# SWOT Analysis of Taiwan Semiconductor Manufacturing Company's Development and Its Impact on Economic Development and Enlightenment

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**ABSTRACT**
Chip is a key device in electronic products. With the fast development of information industry, chip application is becoming more and more widespread. Taiwan's chip industry gradually gained a firm foothold in the world after decades of development. Taiwan Semiconductor Manufacturing Company (TSMC) is the largest foundry for chips all around the world and the originator of the Wafer Foundry model. TSMC dominates the global chip market amid a shortage of chips and fierce competition from new technology. This article has introduced the development course of TSMC and summarizes its development status using SWOT. According to the tax paid in the last three years, TSMC plays an important role in Taiwan finance. By analyzing the number of employees and its 2021 recruitment plan, we got the conclusion that TSMC has made a great contribution to solve Taiwan employment; and in addition, from the point of technology and industry chain, we analysed TSMC's contribution to the global chip industry and global economic development. Although TEMC's products are diversified, its advanced production technology has obviously contributed more to the development of the world chip industry. Finally, to learn from the development process of TSMC, we get the inspiration that the mainland chip industry needs the government support and strengthens the talent introduction.

***Keywords:*** *TSMC, chip industry, foundry, SWOT*

## 1. INTRODUCTION

Taiwan Semiconductor Manufacturing is the first manufactory in the world which focuses on OEM integrated circuit mannufacturing.it is the pioneer of the wafer foundry mode land the global leader in chip foundry industry, ranked 100 in the top 500 Hurun in 2021.Chip industry is the foundation and cure of the electronic information industry. Therefore, TSMC has a decisive impact on Taiwan's economy and even the global semiconductor industry.

Observing the Taiwan industry technology field, the most significant development is the High-tech industry, among which the semiconductor is up to 8.9 times in ten years[1]. The emergence TSMC has changed the semiconductor industry. The separation of chip design and manufacturing is the most valuable thing TSMC brings to the semiconductor industry. At the crossroads of scientific and technological development Zhang Zhongmou led TSMC in the right direction[2]. This makes TSMC form a technological monopoly to some extent. And the technological monopoly competence is the key guarantee for enterprises to obtain monopoly profits[3]. In addition, the semiconductor industry is closely related to the national income and consumption level[4]. TSMC's success shows that efficient government funds are the accelerator of the rise of industries[5]. Nowadays domestic wafer manufacturing are still relatively backward in technology, most of companies only follow TSMC's production methods, and make low-end chips[6]. China's high-end chips rely on imports for a long time. High-end lithography machine, eclipse machine, high-end equipment and materials such as high-purity large silicon wafers and ultra-high-pure electronic gas are controlled by others[7]. Not surpassing the high-end manufacturers such as TSMC in short term, the core competence of

 

Chinese mainland enterprises may be how to reduce differentiation and make precise productions of demand at the same time [8]

The paper aims to study TSMC's success and analyze the impact on Taiwan and the global semiconductor industry chain from the development of TSMC. This article introduces the development course of TSMC and summarizes its development status using SWOT. The financial analysis, technical analysis and industrial chain analysis of TSMC show that it has played a vital role in promoting the field of chip manufacturing. Finally got the inspiration that the mainland chip industry needs the government support and strengthens the talent introduction.

## 2. BACKGROUND OF TSMC

Starting from contract manufacturing, Taiwan's chip industry gradually gained a firm foothold in the world after decades of development. As a representative enterprise, TSMC takes a leading position in the industry[5]. In the 1980s, the United States forced currencies of other countries to appreciate because of its long-term debt. As a result, the exchange rate of Taiwan Dollar soared, leading to a sharp decline in Taiwan's export competitiveness. In such a critical situation, the Taiwan government hopes that Zhang Zhongmou can lead visionary people to promote industrial upgrading through science and technology and cultivate new competitive trade and competitive advantages [9]. TSMC was founded in 1987 with the support of the Taiwanese government and won Intel's certification a year later. On September 5, 1994, TSMC's shares were listed on the Taiwan Stock Exchange, marking another milestone in TSMC's development. In the past ten years, TSMC has become a global leader in technology and has gradually grown into an internationally influential semiconductor enterprise. TSMC is a professional integrated circuit manufacturing service company that produces chips for customers with the most advanced process technology.

