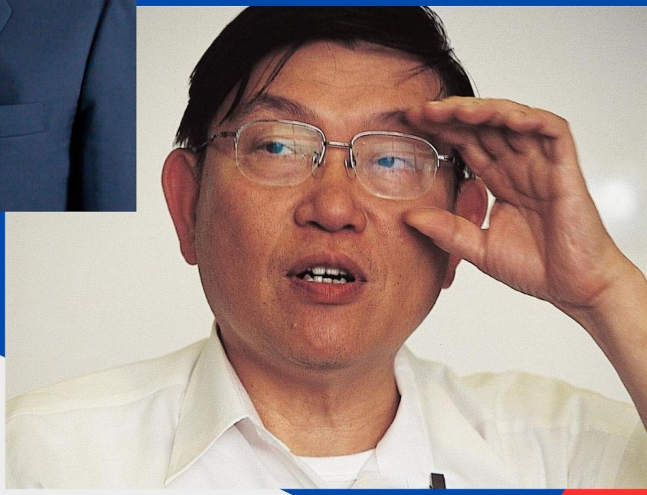




A "FAMILY" AFFAIR

TSMC, SMIC, AND THE GLOBAL CHIP WAR

JUSTIN KO

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1

A Brute Force Breakthrough

One of the most important companies in China is one that foreigners have likely never heard of, with a name as bland as can be. Yet, the Semiconductor Manufacturing International Corporation (SMIC) of China shocked the world in 2023 by reportedly producing a 7 nanometer (nm) chip, the Kirin 9000s, for the flagship phone Huawei Mate 60. [1]This was thought to be impossible for a Chinese company at the time due to the export restrictions on SMIC placed by the U.S. government, which prevented the company from accessing extreme ultraviolet (EUV) lithography tools made by the Dutch company ASML. Now, SMIC may be on the verge of another breakthrough by reportedly producing 5 nm chips using older deep ultraviolet (DUV) tools and a process known as Self-Aligned Quadruple Patterning (SAQP). [2]The significance of this breakthrough, if confirmed, is not just technical but geopolitical, because ASML's industry-leading EUV technology has long been used by chip producers like the longtime market leader Taiwan Semiconductor Manufacturing Company (TSMC) to produce the most cutting-edge and

advanced chips. Hence, if it can be proven that advanced 5nm can be produced by older DUV tools, SMIC may show the world that China's semiconductor industry is capable of producing cutting-edge chips, albeit by using brute-force, inefficient, and slower production techniques.

Although 5nm chips are widely used by leading smartphone companies like Apple and Samsung, neither of these companies are expected to use SMIC chips, as they will likely continue to use chips made by TSMC or in the case of Samsung their own foundries. But the significance of SMIC's breakthrough would be that China's consumers of such chips, such as Huawei or Alibaba, will be more likely to use domestic chips and DUV-based techniques in order to reduce their dependence on foreign suppliers like Nvidia and thereby lower their risk of suffering export restrictions of their own. SMIC's success in fabricating an even more advanced chip than the Kirin 9000s will likely contribute to the creation of a self-reliant semiconductor supply chain that is increasingly able to withstand harsh export restrictions from companies like ASML and TSMC. Ironically, SMIC's innovative solutions may have been directly motivated by a desire to circumvent sanctions, because it is unlikely that a semiconductor company would have spent so much effort trying to improve the viability of an inefficient and slow production technique if EUV tools were readily available.

However, while much fanfare and Western consternation has accompanied SMIC's potential chip fabrication breakthroughs, less attention has been directed towards SMIC's engineers and leaders who were responsible for such discoveries. SMIC's complicated relationship with TSMC has also been largely

overlooked. A quick overview of both companies is therefore quite illuminating. Based in Hsinchu, Taiwan, TSMC is the world's leader in contract semiconductor manufacturing, and it has long held over 50% global market share in foundry revenue. [3]TSMC's founder, Morris Chang (Zhang Zhongmou), is rightfully regarded as the leading figure of the semiconductor industry in Greater China. [4]However, over the past two decades, SMIC emerged as a credible rival in the pure-play foundry field. What is even more interesting is that the founder of SMIC, Richard Chang (Zhang Rujing), was a subordinate to Morris Chang when both were employed at Texas Instruments under Jack Kilby, the inventor of the integrated circuit. Richard Chang also sold his own foundry, Shida Semiconductor, to TSMC, in 1999 before founding SMIC in 2000.

As of 2025, neither Morris Chang nor Richard Chang are currently leading the companies that they founded. Richard Chang resigned from SMIC in 2009 after he was involved in a financially catastrophic lawsuit between TSMC and SMIC which led SMIC to be ordered to pay $200 million US in compensation for patent infringement. The elderly Morris Chang also retired from his position as TSMC Chairman in 2018. However, both Changs continue to exert considerable influence over the semiconductor industry in Greater China. Richard Chang founded Shanghai Xinsheng, the first "large silicon wafer" company in Mainland China, before establishing the foundry SiEn (Qingdao) Integrated Circuits. Morris Chang has represented Taiwan in APEC meetings in his capacity as TSMC's founder, and he oversaw TSMC's construction and expansion of two fabs in Nanjing along with two new fabs in Kumamoto, Japan that began operation in 2024.

Chang or Zhang is one of China's top three surnames in terms of prevalence, so it is no surprise that Morris Chang and Richard Chang are not literally family members or kinsmen. Nonetheless, despite their fierce rivalry on opposite sides of the Taiwan Straits, they do share an uncannily similar background. Both were born in the Jiangnan region before moving to the United States for their engineering education, and then joining Texas Instruments' semiconductor division. Both became American citizens before moving to Taiwan to found or lead semiconductor companies (TSMC and Shida Semiconductor). Both are known to be ambitious, highly intelligent, persistent, and cost-efficient. Both shunned lucrative opportunities to build their careers in the United States in favor of returning to Greater China and seizing opportunities offered by government officials to make a name for themselves as tech entrepreneurs. And both made use of networks of talented Taiwanese company engineers to constantly innovate and stay ahead of their rivals.

Despite SMIC's advancements, TSMC boasts a nearly 67% market share of foundry revenue. [5]The nearest competitor, Samsung, only has a 8% market share, and SMIC remains even more behind with 6% market share. Still, even the mighty TSMC may one day be surpassed by SMIC or by another competitor. Richard Chang has been quoted as saying that he is highly confident in SMIC and in the broader semiconductor industry in Mainland China, and his legacy as one of the first Taiwanese semiconductor entrepreneurs to enter the Mainland has had a powerful effect on other Taiwanese engineers who have seized career opportunities in the Mainland. For instance, the co-CEO of SMIC, Liang Mong-song, is another U.S.-educated Taiwanese who was a star engineer at TSMC and

Samsung before accepting his position at SMIC.

Amidst the ongoing U.S.-China "Chip War," which shows no signs of diminishing, SMIC and TSMC are caught on opposite sides of the conflict. TSMC, despite having extensive commercial ties and fabs in the Mainland, is a beneficiary of U.S. efforts to stifle competition from Mainland competitors like SMIC. Geopolitical considerations, therefore, are increasingly influencing TSMC's business decisions, as shown by TSMC's construction of fabs in Japan and the United States despite Morris Chang's longstanding opposition to overseas fabs due to their high costs. SMIC, meanwhile, is the Mainland's best hope for creating a "red chip supply chain" and achieving 70% semiconductor self-sufficiency via domestic suppliers, which has taken on even more importance due to U.S. sanctions on advanced chips for AI model development. Thus, Richard Chang's dream of building a red chip giant on the Mainland that can rival or even replace TSMC will directly conflict with Morris Chang's dream of solidifying TSMC and Taiwan's position as the irreplaceable center of the semiconductor industry well into the 21st century. Whose dream will ultimately be fulfilled will depend on the decisions made by the complex cast of characters who lead TSMC, SMIC, and the rest of the global semiconductor ecosystem.

