Political Risk and the Semiconductor Industry: National Risk Management and Corporate Resilience in Taiwan

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<u>Geopolitical Risks and Technology</u> <u>Outflow</u>

- In recent years, China has been experiencing rapid economic growth and exerting political pressure on neighboring countries and regions, such as Taiwan and Hong Kong, supported by its military power.
- As a result, the U.S. and Japanese governments are nervous about the outflow of technologies to China.

<u>Geopolitical Risks and Technology</u> <u>Outflow</u>

•The U.S. and Japanese governments are not alone in being nervous about the outflow of technology to China.

•Taiwan, which has experienced economic development based on high-tech industries for about 20 years prior to China's explosive economic growth, has been concerned about the outflow of core technologies to China. <u>Geopolitical</u> <u>Risks and</u> <u>Technology</u> <u>Outflow</u> •Especially due to the political conflict with China, the outflow of technology is a major national security risk.

• Preventing the risk of technology outflow to China has national security policy importance and legitimacy for the Taiwanese government.

How important are semiconductors to Taiwan?



EXPLAINER

Economy | Business and Economy

Why China is not sanctioning Taiwan's key chip industry

Beijing relies on self-ruled island's semiconductors to keep its economy on track.



Why China is not sanctioning Taiwan's key chip industry: 4 Aug 2022, Aljazeera

- China has turned to the familiar playbook of trade restrictions following US House of Representatives Speaker Nancy Pelosi's visit to Taiwan.
- After Pelosi proceeded with her trip to the democratically-ruled island in spite of Beijing's warnings, Chinese authorities suspended imports of Taiwanese citrus fruits and fish, and exports of sand.
- Beijing's latest apparent attempt at economic coercion, however, conspicuously left Taiwan's most valuable export of all untouched: semiconductors.
- That is most likely because China depends on Taiwan's exports of the critical components almost as much as the island does itself.

Why China is not sanctioning Taiwan's key chip industry: 4 Aug 2022, Aljazeera

• Taiwan dominates the global industry for semiconductors, critical components used in everything from smartphones and medical devices to cars and fighter jets.

TECHNOLOGY

Taiwan leads the world in semiconductors

Taiwan is **the world's largest contract chipmaker.** The island's **most valuable company, TSMC,** produces some of the world's most advanced chips for Apple, Qualcomm and Nvidia.



Theoretical Implications: Non-Market Risk and Tech-capitalism

- Political risk has a significant impact on corporate management by disrupting the principle of market-mediated economic rationality.
- Such non-market risk cannot be controlled within a company and includes various factors such as natural disaster, social conflict, and technological disaster, in addition to political risk.
- Technology is a sort of power of capitalism, which can control the economic development and political hegemony.

Research Purpose and Methodology

- This study focuses on political risk of Taiwan-China conflict for Taiwanese semiconductor firms.
- I focused on the case study of the relationship between Taiwanese government and Taiwanese major semiconductor giants from risk management perspective and reviewed related news media and industrial reports to trace changes in government and firms' strategy.

History of the Development of Taiwan's Semiconductor Industry

- Taiwan's semiconductor industry achieved dramatic growth from the 1980s to the 2000s, as Taiwanese engineers returning from the U.S. brought cutting-edge technology into the country.
- Taiwan's LCD panel industry, which developed significantly from the late 1990s to the early 2000s, also succeeded in establishing a production system and mass-producing LCD panels as quickly as five years by introducing technology from Japanese companies and hiring Japanese personnel (Tabata 2012:157).

Economic Relations with China

- Since the 1990s, as China's domestic industries have been starting up one after another, Taiwanese companies entering China have shifted from labor-intensive industries to knowledge-intensive and capital-intensive industries.
- Taiwanese high-tech companies have also expanded into China with the support of incentives and other policies from the Chinese government, providing opportunities for Chinese personnel to learn about Taiwan's cuttingedge technology, and moreover, Taiwanese high-tech personnel have also been assigned to Taiwanese companies operating in China.

Taiwan's National Risk Management

- Taiwanese government has continued to restrict Taiwanese companies from investing in China due to the national security considerations.
- Lee Teng-hui, who was elected president by direct vote for the first time in Taiwan in 1996, launched the policy of "no haste, be patient" (Huang 2008:97-98), regulating investment in China by Taiwan's large companies, particularly in the semiconductor industry, to prevent the outflow of key semiconductor manufacturing technology.

<u>Risk Governance to Protect Technology in</u> <u>Taiwan</u>



Unintended Technology Outflow

- Two types of technology transfer: one is formal technology transfer and the other is informal technology transfer.
- In formal technology transfer, technology is transferred in the form of "explicit knowledge," e.g., licensing, use of patents, manual instruction, etc.
- In informal technology transfer, technology is transferred as "tacit knowledge" (Polanyi 1966), which is highly situation-dependent and is acquired through the accumulation of on-the-job training.

