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TSMC: A PEST Analysis of Semiconductor Market

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Abstract

With the advent of the pandemic and the outbreak of individuality in inter-state politics, semiconductors, products that have become widely used by high-tech companies, have led to an increase in worldwide demand. But growing nationalism has led nations not to cooperate on the successful joint and equitable growth of these innovative technologies. This research analyses through a PEST analysis the political, economic, social and technological consequence of these choices for the largest semiconductor company, TSMC. The results show how, to date, the international chessboard poses four choices facing TSMC's future, each based on how nations will approach future collaborative choices.

Key words

TSMC, PEST, International Relations, Market conflicts.

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1. Introduction

The semiconductor market has undergone strong fluctuations and instabilities during the pandemic. The introduction of new medical and non-medical devices requiring such technology has not only increased dramatically, but has, as a result, created a significant increase in international demand. However, the supply in the markets for such products is not able, to date, to meet the demand. The consequence of this has been a new 'arms race' on the part of the major international powers to open up new investments in high-tech infrastructures for the production of semiconductors, but the great mistrust that the pandemic has brought with it and the individualisation of each state's national policies to defend its own population from the others has led nations to nationalise their policies for investment

in these products. This study aims, through a PEST analysis, to understand how international attitudes and understand how nations will turn their gaze towards TSMC, the Taiwanese semiconductor company that holds 57% of the global market to date. In the need, therefore, to understand how Political, Economic, Social, and Technological dynamics will influence TSMC's approach internationally in shaping its expectations in the market, the following study will consider not only TSMC and consequently Taiwan, with its delicate political relationship with China, but also the international behaviour of the United States, the European Union, and India, the first two markets developing towards these new technologies, while the last, India, a country that has understood the great importance in developing this technology in its own territory for national and international interests.

2. Methodology

This research uses the PEST approach as a method of analysis. This methodology was considered to be the most suitable for carrying out the research as it is able to offer a general overview that includes all the information essential for understanding the behaviour of a subject on several fronts, namely Political, Economic, Social and Technological. As indicated by T. Sammut-Bonnici & D. Galea (2015), it is seen as a “powerful and widely used tool for understanding strategic risk. It identifies the changes and effects of the external macro-environment on a company’s competitive position.”

3. PEST Analysis

3.1. Political Factors: Taiwan - China - United States - European Union

On the political level it is necessary to consider the following variables:

1. The TSMC – Taiwanese government report;
2. Relations between Taiwan and the People’s Republic of China (or also Cross-Strait relations);
3. Relations between China and the United States;
4. United States - Taiwan relationship.

There are two major political problems for TSMC: the first relating to the possible invasion of Taiwan by the People’s Republic of China, and on the other the conflict over trade tariffs between China and the United States.

3.1.1. People’s Republic of China

On the first point, it should be noted that the current President of China, Xi Jinping, has decided to embark on an uncompromising path with Taiwan, with the aim of national unification of the «two Chinas», as it is considered «inevitable» (Dickey, 2019; To, 1989). The situation is also accentuated by the constitutional reform conducted by the National People’s Assembly of the PRC on 11 March 2018 which abolished the limit to two presidential terms, making the current president of Beijing re-eligible for life (always with the consent of the Congress) and consequently decreeing the concrete possibility of a political continuity of the «hard fist» by Beijing towards Taipei (BBC, 2018). This condition could have serious negative repercussions on TSMC as the company holds two of its foreign subsidiaries in China, Shanghai and Nanjing (Hao, Bu, 2022), and in July 2021 the company decided, after obtaining the

consent from the Commission for investment of the Taiwan Ministry of Economic Affairs, to undertake a 2.89 billion dollar investment in China for the expansion of production of the plant in the city of Nanjing. The consequence of this is that the Chinese state could endanger the investments in place in the country, also due to the particular relationship between TSMC and the Taiwanese government, as demonstrated by the representation within the TSMC Board with the figure of Mr. Ming-Hsin Kung, minister of the National Development Council (NDC) and minister without portfolio since 2019 (TSMC, 2021).

3.1.2. United States

On the second point, the current political and trade tensions between the US and the PRC have affected not only products, which have seen prices rise, but also companies in various sectors, particularly manufacturing and technology. The US has threatened to extend Huawei’s sanctions to its non-US chip suppliers, which is a risk considering that Huawei is currently TSMC’s second largest customer. As TSMC relies heavily on the US market, these sanctions could lead to potential losses (Momoko, 2020).