2

Jiangnan Origins, Texan Pedigrees

For hundreds of years, Ningbo and Nanjing have been two of the leading cities of the prosperous and highly educated Jiangnan region, along with Suzhou, Shanghai, and Hangzhou. Today, Jiangsu Province and Zhejiang Province continue to lead the country in terms of economic production, global trade, and entrepreneurship, especially after the Reform and Opening Up period. More pertinently for this monograph, Nanjing was chosen as the location of the only TSMC fab in Mainland China, while Shanghai is the headquarters of SMIC. Thus, it is perhaps no coincidence that Richard Chang and Morris Chang, two titans of industry, were both born in the Jiangnan region as well.

Morris Chang was born in Ningbo, while Richard Chang was born in Nanjing. Both experienced the ravages of the Sino-Japanese War as children, which had a significant impact on their worldviews, and both of their families were ideologically and socioeconomically aligned with the Nationalist government rather than the Communist government during

the Chinese Civil War. As an example, Morris Chang's father was a bank manager, and his mother was a descendant of Xu Shidong, a famous literati from the Qing Dynasty. For this reason, along with the overall state of chaos in the country during the Sino-Japanese War and its aftermath, neither of the Chang families chose to remain in the Mainland after the founding of the People's Republic of China.

Morris Chang lived in Chongqing, Shanghai, and Hong Kong for most of his childhood before leaving for the U.S. to attend Harvard University, using the last $1,000 of his father's savings. In his first year at Harvard, he was the only Chinese student in his class. After deciding to focus on engineering, he transferred to the Massachusetts Institute of Technology, where he completed his Bachelor's and Master's in mechanical engineering before working for Texas Instruments in Dallas. In the case of Richard Chang, his parents were involved with the resistance against Japan, as his father produced steel and his mother produced gunpowder for the Nationalist forces in Chongqing. Thus, instead of moving abroad or to Hong Kong, his family decided to move to Taiwan with the Nationalists after 1949. After graduating from National Taiwan University, Richard Chang went to Southern Methodist University in Texas for his PhD in electrical engineering.

Ironically, although today Richard Chang is known as the godfather of the Mainland semiconductor industry while Morris Chang is seen as the architect of Taiwan's impenetrable "Silicon Shield," Richard Chang spent most of his youth and his formative years in Taiwan, whereas Morris Chang never actually set foot on Taiwan until he had already risen in the

ranks at Texas Instruments. In other words, if we are to judge purely based on life experience, one would have expected Richard Chang to be more likely to have founded TSMC rather than Morris Chang. In fact, Morris Chang did not found TSMC out of any familial or personal attachment for the island, but rather because he was explicitly invited to spearhead the pure-play foundry business model by Taiwanese government officials at a time when he was experiencing career frustrations in the U.S.

To provide some context, Morris Chang's highest position at Texas Instruments was as senior vice president and general manager of the Semiconductor Group. Although this meant he was in charge of 30,000 employees, he was still subordinate to the Chairman and the President. Chang's contributions to the company along with those of his co-worker Jack Kilby (the inventor of the integrated circuit) were tremendous, and his stern leadership is credited for Texas Instruments' emergence as a national leader in memory chips and microprocessors that competed head-to-head with Intel and Japanese rivals. As such, he earned the respect of many of his rivals, including Andrew Grove, the Intel CEO. He was also a trailblazer as one of the only ethnic Chinese to lead a large American company. However, as racism was still prevalent at the time, he was never seriously considered as a candidate for Chairman or President of the company. This tension eventually led him to be moved to lead the Consumer Electronics Department. As expected, he was unhappy with this demotion, and he complained both internally and externally about what he regarded as the company's lack of investment in semiconductor research and development. This finally convinced Chang to step down from Texas Instruments,

ultimately setting the stage for him to become the founder of TSMC.

As for Richard Chang, after earning his PhD, he was also employed at Texas Instruments' semiconductor group at the same time that Morris Chang was the senior vice president. His position was not as senior, and the two would only meet occasionally in the hallway. Nonetheless, Richard Chang's twenty years at the company left a strong impression on him. He was quoted as saying that he was amazed by the work ethic of Texas Instruments employees, who often brought a cot to work so they could sleep at the office instead of returning home. Also, according to Richard Chang, employees never accepted failure, but instead saw "failure" as a temporary setback that after repeated attempts would invariably be overcome. Finally, Richard Chang noted that the company had a "flat hierarchy" where everyone was treated equally in spite of their different roles and responsibilities For instance, the Chairman did not have his own dedicated parking space; if he was late to work, he would have to park his car further away from the office. Also, senior employees like Jack Kilby were willing to take the time to share their technical knowledge with subordinates. This kind of environment spurred everyone to invest maximum effort into their jobs, regardless of their rank.

Consequently, we can say that the two Changs derived different lessons from their experiences at Texas Instruments. For Morris Chang, regarded as a demanding and ambitious leader with an iron fist, his frustration at the company's unwillingness to promote him to the Chairman position and to invest more in semiconductor research and manufacturing spurred him to

take the plunge and become an entrepreneur. If, by contrast, he had been given the leadership position he coveted, it is quite unlikely that he would have taken the Taiwan government's offer to spearhead the launch of the pure-play foundry business model. After all, Texas Instruments was still a global leader in the semiconductor industry until Morris Chang's departure, and his co-workers had invented the integrated circuit. There was no indication at the time that he preferred the risks of entrepreneurship, especially in an unfamiliar region with a new and unproven business model, as this was exponentially more uncertain than steadily rising in the ranks of an already established American company. Finally, as mentioned above, Morris Chang did not have family in Taiwan and he had rarely spent time on the island before his resignation from Texas Instruments, so it is hard to imagine him opting to resign from a prestigious position as Chairman of Texas Instruments to lead TSMC.

As for Richard Chang, he spent eight years working in research and development at the company before moving into operations and presiding over semiconductor factory construction in many regions, including the U.S., Japan, Singapore, Italy, and Taiwan. Thus, though he never achieved the level of seniority in Texas Instruments as Morris Chang, he was widely respected for his prowess in building semiconductor factories. These experiences would certainly serve him well in his later roles as a semiconductor company founder in Taiwan and then in Mainland China. Moreover, he was able to transplant the tireless work ethic and the flat corporate hierarchy he observed at Texas Instruments into his future companies, where his management style was able to earn the loyalty

and dedication of his employees. Of course, Richard Chang also learned vicariously from Morris Chang's example to be highly demanding of himself and of his employees, and also to constantly focus on cost efficiency and innovation to outlast rivals. In this way, he was a student of Morris Chang, just as much as he was of Jack Kilby.

3

No Place like Home

The first time that Morris Chang visited Taiwan was in 1967, twenty years before TSMC was established. At the time, he was still working for Texas Instruments, and he was overseeing the construction of the company's first transistor assembly plant in Asia. More and more American companies were motivated by the lower costs in the region to outsource assembly and production, and Richard Chang would later be involved with constructing factories in Taiwan on behalf of the company for similar reasons. Thus, based on his own observations, Morris Chang was well aware by the 1980's that Taiwan offered considerable cost advantages and a solid foundation in semiconductor manufacturing compared to other developing Asian economies due to a plethora of foreign investments in Taiwan in the 1960's made by electronic companies like Fairchild Semiconductor, Texas Instruments, and Philips.

However, it should be noted that Chang's Chinese ethnicity and his upbringing in China did not play a role in Texas

Instruments' decision to invest in Taiwan. These investments were predominantly guided by economic factors, such as the rising labor and manufacturing costs in America and low-cost competition from Japanese companies, not by a desire to benefit Greater China or its people. Morris Chang had become an American citizen in 1962, and while his native language was Chinese, his success at Texas Instruments shows that he was more than adept at navigating the Western corporate and cultural environment. As a child living through constant warfare and unrest, he moved from place to place throughout China and Hong Kong, which strengthened his adaptability to new environments but hardly formed a solid foundation for patriotism or affection for his motherland. His father's decision to spend the last amount of his savings to sponsor Morris Chang's education in Harvard shows that his family was, at best, ambivalent about their child's future prospects in the Greater China area.