## 3. ANALYSIS OF TSMC'S BUSINESS

### *3.1. Swot Analysis*

SWOT analysis of TSMC's development is conducive to a deeper understanding of the potential law of its development, so that we can better analyze the impact of its development on economic development. Table 1 shows the analysis of TSMC using swot.

**Table 1.** SWOT analysis of TSMC's development conditions

| | Strengths ( S ) | Weakness ( W ) |
|---|---|---|
| Internal environment | 1.The founder has exceptional leadership skills.<br>2.The creation of the new business model of WAFER foundry. | 1.High cost of advanced process chips.<br>2.Foreign ownership is too high. |
| | **Opportunities ( O )** | **Threatens ( T )** |
| External environment | 1.Government policy support.<br>2.Direct investment by the government. | 1.The potential threat of data blackmail.<br>2.Rapid development of enterprises in the same industry. |

The founder of TSMC has outstanding leadership. And in terms of technology, TSMC has created a new business model of wafer foundry. Zhang Zhongmou was already over 50 years old when he founded TSMC. He had accumulated rich experience and social capital by working in several foreign semiconductor divisions in technical research and development. Under his leadership, TSMC was certified by Intel in 1988, listed on the Taiwan Stock Exchange in 1994, and freed itself from American technology in 2000 to become an industry leader.

IDM mode refers to the semiconductor vertical integration company operating mode, which does everything from design, manufacturing, packaging and testing to sales of its own brand IC. TSMC did not adopt the IDM model, which was common at the time, but took a different approach to achieve the ultimate in wafer foundry business[5]. TSMC focuses on wafer foundry, which promotes TSMC's advanced process technology research and development, narrowing the technological gap with Intel, and truly entering the world's first-class advanced process technology company.

When it comes to its disadvantages, TSMC' s advanced process chips cost too much and foreign ownership ratio is too high, which are not conducive to better and faster development of the company. After TSMC technology entered advanced manufacturing process, the process cost of chip increased rapidly. TSMC said in its 2020 earnings report that capital expenditure would rise to $25 billion to $28 billion in 2021, up from $17.2 billion in 2020. 80% of the capital will be used for the research and development of advanced manufacturing processes, including 3nm, 5nm and 7nm [10], resulting in

relatively less available funds for infrastructure construction and talent recruitment.

Most of TSMC's shares are owned by American investors, and currently foreign investors account for more than 80% of TSMC's shares [11]. This will affect the autonomy of enterprises to some extent, especially in the context of tense international economic and trade relations. Enterprises may be unable to make the most favourable decisions for their development due to political factors.

There are also many opportunities in TSMC's development, the government's policy support, direct investment and good business environment are all driving forces for TSMC's rapid development. In the rise of Taiwan chip industry, the role of government funds should not be underestimated. In the early days of TSMC, the Taiwan government established Taiwan Hsinchu Science and Technology Park, which was a greenhouse for industrial nurturing, and established the National Development Fund of the Executive Yuan to guide private investment. The government also cooperates with established foreign companies to actively introduce technology and promote studying abroad.

When TSMC was founded, the National Development Fund of the Executive Yuan of Taiwan authorities was the largest shareholder, which laid a solid foundation for TSMC's development. After the successful development of the industry, the timely withdrawal of government funds gave the industry confidence to invest in the real industry[5].

TSMC faces many threats as it grows. TSMC is facing the potential threat of data extortion in its development. At the same time, the rapid development of enterprises in the same industry also brings it great pressure. The United States was trying to regain the initiative in the semiconductor industry by forcing major chip companies to submit commercial data and invoking laws such as the Defense Production Act. As Samsung, the world's second largest contract chip manufacturer, gave in, TSMC changed its original toughness and provided supply chain information data to the US Department of Commerce [11]. If the US has these data, it has all its cards in hand, which makes IT likely that TSMC will lose its bargaining power with the US from now on.

In recent years, South Korea's Samsung has been able to grab orders from TSMC's big customers qualcomm, programmable logic chip manufacturer Celins and so on due to the rapid growth of its foundry business. Samsung is also trying to make its key technologies the industry standard, gradually jamming the semiconductor equipment supply chain into an irreplaceable lead that threatens TSMC's position in the semiconductor industry and its global market share.