On the other hand, however, the trade conflict has created new opportunities for TSMC, as the trade sanctions against China have challenged the import/export market between the PRC and the US (Cigna et al., 2020; Fajgelbaum, Khandelwal, 2021), resulting in many sectors, including semiconductors, where the US and other advanced industrial economies no longer fully trust the supply of high-tech products and services from the PRC. The coronavirus pandemic has only exacerbated this growing distrust. For example, for the pharmaceutical and biomedical industries, a bipartisan group of US senators has called for measures to reduce US dependence on products, medicines and ingredients from the PRC (Warren et al., 2019). The implication of this is that this growing mistrust means, at the very least, that the US government and many US-based companies will look to diversify their supply chains over the next three to five years to reduce dependence on Chinese supply and with a subsequent wider resonance as other governments (Feigenbaum, Nelson, 2021), especially in Western Europe and Japan, consider whether to follow suit. Confirming this, the US has approved a \$52 billion semiconductor manufacturing investment plan for the next 10 years (Xinhua, 2021), with the US willing to create an ‘onshore’ supply

chain to decrease foreign dependence on chips, and foreign semiconductor companies, such as TSMC, have been excluded from the funding (Cheng, Lauly, 2021), leading to the need for the company, in order to remain competitive in the US market, to triple its investments, as happened in Arizona, where TSMC is currently building a \$12 billion chip plant. TSMC could build up to six plants in the area, some of which could use its most advanced technology (SCMP, 2021). The decision to fund these new hubs in the US is closely linked to the military support extended by Washington to Taipei. Taiwan also hopes that such moves will translate into greater support for its efforts in other areas, such as a presence at the World Health Organisation (WHO) (Laskar, 2021).

3.1.3. European Union

TSMC seems to envisage a possible investment in Germany, the Czech Republic, Slovakia and Lithuania. However, in addition to sporadic meetings with EU delegates, this investment does not seem to take shape yet, also due to the unclear diplomatic relationship between Taiwan and the countries of the European Union (Johansson, 2021). Furthermore, the possible frictions for industrial and technological interests between European nations could interrupt this path of modernization of the European technological infrastructure. TSMC President Mark Liu himself called the European plan «unrealistic» during a speech at TSMC, adding that it would lead to a great deal of «unprofitable capacity» (Gooding, 2021).

3.1.4. India

TSMC is also in contact with the Indian state for the opening of a hub in the area. This project seems to be interesting and possible, both for the possibility of India and Taiwan to create a free trade agreement (regional FTA) (Laskar, 2021), and for the presence of a rapidly growing Indian local technological infrastructure that could support and facilitate the opening of the new headquarters (thanks to ten-year government investments) (India Today, 2021), and also for the good diplomatic relations between Taiwan and India.

Furthermore, the tax burden on Chinese companies due to the tariff war with the United States has prompted many companies to relocate production sites out of China, to India and other Southeast Asian nations, making these nations increasingly attractive to do business (Xie, 2019).

Susana Hashmi, of the Institute of International Relations at National Chengchi University in Taipei, said the advancement of economic ties falls within the framework of unofficial relations between India and Taiwan

3.2. Economic Factors

The economic crisis unleashed by the COVID-19 pandemic has positively influenced the global demand for semiconductors leading to a significant increase not seen since 2010 (WSTS, 2021). The Semiconductor Industry Association (SIA) announced in December 2021 that worldwide semiconductor sales were \$ 48.8 billion in October 2021, an increase of 24.0% from the October 2020 total of 39.4. billion dollars and 1.1% more than the September 2021 total of 48.3 billion dollars (Chang, 2021) (Fig. 1).

Regionally, year-over-year and month-to-month sales increased across all major regional markets: Americas (29.2% YoY, 2.6% YoY), Europe (27.3%, 2.8%), Japan (23.7%, 1.1%), Asia Pacific / All Others (22.6%, 0.2%) and China (21.1%, 0.3%). Below is the market forecast data from World Semiconductor Trade Statistic (Table 1).

Faced with a rapidly expanding market, TSMC proves to be the market leader with a production equal to 54% of the global total (Platzer et al., 2020). Additionally, it began investing in building a 12-inch wafer fabrication facility in Arizona, which is expected to begin series production in 2024, and has partnered with Sony to build a new manufacturing facility in Japan for 22 and 28-inch chips. nanometers with production starting at the end of 2024 (SONY, 2021).

3.3. Social Factors

For A. Villard et al. (2015), the semiconductor industry will play an increasingly important role for future companies.