Instead, what ultimately drew Morris Chang to Taiwan in 1985 besides the lack of promotion to the Chairman position of Texas Instruments was the unique opportunity offered by the Taiwan government to become both the President of the Industrial Research Institute (ITRI), a government-founded research institute, incubator, and research lab, and also the chairman of the world's first-ever pure-play foundry. Until the founding of TSMC in 1987 by Morris Chang and the ITRI, every major manufacturer of semiconductors like Intel and Texas Instruments was an integrated device manufacturer (IDM), which referred to a company that was fully responsible for designing, manufacturing, testing, and packaging its own chips. Besides IDMs, dedicated chip design companies did exist

in Taiwan and in the U.S., but they lacked the capital and the expertise to build their own foundries, and they were seen as competitors by the IDMs since they designed their own chips as well. As such, the chip design companies had great difficulty in achieving growth, and there were only 100 or so companies in the world in spite of the rising demand for chips. The struggles of chip design companies were especially acute in Taiwan, a small island with limited chip production capacity. In 1980, the ITRI had already founded a IDM in Taiwan called United Microelectronics Corporation (UMC), which was the first semiconductor company in Taiwan. However, UMC lacked the production capacity to meet the growing needs of Taiwan's chip design companies, and there was a conflict of interest given that UMC also designed chips.

Morris Chang recognized that UMC would never be able to be a true competitor to American IDMs like Intel because of the enormous capital investments required (over $200 million USD per production line in the 1980's). These limitations would also place a ceiling on the growth potential of the Taiwan semiconductor industry as a whole, even if UMC was willing to cooperate with the chip design companies. In contrast, by building a pure-play foundry that would not compete with the chip design companies and focus solely on production capacity, Morris Chang could not only accelerate the development of the entire semiconductor ecosystem in Taiwan but also give rise to a juggernaut that could one day eclipse even the IDMs like Intel and Texas Instruments. Furthermore, this business model would overcome the demand problem encountered by all semiconductor companies in that each foundry required enormous upfront capital investment with no guaranteed

return on investment due to uncertain consumer demand for chips. Instead, under a pure-play foundry model, production capacity would be optimally maximized because the foundry would seek orders from chip design companies around the world, which would in theory represent a steady and unlimited demand for chip production.

The pure-play foundry model was a massive success, and Morris Chang was able to implement the business model by making use of his clout and connections to win orders from chip designers all over the world by strictly limiting foundry employees' ability to share the chip designs without authorization. He also made use of his prior relationships from his time leading Texas Instruments with the CEOs of companies like Philips and Intel, which despite possessing more advanced technology still agreed to outsource some of their production orders to TSMC. For example, Chang convinced Intel CEO Andrew Grove to outsource production of low-end 3 micron chips to TSMC to better compete with low-cost competitors in Japan, even though Intel's technology was over two generations ahead of TSMC's at the time. Philips also agreed to invest billions in founding TSMC, along with Taiwanese businessmen like Formosa Plastics' Wang Yun-Ching, who were "persuaded" to do so by the Taiwan government. Finally, the ITRI converted a large-scale chip factory originally meant for research into TSMC's first factory. With all the capital amassed for TSMC, Chang was able to meet the high demand from chip designers around the world who lacked their own foundries. One of these designers, Nvidia, is now the world's largest company by market capitalization with a US$4 trillion valuation as of July 2025.[6]

Morris Chang's contributions to Taiwan and to Greater China's semiconductor industry are undoubtedly second to none. However, as explained above, what drew him to Taiwan and to TSMC was the potential of the pure-play foundry business model, since the Taiwan government was the only government willing to provide the resources to found such a company at the time. Conversely, Chang may very well have decided to remain in America if he had been given the opportunity to lead such a company in the U.S. The same cannot be said for Richard Chang, whose motivations behind founding SMIC were never purely financial. Richard Chang's father, Zhang Xilun, had worked in the steel industry to serve the Nationalist government during the war against Japan. Even though the family fled to Taiwan, they still harbored a deep attachment to the Mainland.

Thus, according to Richard Chang, while he was overseeing construction of semiconductor factories in Taiwan, his father would often ask when he planned to build a factory in Mainland China. By this time, Richard Chang had already become an American citizen and a fairly senior employee in Texas Instruments, so the fact that his father continued to insist that his son contribute to the semiconductor industry in the Mainland demonstrates that his family was motivated not only by personal success but also by the desire to restore the competitiveness of the Chinese economy. Richard Chang shared his father's beliefs, as he would eventually adopt his father's wishes to build a factory in the Mainland as his own. He may also have been driven by his Christian faith. According to Bloomberg, when asked why he decided to found SMIC in 2000, he said: "The Lord wants us to come to China and share God's love with the Chinese people."[7] Regardless of what truly

drove him to set up his company in the Mainland, he is generally viewed as a patriot by Mainland authorities.

Although Richard Chang had not lived in or visited the Mainland since he was a young child, he knew very well that conditions for semiconductor manufacturing there were not suitable for factory construction in the 1980's. By this time, China had already spent over a decade transforming the economy as part of the Reform and Opening Up policies, but China still lacked the domestic capital and the experienced technical personnel to build a semiconductor factory that could compete with those in Taiwan, Japan, or the U.S. Therefore, when Richard Chang was asked to assist Texas Instruments with building the first memory chip factory in Taiwan as part of its joint venture with the Taiwan company Acer in 1989, he initially planned to recruit Mainland Chinese engineers so that they could gain experience that could be used to eventually help him build a factory in the Mainland. However, his request was rejected by the Taiwan government, which feared that training Mainland engineers would reduce Taiwan's competitive edge. Only when Richard Chang opened a factory in Singapore was he allowed by Singapore authorities to recruit 300 Mainland engineers to join the project. Just as he had planned, dozens of these engineers would later join him in Shanghai after SIC was founded in 2000.

Richard Chang would make his first formal contact with Chinese government officials in 1996, when the Ministry of Industry and Information Technology visited Texas Instruments' offices in Dallas. Richard Chang was in charge of receiving the officials, and he would continue to stay in touch

with the officials after they returned to China. By this time Richard Chang had already spent nearly two decades at the company, and so he was looking for a change of scenery. Thus, when the Chinese government announced the "909 Project" to kick-start the domestic semiconductor industry as part of the Ninth Five-Year Plan in 1996, the Ministry did not hesitate to invite the veteran Richard Chang to return to China to serve as the general manager of the newly established flagship semiconductor company Shanghai Hua Hong (now Grace Semiconductor), the Mainland's second-largest foundry. While Richard Chang declined the offer, as he was preoccupied with building a factory in Thailand for Texas Instruments, he promised that he would definitely contribute to setting up a factory in the Mainland in the future.

The pivotal event that motivated Richard Chang to return to Greater China was the Asian financial crisis of 1997, which led Texas Instruments to sell its memory chip business to Micron. Since memory chips represented most of the company's revenue, the company would never again regain its position as a market leader in the semiconductor industry. With the realization that Texas Instruments' best days were over, Richard Chang resigned and returned to Taiwan to help take over Shida Semiconductor, which was the third foundry in Taiwan after TSMC and UMC. His long-term goal after removing unqualified and inefficient personnel was to make use of Shida's expertise and capital to open a semiconductor factory in China. By taking advantage of the chaos of the Asian Financial Crisis to seize market share and expand production capacity while rivals were scaling back, Shida was able to become profitable in three years and even managed to reach one-third of TSMC's

production capacity despite being established ten years later. By 1998, Richard Chang felt confident enough in the future prospects of Shida to begin planning seven factories that were to be built in Mainland China. He was also invited that year to visit Shanghai and provide suggestions to local officials on developing Shanghai's semiconductor industry. It seemed to be only a matter of time before he would fulfill his father's wishes and contribute to semiconductor development in the Mainland.

4

The Makings of a Rival

The year 1999 was an eventful one for Richard Chang. Not only was he at the helm of Shida on its road to profitability, but he had since 1998 served simultaneously as the general manager of Huajing (now China Resources Microelectronics), one of the first semiconductor companies set up on the Mainland, that had suffered heavy losses for many years until Richard Chang took over in 1998. In only half a year, Huajing had changed its fortunes and built the first foundry in Mainland China, thanks in large part to Richard Chang and his business partner's introduction of management teams from Taiwan and the U.S. Huajing, like Shida, swiftly achieved profitability before being acquired by the China Resources Group. This achievement attests to Richard Chang's early contributions to the realization of the Chinese government's "Project 909."