### *3.2. The impact of TSMC's development on Taiwan's economy*

The regional GDP is disclosed by the Taiwan authorities.(The monetary unit is the new Taiwan dollar) Since the added value measured by GDP is similar to the gross profit margin of enterprises, in order to reflect the development and change of TSMC in Taiwan's economy, it is approximately fitted with the ratio: TSMC net income / GDP accounting.

**Table 2.** TSMC revenue change data (billion NT$)

| Fiscal Year | TSMC | | Taiwan |
|---|---|---|---|
| | Consolidated Revenue | Net Income | |
| 1994 | 193.4 | 84.7 | 66739.39 |
| 1997 | 439 | 179 | 86101.39 |
| 2000 | 1662 | 651 | 100320 |
| 2003 | 2019 | 472 | 105195.7 |
| 2006 | 3174 | 1270 | 119176 |
| 2009 | 2957 | 892 | 125273.9 |
| 2012 | 5062 | 1661 | 140350.3 |
| 2015 | 8435 | 3065 | 167062 |
| 2018 | 10314 | 3511 | 177737 |
| 2021 | 15874 | 5965 | 216493 |

Source: TSMC annual reports [12]

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It can be seen from the Table 2 that in addition to the decline in revenue at the beginning of the 21st century, TSMC's revenue has been on the rise, and after 18 years, due to the progress of chip manufacturing technology, the revenue has increased rapidly.

It can also be found that the GDP growth of TSMC and Taiwan is synchronous.

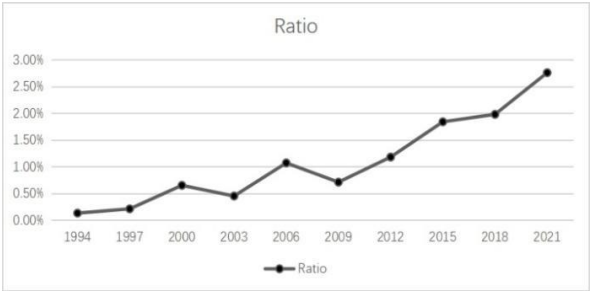


**Figure 1.** Ratio (TSMC net income / GDP accounting.)

The data of line chart is from Table 2. It can be seen from the figure that the proportion of TSMC has increased significantly after 2009. By 2021, the revenue of TSMC alone is about 3% of the GDP of Taiwan, which means TSMC has become the mainstay of Taiwan's economy.

Public data shows that the pattern of the global chip foundry industry has basically remained stable. TSMC is the world's largest wafer foundry enterprise, accounting for more than 50% of the world's first market share. Samsung ranks second with a share of less than 20%, while SMIC ranks fifth in the world with a share of about 5%.

## 4. ECONOMIC IMPACT

### *4.1. How TSMC promotes Taiwan's economy*

#### *4.1.1. Technology monopoly promotes enterprise revenue*

Firstly, focus on the core technology of TSMC. As the world's largest chip foundry, TSMC undoubtedly occupies a global leading position in the field of chip foundry.

TSMC has 37,000 core patents in the semiconductor field, ranking first in the United States. In 2020, 58% of TSMC's revenue comes from chip manufacturing in 16 nm and below processes. In addition, TSMC also actively promotes the research and development of semiconductor materials and advanced packaging technology, which complement each other with its process technology advantages[5].

TSMC has begun to break through the 3-nanometer process [13]. At the same time, SMIC has just realized the mass production of 14nm and started the development of 7nm process.

In short, TSMC has mastered the world's most advanced five nanometer process technology and continues to lead its peers.

For TSMC, advanced chip manufacturing technology and sincere cooperation with ASMC in the Netherlands have formed. This will bring many technological monopoly advantages to TSMC.

Technological monopoly produces core competitiveness. TSMC is currently the only chip foundry that can produce advanced 5nm process chips, and ASML is the only manufacturer in the world that can produce EUV lithography machines. ASML and TSMC signed various agreements to ensure that TSMC can obtain the supply of EUV lithography machines from ASML at the first time, which makes the technical barrier higher and forms an insurmountable mountain in front of competitors [13].