As Taiwan's most profitable and high-profile company, TSMC takes social responsibility to strengthen its brand image. For this reason, TSMC has placed a lot of emphasis on employee training and green transition (TSMC, 2020). On human capital, TSMC has invested over 3.4 million dollars in training in 2020 and 3.72 billion dollars (+ 26%) in research and development. On the environmental level, the company has been able to take significant steps ahead of the competition:

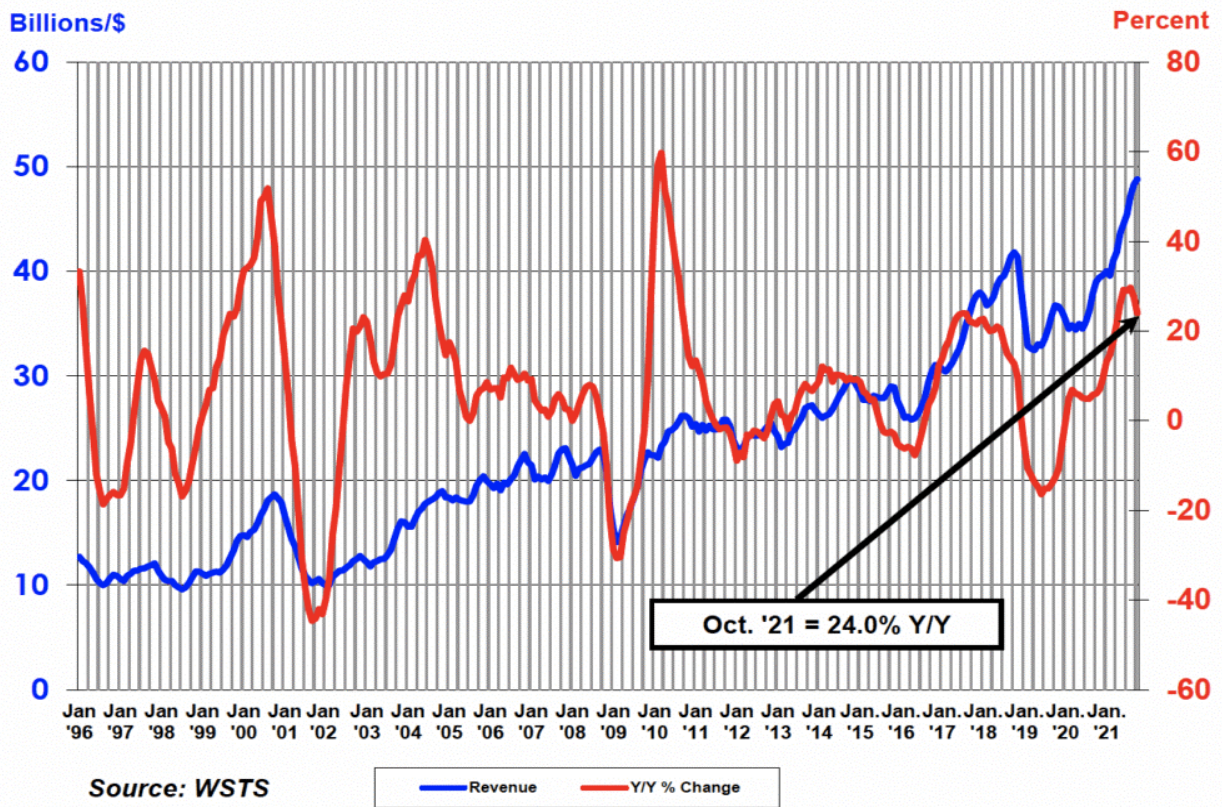


Fig. 1. Worldwide Semiconductor Revenues 2021.
Source: Ravi, 2022.

Tab.1. Numbers in the table are rounded to whole millions of dollars, which may cause totals by region and totals by product group to differ slightly.