Later that year, Richard Chang made the decision to sell Shida to TSMC for $515 million USD and TSMC shares, which was equivalent to 8.5 times the share price of Shida. According

to Richard Chang, Morris Chang was the one who came to him with the proposal, and although he was taken aback by the offer he was very pleased with the price. In truth, there was no way he could have refused such a generous offer, which his shareholders would have overwhelmingly supported. In terms of why the offer was so high, Morris Chang respected what Richard Chang had achieved in such a short time with Shida, and he was motivated by the desire to eliminate a fast-growing domestic rival. There was no chance he could acquire UMC, which by then had decided to became a pure-play foundry as well, but acquiring Shida would ensure TSMC's dominance in Taiwan.

Thus, the acquisition of Shida represented a potential meeting of the minds and pooling of resources between two titans in Taiwan semiconductor manufacturing. If the two Changs could have agreed on the future direction of TSMC in terms of its expansion plans, it is possible that Richard Chang may never have decided to found SMIC. After all, he agreed to sell Shida to TSMC with the assumption that his plans of building factories in the Mainland could still be achieved via TSMC. However, Morris Chang was not inclined to agree with Richard Chang's plans to expand semiconductor production on the Mainland, as he felt there was no business case for doing so. (Ironically, as mentioned before, he would change his mind in 2017 when TSMC decided to build a factory in Nanjing). When Richard Chang learned that Morris Chang would not build factories in the Mainland after all, he decided to sell his TSMC shares and establish his own semiconductor company, this time in the Mainland rather than in Taiwan.

As with Morris Chang and TSMC, which relied heavily on government support to acquire the necessary start-up capital, Richard Chang and SMIC would be very dependent on the support of the Mainland Chinese authorities. One official, Jiang Shangzhou, would be pivotal to SMIC's creation. Jiang was the Deputy Director of the Shanghai Municipal Economic Committee. He was also the founder of the Zhangjiang High-Tech Park in Shanghai, which is where SMIC is now located. Jiang personally reached out to Richard Chang when he learned of his desire to build a chip factory, and his welcoming attitude was in contrast to many other officials in China who were suspicious of Richard Chang's intentions and were not receptive to his proposals. Consequently, while Richard Chang had registered SMIC in Hong Kong and briefly considered building the chip factory in Hong Kong with government assistance to take advantage of the SAR's easier access to American semiconductor equipment, Jiang persuaded him to establish SMIC's factories in Shanghai instead. He was able to do so in large part because he possessed a scientific and business background in semiconductors, unlike other bureaucrats, and he also understood that Richard Chang was a patriot who had a authentic and deep-felt desire to contribute to the motherland by sharing his expertise from Taiwan and the U.S.

Nonetheless, all the patriotism and idealism in the world would not be enough to build a company that could compete with the likes of TSMC and Intel without government support. Jiang Shangzhou had promised that the Shanghai government was committed to nurturing the semiconductor industry, but Richard Chang needed assurances from the central government before he would formally go ahead. As such, in January

2000, he was invited to visit the Ministry of Industry and Information Technology in Beijing and meet leaders of the State Planning Commission to discuss policies to support the industry, including value-added tax exemptions, import and export tariff exemptions, government investment, and programs to attract overseas talents. Based in large part on these discussions, the State Council issued Document No. 18 later that year, which addressed a range of issues including investment and financing, taxation, industrial technology, import and export, enterprise software, and intellectual property protection. Most importantly for SMIC, Document No. 18 announced that the government would invest over 8 billion yuan in the industry and create a tax-free policy for companies developing semiconductor manufacturing technology of below 0.25 microns.

With these promises in hand, Richard Chang conducted a personal inspection of the Zhangjiang High-Tech Park and selected the final site for the first factory alongside Shanghai Mayor Xu Kuangdi, before formally founding SMIC in Shanghai in April 2000. Due to the contributions of Jiang Shangzhou and Richard Chang (Zhang Rujing), some industry experts joked that the high-tech park was actually named after Zhang and Jiang instead of Zhangjiang Town in Pudong. Soon after, Richard Chang moved his wife and children from Taipei to Shanghai, and he even convinced his 90-year old mother to move to Shanghai as well from the U.S. But his decision to set up SMIC in the Mainland was met with a strong backlash from the Taiwan government, which at the time was led by the pro-independence DPP President Chen Shui-Bian. Since Richard Chang still had his Taiwan household registration, he

was cumulatively fined over 20 million NTD by the government for investing in and constructing factories in the Mainland via SMIC without gaining the approval of the Taiwan authorities. Nonetheless, he refused to withdraw his investments and even attempted to give up his household registration, although the Taiwan government denied this request.

The Taiwan government's heavy-handed suppression of Richard Chang and SMIC was motivated by a fear that SMIC would one day become a powerful rival that would take away market share from Taiwan's "national" champions, including TSMC. They also realized that many Taiwanese businessmen would be tempted by the opportunity to tap into China's vast market and its skilled workforce. By becoming the first and most prominent Taiwanese entrepreneur to set up a semiconductor company in the Mainland, Richard Chang became a guinea pig whose success or failure would have an enormous influence on other Taiwanese businessmen who were considering expanding into the Mainland as well. As such, the Taiwan government did all it could to ensure that he would fail by fining him tens of millions of NTD every time a new factory was opened. Yet, according to Richard Chang, he received enough support from fellow "Taishang" to withstand the pressure from the Taiwan government, and his passion and dedication inspired over 300 engineers from TSMC and Shida to join him in Shanghai. His global connections from his twenty-year career at Texas Instruments also helped him attract engineers from Europe, the U.S., Japan, South Korea, and New Zealand, as well as Mainland Chinese engineers with overseas PhD degrees.

In truth, as anyone who knew Richard Chang well would attest to, tens of millions of NTD in fines could not dissuade him or his loyal employees because he was not overly interested in wealth to begin with. A low-key and humble leader as well as a devout Christian, Richard Chang surprised even his cost-conscious peers with his frugality. For example, when he was invited to Shanghai in 1998 along with other overseas experts to give advice on semiconductor development, he was the only guest who did not pay an extra 10 yuan to stay in a hotel room with a view of the Huangpu River. Considering the fact that he was already a wealthy entrepreneur who would be offered $515 million USD to acquire his company one year later, it is astounding that he would have been so cautious about spending an additional 10 yuan. This single-minded focus on lowering costs in both his personal and professional life made him a legend in the industry.

For example, when building factories in the Mainland, he often chose remote locations away from the city center to save money, but this was potentially quite inconvenient for employees and their families. To address the issue, he built dormitories, schools, and other facilities near the factories, and he allocated 1,500 apartments in Shanghai, Beijing, and Wuhan as well as SMIC stock to the employees as well. Both the apartment values and the stock rose over time, which rewarded the employees for their sacrifices. To reduce turnover and recruitment costs, he provided career development assistance and resources for his employees and encouraged their spouses to work at SMIC as well. He also did his best to make sure his employees felt like a part of a "big family" by remembering their names and calling them by their names in the hallways. As a

result, even though SMIC did not offer high salaries, he was still able to attract a high number of talents from around the world to leave their companies and join him in Shanghai.

Richard Chang's obsession with lowering costs and his patriotism often went hand-in-hand. For example, instead of purchasing expensive packaging and testing equipment from the world leading Japanese company Advantest, Richard Chang decided to self-develop his own testing equipment by partnering with the packaging and testing Licheng Technology in Taiwan. This focus on prioritizing and nurturing domestic partners to lower costs from purchasing overseas equipment also helped to ensure the loyalty and commitment of the partners' employees. Preferring "guochan" or domestic brands, or buying and repairing second-hand equipment, instead of importing new equipment from foreign companies is now often expected from Mainland businessmen, but Richard Chang had spent his entire adult life in America and Taiwan, so it was indeed quite a departure from traditional practice for an overseas businessman to give opportunities to unproven domestic companies instead of more mature international brands. To avoid sacrificing quality and accuracy in the process, he carefully tested and compared domestic prototypes with international equivalents and sent the prototypes back to the suppliers for upgrades until the prototype were able to reach international standards.