Unintended Technology Outflow

- Technologies transferred as "tacit knowledge" are transferred through faceto-face education and training of engineers.
- However, there is a risk of excessive outflow of technology beyond the expectation and extent of those transferring the technology, accelerating the catch-up of foreign firms.
- Because "unintended technology outflows" are affected by different cultures, legal systems, and business practices (METI 2003:2), it is extremely difficult for a country or company to control the degree of technology transfer.

Risk Society and Brain Drain

- Technology outflow hinders industrial development and causes loss of competitiveness.
- According to "Risk Society" (Beck 1992), modernization has disrupted state-centrism and class society to some extent, but on the contrary, it has also reduced the sense of belonging to an organization ("individualization"), more people move freely across borders, and technological outflows have become more frequent due to globalization.

Development of Taiwan's Semiconductor Industry and National Risk Management

- The Taiwanese government has prohibited all investment in China since the time of the first president Chiang Kai-shek.
- Since the 1970s, China's reform and open-door policy, as well as the lifting of the ban on travel from Taiwan to China in 1987, have contributed to the development of economic and trade relations between Taiwan and China.
- However, as military tensions with China increased in 1995 and 1996 due to the missile crisis in the Taiwan Strait, President Lee Teng-hui strongly emphasized economic security and positioned the policy of "no haste, be patient" as Taiwan's national strategy (Huang 2008:97).

Initiatives by Lee Teng Hui

- An overemphasis on Taiwan's independence would generate anger from the Chinese government, which recognizes Taiwan as territory of China, and would lose the economic benefits that could be gained by economic exchanges with China.
- However, Lee Teng-hui believed that Taiwan's economic benefits could be gained in the long run not through economic exchange with China, but by encouraging the independent development of Taiwanese industry.

Risk Management by Lee Teng Hui

- In 1996, Lee Teng-hui launched the policy of "no haste, be patient" and imposed restrictions on investment in China.
- First, he regulated investment in the infrastructure and advanced technology sectors by classifying Chinese investment into three categories: "prohibited," "permitted," and "reviewed.
- The regulations also prohibited large investments exceeding US\$50 million per case and set conditions on the cumulative amount of investment in China based on the size of the company.
- The purpose of this policy was to prevent the outflow of Taiwan's cutting-edge semiconductor technology to China and also to prevent the hollowing out of the Taiwanese economy (Oshima 2010:12-13).

<u>Reactions from Taiwanese Business</u> <u>Community</u>

- Morris Chang, founder of Taiwan Semiconductor Manufacturing Company (TSMC), the world's largest semiconductor foundry, was initially reluctant to accept the government's policy of restricting investment in China.
- However, he eventually supported the government's policy and refrained from investing in China.

Reactions from Taiwanese Business Community

• By contrast, UMC, unlike TSMC, did not follow the Taiwanese government's policy and secretly started investing in China (Zheng 2020).



Former President Lee Teng-hui

Morris Chang, TSMC Founder



UMC President: Robert Tsao

Difference between TSMC and UMC's stance on investment in China

- In the 1990s, Taiwan's two largest semiconductor manufacturing foundries, TSMC and UMC, took very different stances on the Taiwanese government's China investment control policy in 1996.
- While TSMC followed the government's policy and refrained from investing in China, UMC dared to invest in China, bypassing regulations.
- Robert Tsao, UMC's chairman, sought to increase the scale of UMC's operations by collaborating with Chinese companies.
- President Yi Ming-chih also visited China with a group of UMC executives to promote Taiwan's advanced integrated circuit (IC) design technology.
- In 2001, HJTC, a wafer foundry business, was established in China's Suzhou Industrial Park. HJTC's 8inch wafer fab began production in May 2003, and within a year the business was back on track, becoming one of the top ten wafer foundry manufacturers in China in 2010. In 2001, the Taiwanese government had restricted investment in 8-inch wafer fabs in China, but industry insiders realized that UMC had invested in HJTC.

UMC's Investment in China

- In April 2002, Taiwanese media reported that UMC, through its former deputy plant manager, Xu Jianhua, had invested in HJTC in China via an overseas holding company.
- All the equipment used in HJTC's factory in China was provided by UMC, and Xu Jianhua became the company's chairman. Moreover, dozens of Taiwanese engineers from UMC were transferred to China HJTC.

<u>UMC was punished severely for illegal</u> <u>Chinese investment</u>

- In January 2005, Taiwanese prosecutors indicted UMC's chairman and others on charges including breach of trust and violation of the Commercial Accounting Act.
- Taiwanese government imposed a US\$160,000 fine on UMC for violating the "Investment and Technology Partnership Permit Law in China.

UMC suffers big failure in China plant management

- In 2008, the pro-China KMT government of Ma Ying-jeou came to power and fully deregulated Chinese investment in 8-inch wafer fabs.
- Therefore, HJCT was also legally promoted to a Chinese subsidiary of UMC, and in 2018, it posted more than US\$10 million in revenue, accounting for 14% of UMC's total revenue.