Technological monopoly keeps orders growing. Both the A15 chip launched by apple in 2021 and the M1 series chip equipped with the new generation MacBook Pro adopt the new and improved 5nm process of TSMC. At present, all countries are negotiating the output distribution of TSMC to ensure the supply of automotive chips for domestic auto enterprises; It can be said that TSMC's technology monopoly has even risen to the focus of the global geopolitical game. The continuous and even excess chip orders have brought a steady stream of revenue to TSMC and the whole of Taiwan.

#### *4.1.2. TSMC paid approximately NT$50 billion in taxes in 2021*

**Table 3.** Taiwan tax revenue and TSMC tax payments for the past three years

| | 2019 | 2020 | 2021 |
|---|---|---|---|
| Tax revenue (NT$ trillion) | 2.45 | 2.38 | 2.85 |
| Income tax on profit-making businesses (NT$ billion) | 645.3 | 474.8 | 69.85 |
| TSMC tax payments (NT$)* | 35 | 30 | 50 |
| TSMC tax payments as a proportion of income tax for profit-making businesses (%) | 5.4 | 6.3 | 7.1 |
| Operating income of TSMC (NT$ trillion) | 1.07 | 1.34 | 1.59 |

Note: *represents an approximate number

According to the above Table 3, it can be seen that TSMC paid approximately NT$30 billion in taxes from 2019 to 2020, which increased dramatically to nearly NT$50 billion in 2021.

Due to the impact of COVID-19 epidemic in 2020, the overall tax revenue in Taiwan experienced some fluctuations. In 2021, the overall tax revenue in Taiwan realized an increase and achieved the highest value in recent years. In contrast to TSMC, it still maintained a high level of tax payments and made a significant contribution to Taiwan's tax revenue, despite the negative impact of COVID-19 epidemic. It shows that TSMC is becoming an increasingly important part of Taiwanese finances.

A major reason for the increase in tax revenues in Taiwan is that Taiwanese companies are generally more profitable. Among them, TSMC performed exceptionally well. As can be seen from the data in the above table, the overall trend in TSMC's operating income from 2018 to 2021 is increasing, and the growth rate is progressively greater. This indicates that TSMC is a highly profitable company that ensures a certain amount of tax revenue for the Taiwanese government, thus promoting the stable development of the entire Taiwanese economy.

#### *4.1.3. TSMC planned to recruit nearly 9,000 new employees in 2021*

**Table 4.** Employee sector composition in Taiwan

| | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|
| Agriculture, forestry, fishing and livestock(%) | 5.0 | 4.9 | 4.9 | 4.9 | 4.9 |
| Industry(%) | 36.0 | 35.9 | 35.8 | 35.7 | 35.6 |
| Service(%) | 59.0 | 59.2 | 59.3 | 59.4 | 59.6 |

According to the about Table 4, the industry composition of Taiwanese employees has remained basically stable from 2015 to 2019. Manufacturing taking up the largest share of industry at 27%. Among the share of manufacturing, semiconductor manufacturing dominates. With TSMC as its representative, the semiconductor manufacturing industry contributes a large number of jobs to the labour force and increases the employment rate in Taiwan.

TSMC offers an extensive range of products, and a major feature of the chip industry is the rapid renewal. As the demand in the semiconductor market increased in March 2021, TSMC announced that it planned to expand its recruitment scale and expected to hire a historic record number of approximately 9,000 new employees. In contrast, TSMC Chairman Liu Deyin said in an interview six months ago that TSMC would expand its recruitment to 8,000. It appears that 8,000 people will not be able to sustain TSMC's rapid growth, while TSMC's expanded recruitment plan provides a large number of jobs for young people in Taiwan.

### *4.2. TSMC's impact on the global economy*

TSMC dominates the global chip market amid a shortage of chips and fierce competition from new technologies. At every point of the new process technology, TSMC dominates. It has almost 90% of the market share in the latest advanced technology, which is unmatched by any other semiconductor company.

TSMC raised its capital investment forecast to $25 billion to $28 billion in 2021, far ahead of Intel and Samsung. Currently, the most advanced chip in the world is 5nm. In recent years, TSMC has built a 3nm chip factory in Tainan and is expected to start mass production of 3nm chips from this year. It is undoubtedly occupying the forefront of new technology.