Whether the savings amounted to 10 yuan or 1 million yuan, Richard Chang would insist on exploring all avenues to attempt to reduce unnecessary expenses and build self-sufficiency and self-reliance instead of relying on overseas partners. This

mentality surely had a significant role in building SMIC into a credible threat to TSMC, especially given the constant threats of international sanctions and limitations on importing overseas equipment into China. Chang's emphasis on self-sufficiency and in-house ingenuity can also be seen in SMIC's recent efforts to fabricate 5nm chips using older DUV tools without EUV technology. However, Richard Chang's zeal for thrift would almost undermine the company when he did not invest sufficient time and resources in a devastating lawsuit with TSMC, which will be discussed at length in the next chapter.

5

From Acquisition to Litigation

Family relationships can be double-sided, as the characters of the Chinese literary classic "The Dream of the Red Chamber" are well aware. On the one hand, relying on family members can allow individuals to supersede their own limitations and obtain opportunities they could not have attained otherwise. On the other hand, family relationships and their expectations of reciprocation also can be burdensome, and when expectations of family members are not met, this can lead to bitter acrimony and conflict. The same can be said for family-like relationships in the corporate context. Richard Chang aimed to build a "big family" in SMIC in the form of literal and figurative family relationships that would stick together through the difficulties of founding a semiconductor startup. But in relying on his prior connections to poach 180 employees from TSMC, and investing the massive bounty he received from TSMC to give birth to a rival in SMIC, he angered Morris Chang, who was Richard Chang's former superior at Texas Instruments. Morris Chang had also laid the foundation for the growth of semiconductor companies like

Shida during his tenure as the President of the ITRI. This sense of betrayal from a "subordinate" to a "superior" would lead to a chain of events and a punishing lawsuit that eventually led to Richard Chang's resignation from SMIC and almost crippled SMIC for good.

We should not assume, of course, that Morris Chang's offer of $515 million US for Shida was an act of charity, or that the acquisition contractually prevented Richard Chang from establishing a rival to TSMC. As mentioned before, Shida had become the third-largest foundry in Taiwan in only a few years under Richard Chang's leadership, so Morris Chang had every reason to want to eliminate a fast-growing potential competitor to TSMC on its home turf. It was his decision to "overpay" for Shida rather than Richard Chang's. By the same token, Richard Chang did not insist in writing that TSMC had to expand in the Mainland in order to agree to the acquisition, so he could not have been overtly surprised when Morris Chang declined to follow through on such plans.

But from a moral perspective, it is understandable that Morris Chang would feel betrayed by Richard Chang's actions. This is because Richard Chang not only established a rival semiconductor company but also did so in the Mainland, using the Mainland government's considerable resources and policy support. Had he simply tried to rebuild another foundry in Taiwan, Morris Chang may not have deemed this to be a meaningful threat. It is also fairly normal in the semiconductor industry to resign from a company and poach former employees, since Morris Chang himself had departed Texas Instruments and applied his knowledge and connections from the company

to benefit TSMC. What was unusual and unprecedented was that Richard Chang was attempting to found a company in the Mainland, which no Taiwanese had done in the industry before. With the weight of the Mainland government and the Mainland economy behind SMIC, Richard Chang had to be taken seriously as a credible long-term rival to TSMC. This was not likely to be within Morris Chang's expectations, and he may well have refused to acquire Shida at such a lofty price if he had known of Richard Chang's true intentions.

With this backdrop of betrayal, Morris Chang and TSMC could not look the other way when former TSMC employees who joined SMIC committed acts of patent and trade secret infringement and trade against TSMC. Even though SMIC had the backing of the Chinese government, which could threaten to retaliate against TSMC by limiting its sales in the Mainland, Morris Chang was still determined to sue SMIC. The unfortunate aspect of the lawsuit was that SMIC co-founder Wang Yangyuan had long ago identified the importance of securing independent IP rights in product design and manufacturing technology to become a competitive company in the semiconductor industry. However, amidst SMIC's fast and early growth, there was an insufficient emphasis on acquiring these IP rights. Richard Chang's focus on cost-efficiency may also have influenced the company to neglect to invest the time and resources to acquire these IP rights independently. Consequently, when SMIC invited employees from TSMC to join the company, these employees often disclosed confidential information to SMIC or copied TSMC technology, which was then discovered and formed the basis of the lawsuit.

In August 2003, TSMC formally sued SMIC in California for improperly obtaining trade secrets and patent infringement, and it demanded SMIC to pay US$1 billion in compensation. Although SMIC had previously reached several patent cross-licensing agreements with TSMC, there were undoubtedly various incidents of infringement, such as emails containing confidential information between TSMC quality and reliability manager Liu Yiqian and COO of SMIC Marco Mora. Moreover, due to cross-straits tensions arising from the pro-independence stance of President Chen Shui-Bian, private mediation between SMIC and TSMC that could have averted a lawsuit was ineffective. An initial settlement was reached in January 2005, in which SMIC agreed to pay US$175 million in compensation, stop using all TSMC technology and processes, and allow TSMC to inspect all of its technologies for IP right infringement. However, TSMC sued SMIC again in 2006 and accused SMIC of violating the settlement agreement after its inspections revealed more acts of IP infringement on TSMC's 0.13 micron technology. With the prospects of even more legal compensation burdening SMIC, its future was bleak, and several international private equity funds attempted to buy out the company.

Richard Chang refused these offers, even when the share price of SMIC fell to US$0.36, as he knew that the private equity funds like Blackstone and JPMorgan would simply break up the companies and cash out their investment as soon as possible. Even though foreign shareholders were angered by his refusal of JPMorgan's offer of 51% of SMIC shares at a price of $4.8 per share, he was still primarily focused on the long-term future of the semiconductor industry in Mainland China, so he

denied the request. Yet, while his patriotism was admirable, his stinginess also led him to neglect hiring an effective legal team in the U.S. who could adequately defend SMIC. Instead, he pre-emptively countersued TSMC in the Beijing High Court and accused the company of unfair competition and commercial defamation as an attempt to force TSMC to disclose favorable evidence prior to the California trial. However, this attempt failed when the Beijing Court rejected all of SMIC's claims before the lawsuit could even enter a trial stage. Even so, Richard Chang and the SMIC board refused to accept any settlement proposals from TSMC, as they insisted this time on fighting the lawsuit to the end.

At last, on November 2009, the lawsuit concluded with TSMC winning a massive victory. The California court ordered SMIC to pay $1 billion in damages over four years. When coupled with the global economic recession of 2008 and 2009, which led to a collapse in SMIC's revenues, it was hardly within the capabilities of the company to pay the compensation as ordered. Richard Chang was stunned and completely at a loss when he learned of the verdict. Although he admitted that mistakes were made in infringing on TSMC's patents, he could not believe that the court could have ordered for such a large amount of compensation. Yet, due in part to the grievances that Morris Chang had already harbored against Richard Chang, he was prepared to risk the ire of the Mainland government and endangering access to the Mainland market by persisting with the lawsuit. However, after the lawsuit concluded, the reality was that SMIC could not pay all the money it had owed to TSMC, and so some "discount" had to be realistically applied. Otherwise, TSMC could lose the Mainland market, which was

worth much more than $1 billion.

In the end, having made his point to the world, Morris Chang accepted a settlement in which SMIC would pay US$200 million over four years and transfer 7% of its shares to TSMC for free. It also granted TSMC the right to purchase 3% of SMIC shares at the price of HK$1.3 per share. Effectively, this would have given TSMC the right to control SMIC if it had increased its shareholding via the capital market. Yet TSMC took the opposite approach and sold of all its shares in SMIC without even asking for a SMIC board seat. The reasons were simple: TSMC did not really want to control SMIC, as it was simply trying to protect its legitimate IP rights. Increasing its ties to SMIC could have led to other issues could have led to other risks in dealing with the Chinese government, which could have always threatened to bar TSMC's access to the Mainland market, and these were risks and complexities that TSMC and Morris Chang had no interest in.

Though he was still skeptical of the prospects of opening a factory in the Mainland, Morris Chang knew that the further development of TSMC depended on some cooperation with the Mainland, and so he could not afford to push SMIC too hard after the lawsuit was over. He was a businessman, after all, and he did not have personal animus against anyone in the Mainland government or in SMIC, with the likely exception of Richard Chang. But in many ways, the damage to TSMC and Morris Chang's reputation in the Mainland after the lawsuit had already been done. Mainland officials in particular were angered that Morris Chang would resort to "lawfare," in an American court no less, against a national semiconductor

champion. They were also upset that TSMC had sued SMIC a second time after a settlement was initially reached.