<u>UMC suffers big failure in China</u> <u>plant management</u>

- Operating a factory in China brought unexpected risks.
- In 2014, UMC formed a joint venture with Chinese government to establish a semiconductor foundry and build a 12-inch wafer plant in China to produce 40 and 28 nanometer wafers_o
- Due to the huge procurement costs of the equipment, Chinese factory posted a total loss of US\$300 million in 2018 (Lin 2020).

<u>UMC suffers big failure in China plant</u> <u>management</u>

- In 2018, the Trump administration launched a crackdown on Chinese industrial espionage.
- Intellectual property violations of advanced technologies have become a major dispute in the U.S.-China trade friction.
- A Chinese company, a partner of Taiwan's UMC, was also indicted by the U.S. government for stealing DRAM manufacturing technology; the partnership between UMC and the Chinese company was forced to be suspended.

TSMC's Risk Management

- TSMC followed the Taiwanese government's restrictions on investment in China and established its China plant after three years of lagging behind UMC.
- However, TSMC succeeded in posting a profit from its China plant while leaving its advanced technology in Taiwan.

TSMC's Risk Management

- TSMC's founder, Morris Chang, opposed the Lee Teng-hui administration's restrictions on Chinese investment in 1996. However, he later respected the government's policy, abandoned investment in China, and concentrated his resources on R&D in Taiwan.
- In 2003, TSMC developed its own 0.13-μm rule semiconductor mass production technology using copper wiring, breaking the monopoly on this technology held by IBM. Over the next 10 years of steady focus on R&D, TSMC reached the world's top level in semiconductor manufacturing technology (Commercial Times, July 31, 2020).

TSMC's Risk Management: Trade war between U.S. and China

- Trade frictions between U.S. and China triggered a move toward decoupling from China in the global supply chain.
- Orders for high-end IC chips supplied by TSMC increased rapidly from the world's leading IT companies. U.S. and Japan also began actively inviting TSMC to invest in their countries, and TSMC's stock price jumped significantly (Zheng 2020).
- TSMC received a large volume of orders from major customers such as Apple and posted record sales of US\$9.4 billion in the third quarter of 2020 (Chen and Horton 2020).



Source: EET Times-asia (April 2012)





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<u>Avoiding Technology Outflow to China and</u> <u>Industrial Cluster Management</u>

- Technology outflow is facilitated not only by corporate investment but also by the cross-border mobility of human resources. Therefore, national risk management by the Taiwanese government alone will not be sufficient to stop the outflow of technology to China in the future.
- Therefore, in addition to regulations and guidance on investment in China through national risk management, Taiwan's semiconductor industry is trying to prevent technology outflow to China by establishing cluster management for the entire semiconductor industry.

Avoiding Technology Outflow to China and Industrial Cluster Management

- Taiwan's semiconductor industry has established cluster management, and although it relies on U.S. and Japanese manufacturers for key parts and manufacturing equipment, it maintains a high advantage over China.
- Semiconductor manufacturing industry generally consists of management technology, mass production technology, and engineering technology. Taking Taiwan's semiconductor industry as an example, semiconductor products are completed through a series of processes including design, foundry (contract wafer process manufacturing), packaging, and testing.
- In Hsinchu Science Park, each of these series of processes is handled by a separate company, and these companies are agglomerated within the park to form an industrial cluster. This is the horizontal division of labor in Taiwan's semiconductor industry.

<u>Avoiding Technology Outflow to China and Industrial</u> <u>Cluster Management</u>

- Cluster management in the semiconductor industry is the integrated management of the working environment and quality stability of the semiconductor manufacturing processes, which are handled by separate companies in the industrial cluster. The same system is used for the management function that controls a series of manufacturing processes.
- If quality control fails in any one process, it will be impossible to ensure the yield of finished semiconductor products. Companies responsible for each process are clustered in Hsinchu Science Park to form an industrial cluster, making it easier to control quality.

<u>Avoiding Technology Outflow to China and</u> <u>Industrial Cluster Management</u>

- The best companies for each process are clustered in this industrial cluster to innovate products, recruit human resources, and design and manufacture products of consistent quality.
- The management of this industrial cluster is the core of the competitiveness of Taiwan's semiconductor industry, and even if some companies invest in China independently, the competitiveness of the cluster management function will not be transferred unless the cluster itself is transferred to China.

Conclusion: Toward building a social ecosystem that strengthens industrial cluster management

The outflow of semiconductor industry manufacturing technology and cluster management to China could be devastating to Taiwan's national and industrial competitiveness.

Because of these concerns, Taiwanese government has established restrictions on the outflow of the semiconductor industry to China and has provided guidance to the industry. Conclusion: Toward building a social ecosystem that strengthens industrial cluster management

- To prevent political risk and the outflow of Taiwanese semiconductor technology to China, various stakeholders, including the Taiwanese government, semiconductor-related industries, engineers, and universities and government-affiliated research institutions responsible for R&D, need to cooperate to strengthen industry cluster management.
- Surveillance by civil society, which emphasizes corporate social responsibility (CSR), will also help promote investment in human resource and technology development in Taiwan.

Thank you for your attention!