynamic surrounding resolution 2758 as well. While the US and China's relationship is souring, Taiwan's more passive role in the relations between the two remains familiar. This competition over Taiwan and its technological expertise can pose an external security risk to Taiwan as tensions rise: a threat to national security from the outside. As mentioned in section 3.2.3, disturbing the established semiconductor industry also disturbs the technological and economical interdependence between Taiwan and China, which may result in losing one aspect that motivates cross strait peace while also pushing the Chinese to achieve semiconductor independence more quickly.

While the US' policies to limit China's access to semiconductors poses an external

security risk to Taiwan, pressuring Taiwan to transfer its technologies also comes with risks for Taiwan. As President Tsai has written herself, the semiconductor industry is particularly significant as the "silicon shield" that protects Taiwan against authoritarian regimes whose actions may threaten the global supply chains (Tsai, 2021, section "Changing the rules"). The technology has thus become an explicit matter of security and safety, and transferring it away from Taiwan comes with the risk of Taiwan and TSMC losing the unique quality that serves as its "silicon shield". Especially when the countries that want Taiwan to transfer its semiconductor manufacturing expertise are not willing to exchange it for something Taiwan also values greatly, such as a diplomatic allegiance and the sense of security and certainty that comes with it, it is not a very attractive proposition for Taiwan to engage in. Hence, Taiwan maintains this middle position without an official allegiance to either side.

Notably, Taiwan has only been able to be in this position through a combination of its technological, political and societal history. From fleeing the mainland, losing most of its diplomatic ties and becoming a democracy to adopting the semiconductor industry and becoming global leaders in chip manufacturing, each event plays a significant part in Taiwan's story and how this led Taiwan's to its geopolitical place in today's world. Technology specifically has brought Taiwan many good things amidst its tumultuous history: a strong economy, national security, a technologically important role in the world and the (unofficial) political relations that come with it. These positive developments also come with a negative side however: being one of the more valuable geopolitical pawns in the US-China trade conflict has also put Taiwan in a particularly risky position without there being a readily available resolution. The current status quo, as volatile as it is becoming and as hard as it may become to maintain, appears to still be Taiwan's only viable option. Whether this is a good or bad thing is debatable.

CONCLUSION

Concluding remarks

In this thesis, I set out to answer the following research question: *how did the Taiwanese semiconductor industry co-evolve with Taiwan's political capabilities from the 1970s to the 21st century?* Since no single, objective answer exists to a historical question about the developments, evolutions and changes that a society, technology and the geopolitical dimension undergoes, my answer to this question was formulated in parts through the three chapters of this thesis.

The first chapter was a study into how a society can be driven to envision certain aspirations, and how accordingly a society can choose a technology to pursue these ambitions. I did so by analyzing where specifically these "goals and aspirations" came from in that time and place for Taiwan, as well as how the Taiwanese came to choose the semiconductor industry to adopt. I departed from the circumstances surrounding UN resolution 2758, which denoted that the PRC would replace the ROC as representatives of the China seat in the UN. This event in conjunction with the worldwide oil crisis of 1973 left Taiwan in a state of economic and political crisis, which forced the government to come up with a response strategy to protect Taiwan's sovereignty in the near, and potentially far future. The Taiwanese government strategically decided to pursue the semiconductor industry, which would give Taiwan not only technological capabilities, but given the prospected importance of the industry it could also boost its economy. The combination of improving the Taiwanese's capabilities and the nation's wealth should consequently facilitate a continuous effort to maintain relationships with the international community, regardless of whether these relationships were officially diplomatic or strictly economic and trade based. By the end of this chapter, it also became clear that an external factor such as Taiwan's membership with the UN can dramatically change a country's ambitions and wishes for its future. Taiwan's case showed how the Taiwanese government shifted its priorities and focus from the external (reuniting with mainland China) to the internal (the state of Taiwan itself, its capabilities, economy and politics). When Taiwan was rendered mostly powerless in the international sphere, the Taiwanese acted in whichever area they still could, which was for and in their own nation.