In the Chinese government's eyes, although TSMC and Morris Chang were nominally "Taiwanese," they were still a part of the Chinese family and the Chinese nation, just like Richard Chang. Therefore, filing a lawsuit in an American court was a violation of a mutual understanding to resolve differences internally, regardless of the merits. Cooperation with TSMC was inevitable due to SMIC and other Mainland companies' shortcomings, but the takeaway was that TSMC and Morris Chang could not be relied upon to act in China's interests, in spite of their Chinese ethnicity and heritage. Conversely, in spite of Richard Chang's mistakes in the lawsuit, he was still seen as a patriot and the godfather of the Mainland semiconductor industry, and so he was given considerable support from Mainland officials even after his resignation from SMIC.

6

New Beginnings

In the wake of the disastrous lawsuit with TSMC, SMIC's shareholders and board of directors were out for blood. Richard Chang had to take the fall for his admittedly significant role in failing to prevent the patent infringement from occurring and also for his ill-advised legal strategy which lowered SMIC's chances of winning the case. Not only did Richard Chang have to resign from the company he founded, but he also had to agree not to work in the semiconductor industry for three years as part of a non-competition agreement. This surely must have been Richard Chang's lowest point in his career, especially given all that he had achieved in founding SMIC and turning the fledgling company into China's largest and most profitable foundry. He was the "father" of SMIC, along with Jiang Shangzhou, so being forced to resign and leave the industry for three years was akin to forcing a father to abandon his own children.

Fortunately for SMIC, Jiang was a capable leader who filled in admirably for Richard Chang as chairman even while suffering

from cancer. Despite facing unprecedented headwinds from the TSMC lawsuit, the global financial crisis, mounting losses, and Richard Chang's departure, he was able to convince SMIC employees and management to keep the faith by hiring Wang Ningguo, a former global vice president of the Applied Materials corporation in America, and Yang Shining as the new CEO and COO. Jiang Shangzhou was also able to stop SMIC's consecutive years of losses by giving up its previously dominant memory chip business, which lacked technical support after the bankruptcy of key manufacturing equipment partner Qimonda, and transforming SMIC into a wafer foundry. This led SMIC to a US$20 million profit in 2010. To address the depletion of capital and investment after the TSMC settlement, Jiang also convinced the state-owned enterprise China Investments Co. to purchase 11.6% of SMIC shares for US$250 million. As a result, SMIC was able to survive the crisis of 2009 intact.

With the recurrence of lung cancer, however, Jiang Shangzhou fell ill and passed away in June 2011, only two years after he had taken over the helm of SMIC. Though he did not live to see SMIC become a major player in the global semiconductor industry, he did succeed in increasing the total chip output of Chinese companies from 6 billion RMB in 1998 to 157.22 billion RMB in 2011, a 26-fold increase. Shanghai represented half of the value of the industry, which was proof of concept for Jiang's "Zhangjiang model." Mainland China was also much closer to ensuring domestic self-sufficiency in all aspects of the semiconductor industry supply chain, including design, manufacturing, packaging, testing, equipment, and materials. Yet given the fact that Taiwanese expertise was so crucial to SMIC's success, it was fitting that Jiang was replaced in 2011 as

Chairman by Chiu Tzi-yun, a Taiwanese engineer and former senior employee of SMIC and TSMC who like Richard Chang was educated in electrical engineering in the United States. Chiu also replaced Wang Ningguo as the CEO.

Chiu's contributions at this critical stage were even more significant than Jiang's. Chiu had a wealth of experience from his stint working as a senior director of TSMC factory, and he was also a top deputy of Richard Chang's when SMIC was first founded. Due to disagreements with Richard Chang over company operations and management, Chiu resigned from SMIC in 2005 and become vice president of operations at Shanghai Hua Hong. In this role, he oversaw the merger of Hua Hong and Grace Semiconductor, which provided the necessary funds for him to spearhead Hua Hong's revolutionary 12-inch wafer production line. Hua Hong, like SMIC, also had a significant number of Taiwanese engineers, so Chiu's Taiwanese background enabled him to act as an intermediary between the Taiwanese staff and Mainland officials. By the time he left Hua Hong to return to SMIC, he had succeeded in raising Hua Hong's yield rates and productivity by focusing on applying mature processes rather than pursuing more advanced but risky processes that were beyond the company's technological capacities.

Richard Chang's departure provided an opening for Chiu to replace him at his old company. Chiu immediately initiated an all-important cooperation with IBM on the 28nm process and achieved mass production of the 40nm process. At the same time, he took advantage of the rise of the local chip design industry with companies like HiSilicon (a subsidiary of

Huawei), Zhanxun, and GigaDevice providing domestic orders that reduced SMIC's reliance on orders from overseas chip design companies. This enabled SMIC to gradually reach full production capacity and reverse its losses by relying more on the burgeoning domestic market. From 2012 onwards, Chiu steered SMIC to 13 consecutive profitable quarters and doubled SMIC's share value by 2015, which greatly restored confidence in the company from foreign shareholders and the government. For these achievements, Chiu was named the third-best CEO in Asia in the semiconductor category in 2015 by the U.S. Institutional Investor magazine.

As for Richard Chang himself, he was not content to simply observe the turnaround of SMIC from afar. Though he would never again be able to lead the company he founded, he could still contribute to the Mainland semiconductor industry by founding companies that addressed deficiencies in the semiconductor supply chain. Even before the expiration of his three-year prohibition from the semiconductor industry, he invested 3.5 billion RMB and purchased 4 domestic substream and downstream LED companies. After three years, he sold the companies at a significant profit, which provided the start-up capital for him to found the Shanghai Xinsheng Semiconductor Technology Company. Unlike SMIC or TSMC, this company would focus on manufacturing large 12-inch wafers (such as those made by Hua Hong). This enabled him to meet Mainland China's growing demand for 12-inch wafers, avoid competing with SMIC, and also plug a major gap in the domestic semiconductor supply chain, since 98% of the large wafers produced worldwide in 2013 were provided by Japanese, German, Korean, or Taiwanese companies.

Domestic companies struggled with the purity requirements (no more than 1 impure atom in 1 billion silicon atoms) and flatness requirement (no more than 3 nm of undulation) of large wafers, which presented a formidable technical obstacle. Even though 12-inch silicon rods had been produced in the Mainland as early as 1997, the purity and flatness of the rods was insufficient for use in wafer manufacturing. Also, overseas companies were very reluctant to share their wafer technology and equipment with the Mainland, especially those involved in the complex "crystal growth" process, which meant the Mainland companies had to invest in developing their own wafer technology. However, Richard Chang understood the importance of overcoming this "choke point" in the semiconductor supply chain in maintaining the healthy development of the Mainland semiconductor ecosystem. For example, in 2017, a global wafer shortage led the Japanese wafer supplier Sumco to refuse to provide its wafers to Mainland companies and instead prioritized Intel, TSMC, and Micron. Thus, Richard Chang was prepared to dedicate the next phase of his career to addressing these deficiencies in the industry.

Undaunted by the punishing TSMC lawsuit and the humiliation that arose from his resignation from SMIC, Richard Chang set about doing what he knew best, which was building and operating semiconductor factories at low cost and maximally using domestic suppliers for the benefit of the Mainland industry. In just over a year, Shanghai Xinsheng completed the factory construction and equipment installation, and it succeeded in producing China's first high-quality 12-inch monocrystalline silicon rod in 2016 before initiating mass production in 2018. By 2019, Xinsheng had mass-produced 100,000 high-quality

12-inch large wafers. At this time, Xinsheng and Richard Chang had already completed his mission of stimulating large wafer self-sufficiency, as the planned monthly production capacity of large wafers had already exceeded 4 million wafers.