| Fall 2021 | Amounts in US \$M | | | Year on Year Growth in % | | |
|-----------------------------|-------------------|----------------|----------------|--------------------------|-------------|------------|
| | 2020 | 2021 | 2022 | 2020 | 2021 | 2022 |
| Americas | 95,366 | 118,835 | 131,084 | 21.3 | 24.6 | 10.3 |
| Europe | 37,520 | 47,126 | 50,467 | -5.8 | 25.6 | 7.1 |
| Japan | 36,471 | 43,581 | 47,621 | 1.3 | 19.5 | 9.3 |
| Asiz Pacific | 271,032 | 343,419 | 372,317 | 5.1 | 26.7 | 8.4 |
| Total World - \$M | 440,389 | 552,961 | 601,490 | 6.8 | 25.6 | 8.8 |
| Discrete Semiconductors | 23,804 | 30,100 | 32,280 | -0.3 | 26.4 | 7.2 |
| Optoelectronics | 40,397 | 43,229 | 45,990 | -2.8 | 7.0 | 6.4 |
| Sensors | 14,962 | 18,791 | 20,913 | 10.7 | 25.6 | 11.3 |
| Integrated Circuits | 361,226 | 460,841 | 502,37 | 8.4 | 27.6 | 9.0 |
| Analog | 55,658 | 72,842 | 79,249 | 3.2 | 30.9 | 8.8 |
| Micro | 69,678 | 79,102 | 83,980 | 4.9 | 13.5 | 6.2 |
| Logoc | 118,408 | 150,736 | 167,396 | 11.1 | 27.3 | 11.1 |
| Memory | 117,482 | 158,161 | 171,682 | 10.4 | 34.6 | 8.5 |
| Total Products - \$M | 440,389 | 552,961 | 601,490 | 6.8 | 25.6 | 8.8 |

Source: WSTS, 2021.

- Built the world’s first water recovery plant for industrial effluents (Shilov, 2021);
- It was the first semiconductor company in the world to join RE100;
- Achieved 100% renewable energy consumption in TSMC offices in Taiwan and overseas, and net zero emissions for global offices through carbon credits;
- It achieved the 95% waste recycling rate for six consecutive years and only <1% of the waste was sent to landfill for 11 consecutive years.

These policies have ensured that the company has reduced its emissions of air pollutants per unit of product by 46% since 2015, reaching the SDG

2030 earlier than expected and demonstrating how a successful environmental policy can also be conducted by a company with strong social and market responsibility (TSMC, 2020).

3.4. Technological Factors

As the most advanced foundry in the world, TSMC focuses more than half of its production (in terms of revenue) on the most advanced nodes, such as 5nm and 7nm (Tan, 2022) (Fig. 2).

In particular, given the particular demand for 5nm models for iPhones and laptops by Apple,

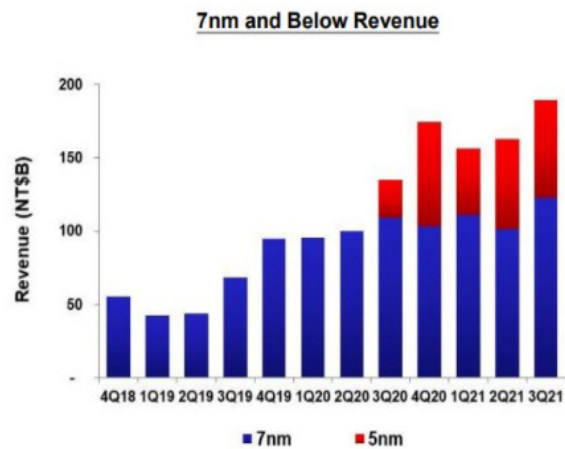
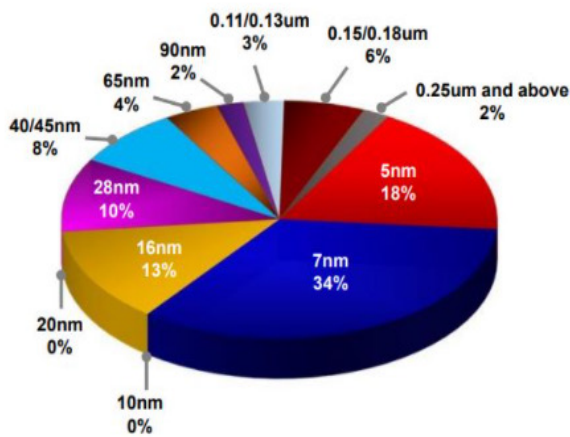


Fig. 2. On the left, market share required by production process; right, billed for semiconductor manufacturing processes of 7nm and beyond. Source: TSMC Q3, 2022.

the largest buyer of chips for TSMC, the latter has decided to focus more and more on this model (Nuttall, 2020). Furthermore, given the market demands, investments in research and development are aimed at the construction of advanced 4 and 3 nm chips (James, 2020; Wang, 2021).