The second chapter depicts the sustaining phase, which I framed by highlighting three areas that Taiwan tackled to develop and grow. Each area I focus on represents a different

aspect of Taiwan's strategy to remain present and relevant in the international sphere, keeping the island from falling into political isolation, which was one of Taiwan's primary ambitions since leaving the UN. This chapter thus studies how this political motivation has driven Taiwan's developments not only in the area of politics, but also Taiwan's economy and semiconductor industry. In the first sections, I analyzed how Taiwan tackled developments in the areas of economy and the semiconductor industry, emphasizing that politics was an important motivating factor behind developing these areas. In the section about politics itself I argued that Taiwan's democratization was another strategy for Taiwan to improve its image in the international sphere, but concluded that the events of the previous chapter and Taiwan's strained relationship with China nevertheless maintained the political struggle for international recognition. Ultimately, this chapter argues that these areas should not be treated separately, but rather that they develop and change in conjunction with each other. Economic preconditions and government intervention were greatly important for kickstarting the semiconductor industry, while growth in this sector in turn impacted Taiwan's economic performance and political influence. The way developments affect the possibilities in other areas also showcases how changes and decisions in one area can mold society in a broader sense. Consequently, while possibilities and the freedom to choose them continued to present themselves, each decision also narrowed down the path Taiwan was taking and therefore narrowed down what was becoming of Taiwan's future.

The third and final chapter takes a leap forward in time to examine the outcomes of the events and decisions I described in the previous two chapters. It focuses on the highly specific outcomes of the decisions and developments that were described in the previous chapters. An important event I discuss in this chapter is the US-China trade war. This global competition exposes a relationship between technology and power on one hand, and has greatly affected Taiwan and its semiconductor industry on the other. At this stage, the Taiwanese semiconductor industry has matured and even reached global leadership status. This has consequently impacted Taiwan's economy, society and relationships with other countries, while also becoming a key link in the global supply chain that the global semiconductor and electronics industry cannot afford to lose. The tensions that arise from the trade war between East and West have thus greatly affected Taiwan's semiconductor industry, and by extension the global semiconductor industry as well as Taiwan itself. I argued that Taiwan's tumultuous political history in combination with its thriving semiconductor industry have ultimately led Taiwan to be stuck in the middle between the two rivaling countries in the trade war. Though the native semiconductor industry has contributed

to many positive developments for Taiwan such as maintaining its sovereignty while also improving its economy, security, and international relations, some aspects of Taiwan's history remain unresolved. As a result, Taiwan has also maintained its geopolitically disputed status, which leaves the Taiwanese not only aware of a constant mainland threat, but also prevents Taiwan from being able to side with either side of the conflict. The ongoing conflicts over advanced technologies on the global sphere have thus allowed me to not only examine how the Taiwanese semiconductor industry and Taiwan have co-evolved over the decades, but they have also provided me with a case to analyze how such conflicts and competitions on the global sphere impact Taiwan and its semiconductor industry. In that sense, this chapter illustrates how the various histories I have discussed throughout this thesis are interrelated, some more visibly so than others, and that all of them are key components in any attempt to analyze what Taiwan and its semiconductor industry have become, and how those changes in turn impact Taiwan's place in the world.

With that said, I would like to highlight what I consider is the main takeaway of this thesis: the semiconductor industry has become an intricate part of Taiwan's identity, and as such its impact can be found in all areas of Taiwanese society. This means that the question of what Taiwan is and where its struggles, capabilities, tensions, wishes, conflicts and place in the world come from, must in part find its answer in Taiwan's semiconductor industry. The historical analysis that I offered in this thesis aimed to understand how this co-evolution took place by focusing specifically on one important aspect of society: politics. This has allowed me to identify where the initial ambition came from, and study how adopting this technology has shaped and evolved with Taiwan and its political capabilities. I would argue that this research has made one aspect of the field of history of technology evident: it cannot treat technology as a separate entity, independent from politics, economy or society as a whole. It is not an isolated pillar that grows and develops in its own vacuum. On the contrary, it is embedded within society, by which I mean that its existence, development, innovation, growth, capabilities and impacts are all an intricate part of society, and vice versa. One does not exist, change or move forward without the other, and I therefore contend that the study of technology (including its history) should always treat it as an intricate part of society. Although this thesis aimed to analyze the history of Taiwan's semiconductor industry, I could not offer a comprehensive analysis of how this industry has shaped and evolved with Taiwan without involving Taiwan's political and economic history as well.