However, disagreements arose between Richard Chang and other managers at Shanghai Xinsheng over his preference of domestic equipment suppliers over international suppliers. Just like with SMIC, Richard Chang wanted to use the company's orders to gradually improve the quality of domestic equipment, especially in terms of polishing and testing machines. He had a long-term vision of securing China's domestic industry from foreign reliance. But this invariably led to delays in mass production and profits, since the improvement of domestic equipment could only be achieved via lengthy, iterative upgrades, while superior international equipment could be used immediately. As a result, Richard Chang left the company in 2018 after it was 100% acquired by the Shanghai Silicon Industry Group. Rather than founding yet another company in Shanghai, however, he decided to relocate to Qingdao, the economic hub of Shandong province, by jointly establishing and serving as lifelong honorary dean of the School of Micro and Nano Technology in Qingdao University. Today, he still teaches at the college, along with other longtime members of his leadership team, to share his knowledge with Mainland students.

Even as a veteran businessman in his seventies, Richard Chang still could not resist the allure of entrepreneurship, especially given the many weak points that still existed in China's semiconductor industry supply chain. In 2018, he founded SiEn

Qingdao Integrated Circuits Co., Ltd., which would once again take his career in a new direction by turning back the clock and building an IDM company similar to Texas Instruments, where he began his career. After breaking ground on the fab in Qingdao in 2018 and investing 20 billion RMB from the government in two phases, the factory started operations in 2021 at the peak of the global semiconductor shortage by producing both 8-inch and 12-inch wafers while cooperating with local chip designers including GigaDevice. As with SMIC, which had substantial state ownership, SiEn is 67% owned by the state-owned Assets Supervision & Administration Commission of Qingdao. Qingdao SiEn is now reportedly operating one of the 11 domestic foundries that cooperate with Huawei to produce 7nm chips, after receiving support from a special Huawei task force to greatly hone its manufacturing capacities.

However, the focus for SiEn was not making chips using advanced manufacturing processes like SMIC but rather on specialty power chips and microcontrollers intended for use in cars and home appliances. These types of specialty processes, which involved small batch sizes, high unit prices, and high reliability requirements, were typically performed well by IDM companies such as Texas Instruments, NXP, and Infineon. China, however, did not have many IDM companies, since the focus from SMIC and Hua Hong onward was on the pure-play foundry model that TSMC had perfected. Among the top 10 semiconductor companies on the Mainland, only China Resources Microeconomics, which Richard Chang had previously sold to China Resources Group in 1998, was an IDM. Thus, with SiEn, Richard Chang was "re-introducing" the

predominant foundry manufacturing model prior to TSMC's ascendance into the Mainland. In fact, besides specialty process wafer production, memory chips were also more suitably produced by IDM companies. The dominant players in memory chips, Samsung, SK Hynix, and Micron, all have their own IDM plants. Thus, if the Mainland is to truly become a dominant player in the full semiconductor industry, it is probable that the IDM model will play a relatively significant role.

Of course, the same capital expenditure issues and difficulty obtaining enough orders to meet production capacity that plagued IDMs in the 1980's still applied to Richard Chang's new IDM company. To overcome these issues, Richard Chang implemented the "Commune IDM" model, a modified version of the IDM foundry in which the IDM raised capital by asking chip design companies both at home and abroad to invest in the company by buying shares. Companies involved in manufacturing, packaging, and testing would also be invited to invest. For this "CIDM" model to work, the personal reputation of the IDM's founder would have to be attractive enough to convince the chip design companies and suppliers to invest in a company that it is also simultaneously competing with. This problem did not arise with the pure-play foundry model, which meant that Richard Chang had to stake his personal reputation to make the model work properly.

While the success of the CIDM model is not yet proven, SiEn was reportedly able to attract investment from Huawei, now one of China's leading chip designers, in 2021. Huawei also reportedly acquired a fab from SiEn along with other companies such as Fujian Jinhua, and SiEn is also offerin

design, production, packaging and testing services as part of the deal. Huawei has ample motivation for investing in the domestic supply chain of chips; even more so than SMIC, Huawei has been in the cross-hairs of the U.S. government, which sanctioned Huawei and severely limited its access to chips and even Google's Android OS. This may well have spurred Huawei to abandon any hesitations about cooperating with IDMs like SiEn in order to maximize the quantity and quality of the domestic supply of chips. Of course, Richard Chang's status as both the chairman of SiEn and the founder of SMIC, as well as his government backing and decades-long efforts to promote self-sufficiency in chips, surely played a role in earning Huawei's trust.

7

An Insurmountable Lead?

For all of Richard Chang's achievements with SMIC, Shanghai Xinsheng, and Qingdao SiEn, the dominant role of TSMC in the global foundry markets as of 2025 is stronger than ever. For example, TSMC's market share actually increased from 2023 to 2024, although this is more so due to TSMC seizing orders from Korean rival Samsung rather than from SMIC. The Mainland also continues to import the majority of the semiconductors that it uses in its electronics production. This is in spite of the fact that TSMC's once-groundbreaking pure-play foundry business model is now widely emulated throughout the world, not least by SMIC and other mainland foundries. Besides, TSMC is no longer an underdog that is dismissed by rivals and given orders out of sympathy; quite the opposite, as its dominance now leads to concerns in Mainland China, Japan, and the U.S., who all would prefer that TSMC be replaced by their own national "champions." Yet in spite of these pressure, TSMC has perfected a delicate balancing act between West and East and solidified its preeminent position as the most integral foundry in the

world. In this regard, Morris Chang's leadership even after his resignation 2018 must be given full credit and admiration.

One reason why TSMC has built up an insurmountable lead on its rivals is because from 1987 until now, the company has continued to abide by Morris Chang's insistence to perform Original Equipment Manufacturer (OEM) work only and diligently refrain from engaging in chip design. This was the only way to convince hundreds of chip design companies to send confidential chip design blueprints to TSMC for production. He also used his fearsome "iron fist" reputation in management to weed out any leaks from employees to ensure that any breaches of confidentiality would be severely punished. For instance, TSMC employees cannot even enter a bathroom without first swiping their employee cards, and their movements on the job are monitored at all times. They also are prohibited from bringing their phones to work, with violators reported directly to Morris Chang himself for punishment and dismissal. With these rules in place, and with TSMC's reputation and client relationships having been established for decades, it is extremely difficult for any competitor like SMIC to fully gain the confidence of clients, who may be wary that their designs could be stolen or leaked at any time.

Morris Chang also made the wise decision to avoid investing in the memory chip business, which was more conducive to the IDM fab model, and maintaining a single-minded focus on wafers and microprocessors. When, for example, the joint venture between Texas Instruments and Acer sold the first memory chip foundry in Taiwan to TSMC in 1999, he promptly transformed the foundry into a wafer foundry. Unlike the

Taiwan government, which in 1990 had attempted to take market share away from Korean and American memory chip companies by encouraging investment in memory technology, Morris Chang was always pessimistic that TSMC would ever be able to compete with the likes of Samsung, SK Hynix, or Micron in the memory business. This was due to the superior support from the Korean government, which provided more state support for their "chaebols" (especially Samsung) than the Taiwanese companies that were still mostly reliant on private investment. Also, since the Korean economy was larger than Taiwan's economy, it was difficult to provide the level of policy support needed after the Korean government emphasized memory as a strategic industry. Morris Chang's predictions in the 1990s were proven correct; as of 2024, Korean companies Samsung and SK Hynix and Micron continue to dominate the memory business, while Taiwanese firms like Winbond and Powerchip far behind.

In terms of domestic competition, after witnessing TSMC's success, its leading Taiwan rival UMC soon adopted the pure-play foundry model in the 1990s as well. TSMC was able to keep its lead over UMC by maintaining a rapid pace of expansion by building a new fab every year, which was essentially the same as Intel's pace of one new factory every nine months. UMC had difficulty matching this level of expansion because as transistors become smaller and smaller with each generation in accordance with "Moore's Law," the technical difficulty and required investment in manufacturing them also becomes higher and higher. As early as 1995, the cost of Intel's new 12-inch wafer fab was US$2 billion. With the cost of a new fab doubling every four years on average, the global average

for building a new 12-inch fab in 2000 would end up costing the same amount of money as that of an aircraft carrier. Since UMC did not have as many orders and client relationships as TSMC, it was unable to justify matching TSMC's production capacity due to the gargantuan capital expenditures for each new fab and the potential for equally massive losses that would result from a failure to meet production capacity.