4. Motivations behind the combination of the factors examined

It is believed that these factors provide TSMC with a clearer picture of the delicate political and market situation in the semiconductor industry. Particular attention was given to the political situation as the sector, given its importance, is subject to strong politicisation by states, particularly in the Taiwan-China-United States triangle, where the delicate geopolitical relationship has become increasingly unstable in recent times. Taiwan is suffering, on the one hand, from increasing territorial interference by mainland China, which is pushing, as has been pointed out, for a unification it considers «inevitable»; on the other, the United States has realised how

weak the American semiconductor market is and is now pushing for greater autonomy from the market. And while Taiwan is trying to strengthen its relationship with the US by investing, through TSMC, in the construction of new plants for ever more advanced chips, as the US is currently the only country able to balance Chinese power (which is why there is talk of a G2 between the two nations), TSMC is trying to exploit the strong market demand coming from the states for semiconductors in order to create new commercial relationships with international powers that will lead, on the one hand, to greater profits, and on the other, to a greater recognition on the international chessboard of Taipei with new political-commercial relations with powers capable of clashing with China, as demonstrated by the increasingly intense relations with India and European nations for investments in the opening, in these two regions, of hubs for the production of chips and the creation of free trade zones (in particular with India).

5. TSMC: Understanding alternative futures

The four possible futures that are hypothesized are:

5.1. TSMC investment only in the European Union and creation of a commercial agreement (20%)

In this event we see the possibility of TSMC to undertake contractual relations only with the European Union. The result of this possible choice is the diversion of international investments in hubs and production centers in European countries, such as those hypothesized during some official meetings between TSMC and EU delegates, with the aim of achieving a series of strategic objectives both for the company as well as for Taiwan. For the first: the possibility of increasing the production of waffle chips to be placed on the market and thus respond to the growing world demand; the possibility of seeing economic aid in the construction of production centers thanks to community investments estimated at 150 billion euros.

For the second: the possibility of strengthening international relations with new powers belonging to the G20, such as Germany, France and Italy; the possibility of seeing a favorable vote of these in the recognition of Taiwan within the WHO and therefore, consequently, a growth in political alliances contrary to Beijing.

5.2. TSMC investments only in the United States and strengthening of diplomatic relations (25%)

In this scenario, it is believed that TSMC may be willing to divert international investments to the United States. This can happen for multiple reasons both related to TSMC as well as Taiwan.

For the former, investments in the US would have the ability to increase TSMC's power in the regional market, at the expense of competitors such as Intel, and strengthen its leadership in the global market. Furthermore, the need for semiconductors would lead the US government to accept in the coming years an opening to foreign companies to use federal investment funds.

For the second, the strengthening of TSMC would lead to a greater dependence of Washington on the Taiwanese market and the need to defend it more from the increasing attacks of Beijing, with the result of inducing a stronger international alliance on the Pacific which, thanks to the particular friendship between The US and Japan would also lead this superpower to support the Taiwanese cause against Beijing.

5.3. PRC invasion of Taiwan and transfer of the company to Chinese hands (10%)

In this scenario, it is believed that Mainland China may decide to engage in an armed confrontation with Taiwan to conclude «national unification». This would bring TSMC under the leadership of Beijing and, consequently, its control of the largest semiconductor market in the world.

5.4. Balancing TSMC's investments between the United States, the European Union and India and strengthening the international position. (45%)

In this scenario, TSMC's strategy will be focused on a fragmented investment between several world regions: United States, EU and India. This decision would have strong international repercussions for TSMC and Taiwan, as:

For the first, it would mean the control of the regional markets of the largest powers capable of investing in semiconductors; the ability to stop the creation of future competitors that could arise from government investments, again in these regions; the possibility of expanding production centers in more locations and consequently increasing Research and Development thanks to new local minds (R&D).

For the second, this would mean expanding commercial relations with almost all of the major international powers and the possibility of lobbying for greater recognition in international institutions and diplomatic agreements.

6. Conclusion

TSMC's strategic choice is closely linked to the political decisions taken by the Taipei government. This implies that TSMC will have a strong subjection in its international manoeuvres, which may change suddenly as the global geopolitical changes vary. As a result of this, it is believed that the company should undertake an international strategic policy that has as its perspective the opening of new foreign offices that give the greatest political impact at the regional level. Influencing markets such as India and the EU, which are among the most important in the world, would result in the possibility of stemming Beijing's interventionist policy.

For this reason, the choice of which strategic line TSMC will have to undertake in the future will have a serious impact not only on international semiconductor supply chains, but will have a strong

political impact on Taiwan and the power of the People's Republic of China that TSMC cannot do not consider and face.

The chances of Event n.3 (Invasion of Taiwan) happening are minimal. Given the need for the United States to prevent China from increasing its economic and productive strength, the former will protect the island in every way from any Chinese war intervention.

The possibility that Event n.1 will take place is given at 20% as the agreements between TSMC and the EU have stalled and, having arrived in January 2022, did not lead to the hoped-for novelties.

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