TSMC has a diversified product portfolio. In 2020, TSMC had produced 11,617 different products for 510 customers by offering 281 advanced process, special process and advanced package technologies, among which 5nm chips are already in mass production. The N5 and N4P processes in the 5nm product were a big leap forward compared to previous products. Outstanding among the diversified products, of course, there are 3nm products to be released in 2021, which also contributes to the diversification of the world's chip products.

Although TSMC has diversified products, it is obvious that its advanced production technology has made greater contributions to the development of the world chip industry. At each node of the new process technology, the dominant position is taken. To some extent, each technological innovation of TSMC represents the progress of the world's chip manufacturing technology.

## 5. IMPLICATION OF ANALYZING TSMC

### *5.1. Development status of chip manufacturing industry in mainland China*

Although China's chip industry has made great progress with the policy support and talent introduction from the mainland, due to the late start of China's chip industry, there is still a big gap with TSMC and Samsung in core technology. Based on the objective facts, the chip manufacturing field in the mainland can not pose a threat to TSMC in the short term. At present, low-end chips are basically self-sufficient, such as those in PC motherboard, set-top box, router, network card, security monitoring, audio, led and other fields. However, digital chips such as processor, controller, memory, logic chip and analog chips such as amplifier basically rely on import [14]. In addition, the market concentration of China's chip industry is low, there is a lack of leading enterprises in the field of manufacturing and design, and leading enterprises in key equipment and materials need to be cultivated urgently.

### *5.2. The key to rapid development is the industry support policies from the government*

The main reason why TSMC was able to get off to a smooth start in its early years and develop rapidly was the series of financial and technological support policies formulated by the Taiwanese authorities. In regard to financial support, TSMC was established in 1987 with US$100 million from the "National Development Fund of the Executive Yuan", which accounted for 48.3% of

the shares. The government contributed nearly half of the equity, which directly solved TSMC's initial funding problem and demonstrated the Taiwanese authorities' strong support for the high-tech industry, thereby establishing the foundation for its rapid development. Through the use of tax incentives, TSMC has invested a large amount of funds into product development, thus owning the most advanced 7nm process technology in the world and also becoming the first professional foundry in the world to provide 7nm foundry services.

### *5.3. Overcome technology monopoly by talent introduction*

As the semiconductor industry in China develops, the talent gap will continue to expand. By 2020, the integrated circuit industry in mainland China faced a talent shortage of 320,000. The shortage of talent can lead to problems such as lagging product development and delayed product production. If mainland wants to overcome its technological monopoly and occupy a place in the global chip industry, it is necessary to strengthen the introduction of talents. TSMC values the recruitment and cultivation of top talent. By the end of 2020, TSMC had 56,831 employees worldwide, which consisted of 38,456 supervisors, professionals and assistants, and 18,375 line technicians. More than 80% of all supervisors and professionals hold a master's degree or higher. Currently, TSMC is also facing the problem of talent drain. In order to keep its core technicians, TSMC has also adopted some salary increase policies. In 2021, TSMC embarked on the most significant structural salary increase ever, with a base salary increase of approximately 20% for employees excluding dividends, in order to facilitate talent retention.

## 6. CONCLUSION

The financial analysis, technical analysis and industrial chain analysis of TSMC show that it has played a vital role in promoting the field of chip manufacturing. Its concept of separating chip manufacturing and design has had a far-reaching impact on the chip industry, and has successfully become the driver of Taiwan's economic development.

In this paper, we find that the success of TSMC is the result of the joint action of the government, enterprises and talents. In the short term, it is hard to surpass chip manufacturers such as TSMC and Samsung. However, we can make efforts in product diversity and differentiation to meet the needs of customized chip manufacturing with low process technical requirements. As well as some low-end mobile phone and automobile chips, so as to improve revenue. In the long run, the government needs to formulate practical personnel training and introduction policies, focus on the global chip industry chain structure, and layout the development of the chip industry. At the same time, we should give more financial support to plant construction and equipment introduction, encourage the development of surrounding enterprises, encourage TSMC, Samsung and other enterprises to build factories in the mainland, encourage the development of new energy vehicles and high-end mobile phone industry to stimulate demand, encourage downstream enterprises of large industrial chain such as Huawei to establish close cooperation with chip manufacturing enterprises such as SMIC, and recognize the huge gap between us and world leading enterprises, We must not be eager for quick success and instant benefits. We should effectively promote the rise of the chip industry.

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