The potential for semiconductor companies to incur huge losses due to lack of orders was far from unprecedented. For example, after the collapse of the "Internet bubble" in 2000, semiconductor companies around the world had to lay off thousands of employees to compensate for the lack of revenue. This is one reason why semiconductor companies can find it so hard to justify the upfront capital costs associated with cutting-edge fabs, because market demand can fluctuate from year to year. However, Morris Chang understood that TSMC had to invest in a counter-cyclical fashion by building more fabs in economic downturns, which would enable TSMC to take market share from its rivals. This counter-cyclical strategy was also how the Korean companies were able to overtake Japanese memory firms to become the industry leaders. Hence, in the wake of the bursting of the "Dot-com bubble", TSMC built not one but three 12-inch wafer fabs, which cemented its lead in production capacity when the global economy recovered.

Morris Chang was also confident that TSMC could justify these massive investments because he had already reached an arrangement with the American chip designer Nvidia, now the leader in the global graphics card industry, to serve as Nvidia's foundry for its ground-breaking graphics processing units

(GPUs). This was the first time that TSMC was able to build advanced chips like GPUs, which previously had only been manufactured by IDMs like Intel. Of course, Nvidia benefited from its arrangement with TSMC as well, since it was a chip designer that did not have the time or the resources to build its own foundry. With TSMC's assistance, Nvidia was able to focus all its efforts on chip design, eventually surpassing its main rival AMD and even Intel to become the world's most valuable chip designer and one of the most valuable companies of any kind in the world. The fact that Nvidia's CEO, Jensen Huang, was another Taiwanese-American like Morris Chang was likely to be another factor that helped TSMC become Nvidia's longtime partner. Jensen Huang has repeatedly stated in interviews that he has never considered any alternative foundry besides TSMC, which is a powerful vote of confidence in TSMC that competing foundries cannot hope to match.

Apart from superior management methods, capital investment, and client relationships, Morris Chang also focused heavily on production technological innovation. He identified and promoted several highly capable lieutenants and engineers who invented new techniques and processes to improve production efficiency and quality. For instance, Burn-Jeng Lin, the inventor of the immersion lithography process now used by the leading lithography machine company ASML, joined TSMC in 2000 after working for IBM. Like Morris Chang, he was a Taiwanese who studied electrical engineering in the U.S. before returning to Taiwan to found his own lithography company, Linnovation, in 1992. Unlike many other CEOs of semiconductor companies, who did not believe that the immersion lithography solution was viable, Morris Chang lent TSMC's support and investment

to Lin's company. With the two companies' fates intertwined, they pooled their resources together and developed the first immersion lithography machine in only one year. Under Lin's supervision, TSMC and Linnovation were able to refine the precision of their machines from 130 nanometers to as low as 10 nanometers. Due to Lin's contributions, TSMC was able to use immersion lithography machines in its fabs much earlier than other foundries. His invention also benefited ASML, which as early as 2007 had already become the world leader in lithography machines thanks to its early adoption of Lin's immersion lithography solution technique.

Another key innovation that was commercialized by TSMC was the fin field-effect transistor, or FinFET. Calvin Chenming Hu, yet another Taiwanese engineer educated in the U.S., was invited to join TSMC as Chief Technology Officer by Morris Chang in 2001 after he helped to develop FinFET as a professor at the University of California, Berkeley. With TSMC's resources, Hu was able to achieve technological breakthroughs in FinFET commercialization after 28 nanometers. Although TSMC's revenues declined for the first time in 2001 after the burst of the Internet bubble in 2000, this only motivated Morris Chang to spend even more money in research and development. The end result was that TSMC succeeded in preparing n-type and p-type FinFETs with gate lengths of 10nm and 5nm, overcoming the physical limitations of semiconductor technology at the time. This is important because reductions in transistor size from 20nm to 10nm and less would lead to reductions in power requirements and increased performance, so innovation like FinFETS would give TSMC an edge on the competition and maintain its lead as the top foundry.

8

Conclusion

Both Richard Chang and especially Morris Chang are now in the twilight of their careers, and both have become elder statesmen in the semiconductor industry who have handed the batons of their respective companies to younger leaders. Much like other CEOs and founders of leading Chinese tech companies like Huawei, Bytedance, and Tencent, both Changs have been fairly low-profile since their retirements, and they rarely give interviews. In the case of Richard Chang, his reticence before foreign media is also probably driven by the increased scrutiny of his new venture, Qingdao SiEn; in December 2024, the U.S. government added Qingdao SiEn to the list of Chinese companies subject to export restrictions on chipmaking tools in an effort to hinder China's AI chip advancement.[8] Arguably, this move from the U.S. government is a testament to Richard Chang's high capabilities, because it recognizes that Qingdao SiEn has become a leading player in the industry after being selected to partner with Huawei as part of its supply chain.

In 2024, Richard Chang was quoted in Malaysian media as praising the country's budding semiconductor industry, which now commands 13% of back-end semiconductor production. [9]Chang argued that the technology transfers from China to Malaysia owing to the two countries' strong bilateral ties would lead to similar benefits as the technology transfers from the U.S. and Japan to Taiwan in the 1980s and 1990s. Chang remarked that due to Malaysia's perceived neutrality in geopolitical affairs, its companies can benefit from expertise from countries and regions as varied as China, Japan, Korea, Taiwan, and the U.S. Interestingly, although Chang is known as the founder of the state-owned SMIC, he noted that private Chinese companies would be more likely to work with Malaysian firms as they are under less regulations and constraints than state-owned firms. Chang likely spoke from experience, as he has been at the helm of both private and public companies in China. He also knows better than anyone how geopolitical tensions between China, Taiwan, and the U.S. can complicate efforts to produce cutting-edge technologies and gain market share.

As for Morris Chang, he recently published the second and final volume of his autobiography in December 2024. [10]In this volume, Chang shares his experiences steering TSMC to the top of the food chain in the semiconductor industry, although he does not address the U.S.-China trade war and geopolitical challenges. It is telling that in a press conference discussing the book, Chang remarked that he never encountered geopolitical challenges such as "friendshoring" and "onshoring" in his tenure, which made his job much easier. Indeed, he has long been known to resist expanding to the U.S. for precisely this reason, because he was not pressured to do so by the U.S.

government prior to his retirement in 2018. However, he noted that he would let TSMC's current leaders manage such challenges, instead of trying to exert influence from behind the scenes. This is a telling quote because it affirms that Chang has tried for his whole life to stay above geopolitical issues and focus solely on the business and technology aspect of the industry. While this attitude has brought much success to TSMC, it is arguably not well suited for present circumstances, as TSMC is increasingly forced to side with the West at its own detriment.

Morris Chang was also critical in his interview of his old American rival Intel, which has been rumored to be on the verge of bankruptcy. Chang noted that while he was friendly with Intel co-founders Robert Noyce and Gordon Moore, former Intel CEO Pat Gelsinger was hostile to TSMC, and Chang criticized Gelsinger as lacking in strategic vision. He also shared an incident with Chang then noted that Intel's "Achilles heel" was its lack of strategy and ongoing CEO search, as well as its ill-timed switch to water foundry services, instead of seizing new opportunities in AI. Regarding Samsung's loss of market share to TSMC in the foundry business, Chang argued that Samsung's flaw was its lack of emphasis on leadership and administration. Perhaps the most interesting revelation in Chang's autobiography was that he invited Nvidia CEO Jensen Huang to join TSMC in 2013, when TSMC's market value was ten times larger than that of Nvidia's. As mentioned, the two had a long cooperative relationship, and Chang highly respected Huang's leadership and professionalism as a designer rather than a manufacturer. Huang declined the offer, which would prove to be the right move after Nvidia exploded in valuation in the wake of the AI chip boom.

History, especially in the West, will almost certainly hold Morris Chang to higher esteem than Richard Chang. Morris Chang may not be a household name, but his company and its geopolitical importance is now known to all, which makes Morris Chang one of the most consequential Chinese or Taiwanese business leaders in modern history. TSMC's importance has even eclipsed that of Taiwan itself, as shown by how any discussions of Taiwan in foreign circles tends to focus on its semiconductor industry first and foremost. As for Richard Chang, his story and that of SMIC is still being told, so there is still a chance that he could someday emerge from Morris Chang's shadow, at least within China.

Notes

A BRUTE FORCE BREAKTHROUGH

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NO PLACE LIKE HOME

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CONCLUSION

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