An interesting aspect that my historical analysis of Taiwan's semiconductor industry highlighted is how this case has shown that society does have a certain level of agency when

it comes to choosing how to pursue an envisioned future, specifically through technology. Though it should be emphasized that while a society can make certain decisions about technology, such as what technology to adopt and what the intention is behind it, they all come with both intended and unintended consequences, due to the complex and context-dependent way in which technology embeds itself in society. Each society is different and constantly evolving, and as such each technology that comes to be adopted by society will evolve with it in different, unpredictable ways. Though we may never achieve complete control over how technology will shape and evolve with society, I do hope to have shown that we can always work towards a better understanding of this dynamic, which in turn can help us make better decisions in both the present and towards the future.

Suggestions for future research

Naturally, this thesis did not offer an exhaustive history of technology and society of Taiwan. The topic of this thesis has been narrowed down to largely only Taiwan and by extension the US and China, for Taiwan's history could not be discussed without these latter two. In addition, I have also used a very narrow approach to the history of technology, an interpretation of Thomas Misa's understanding of this field. Though it has been useful in my own conceptual understanding of history of technology and allowed me to present a more extensive historical analysis of a case that has not been explored through this lens before, I also recognize that there are other ways to approach writing an embedded history of technology of Taiwan. Something I have not managed to do is the inclusion of other concepts or perspectives that could have supplemented my analysis. Examples that come to mind are; a stronger focus on the Cold War context during which many of the developments of this thesis took place; the concept of the entrepreneurial government, of which the KMT government in the 1950s-1990s appears to be an example; and a more comparative aspect that brings into view how the semiconductor industries in East Asians countries around Taiwan developed, which would have allowed me to highlight the aspects that are unique to Taiwan's history. These ideas were unfortunately left out of this thesis since they were beyond the scope of what I was able to do for this one project, but I would highly encourage future research to explore any of these suggestions to further deepen and enrich the history of Taiwan's semiconductor industry. In addition, I also have some suggestions for future research into closely related topics, which could expand academic literature and knowledge on Taiwan's history of technology as a whole without being directly linked to this research.

Firstly, I suggest looking further back in history. While I focused specifically on the semiconductor industry, a comprehensive historical analysis of the interplay between Taiwan's technologies and society prior to the birth of this industry is still lacking. Similarly to what I have found upon this research, Taiwanese history is largely separated into isolated narratives that have not before been brought together. A historical analysis of the role of lower complexity technologies in a largely agricultural Taiwan is left unexplored.

Secondly, one area I have not managed to find literature on with regards to Taiwan has been the question if a society's technological development may be directly linked to its democratization. While in this thesis I do show that the two can occur simultaneously and I identify both developments as part of Taiwan's strategy to achieve its international (political) ambitions, I have not been able to explore whether a causal link may exist between the two areas as well. Further research into this topic could offer a deeper understanding of the decades and rapid developments described in chapter two.

Thirdly, as much as I aimed to write a history that embedded technology, politics and society, I have not been able to explore the aspect of culture in this research. This is because Taiwan has a rich and eventful history, and viewing Taiwan through a political history lens as the Republic of China will yield a different history than if Taiwan is viewed as an island off the Chinese coastline. A combination of both Chinese history and native Taiwanese history would allow us to reach a deeper understanding of how the citizens of Taiwan experience Taiwan as a nation, state and identity. The chapters of this thesis offer some insights that could potentially be used to theorize about how the Taiwanese identity has changed along with Taiwanese politics, economy and industry. This in turn would shed light on one underexplored topic in this thesis, which is how the Taiwanese people have changed in themselves on one hand, and on the other how their perception of Taiwan may have changed along with Taiwan itself. As an integral part of society: those who live in it, change (with) it, experience it and run it, I expect that a research into the intersection between technology and culture in Taiwan throughout history could shed valuable light on the greater question of how technology and society co-shape each other and co–evolve together.

Finally, looking towards the future it would be beneficial to use the insights gathered from Taiwan's history of technology to anticipate the potential futures ahead. The work I have done in this thesis shows the decisions, changes, and outcomes that have all followed the decision to grow a Taiwanese semiconductor industry. As such, it has presented a narrative of how adopting the semiconductor industry has given Taiwan the autonomy and freedom to choose and act, but also how each development has further constrained and

framed the potential futures Taiwan has. A similar method, but anticipatory, can be applied to look towards the future. A logical follow up question from here would be to ask how Taiwan's semiconductor industry will co-evolve and co-shape its society and place in the world from here onwards to the future?

LIST OF ILLUSTRATIONS

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