The 2022 International Conference on Financial Technology and Business Analysis
DOI: 10.54254/2754-1169/6/20220194

Semiconductor Industry Corporate Analysis

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Abstract: The research target is to better understand the model and market for the semiconductor industry, in order to improve the efficiency and maximize the return of the investment and career development strategy. From the objective point of view, this research first introduces the technical knowledge and application of semiconductor electronics which lead to the importance of semiconductor research and production. It then states the current situation and challenge of the semiconductor industry, referring to several examples and convincing data to emphasize the theme. After that, it provides several approaches and strategies to analyze the investment in semiconductor industry to come with industry investment suggestions. The industry was overall a valuable opportunity for investors and technology scholars which could also promote human civilization.The main goal of this research paper is to provide a brief and general understansing of semiconductor business model and investment strategy for non-professional.

Keywords: Semiconductor, Investment, Market, Corporate

1. Introduction

Semiconductor is certainly a modern marvel, a triumph of human creativity and engineering unequaled by any other industry[1]. Over the past decades, semiconductors are playing major roles in many aspects of people's lives. It involves voracious industries from the consumer market to military defense systems. Semiconductors also see a potential for health, social, and environmental impacts. Despite the limitations theorized from Moore's laws, engineers and scientists have reached several breakthroughs, giving the sector possibilities of evolving for another forty years. Semiconductors can conduct or insulate depending on their environment. Temperature, light, electric currents, and electric fields affect semiconductors. Valence electrons determine elemental semiconductor conductivity[2].Because of this distinctive quality, semiconductors are essential to modern technology.Semiconductors are necessary for integrated circuits, transistors, solar cells, and other computing components. Semiconductor materials affect the computing and electronics supply chain.

2. Analysis

The advancement of semiconductors has had a profound impact on human life. Current modern IT and electric technology are developed based on semiconductor technology. Our computer improves the calculation power and networking because of the development of semiconductors. Computers

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can then be used to significantly improve the efficiency of production and information exchange. Integrated circuits, transistors, solar cells, and other computing components require semiconductors. Semiconductors affect electronics and computing supply chains[3]. For instance, semiconductors are utilized to create temperature sensors for air conditioners. Because semiconductors accurately control the temperature, rice cookers produce flawless results. Personal computer CPUs use semiconductors. Smartphones, digital cameras, televisions, washing machines, refrigerators, and LED lights employ semiconductors [3].Semiconductors play a crucial role in consumer electronics such as processors, power management, and memory on mobile devices. The consumer market gives a growing demand for flash memory due to its mobility and reliability to store data even after the device is powered off, a feature that traditional hard drives prove to be impossible to achieve. Based on the report from the US International Trade Commission, due to the rapid growth of portable consumer devices such as phones and laptops, Semiconductor devices have had rapid growth in the IC market share in three years [4]. Semiconductors are essential to the operation of consumer gadgets as well as railways, the internet, communications, and other facets of societal infrastructure, including the medical system used to care for the aged. Additionally, effective logistics systems encourage energy conservation and environmental protection. The number of semiconductor devices put on automobiles has been continually rising. Car-mounted semiconductors come in a variety of varieties. More semiconductors are anticipated to be used, particularly for ADAS (Advanced Driver Assistance Systems) in the future[5]. In 2022, Logic, Analog, and Sensors are predicted to rise by 24.1 percent, 21.9 percent, and 16.6 percent, respectively, according to WSTS. Based on the enormous practicality, the business market for semiconductors has grown quickly. The worst predicted sector, optoelectronics, is anticipated to be nearly flat (+0.2%) year over year[6].All regions should grow in 2022. Asia Pacific will rise 10.5%. Europe will grow 14.0%, Japan 14.2%, and the Americas 23.5 percent. The global semiconductor industry is anticipated to increase by 4.6 percent to US$ 662 billion by 2023, with growth in practically all categories expected to be in the mid-single digits. According to the most recent prediction, the Logic category will account for almost 30% of the market and exceed $200 billion in US dollars in 2023[6].

Foreseeing the huge impact and importance of semiconductor design and manufacture industry, many capitals and governments invest huge amounts of funds into the semiconductor industry, unfortunately, the return rate of most of their investment turned out to be very low. The Deloitte analysis states that a single chip, which often costs less than a dollar, can prevent the sale of a tens of thousands of dollar device in numerous end markets. The chip scarcity during the previous two years cost the semiconductor industry and its customer industries about US$500 billion in lost income, with lost automobile sales totaling over US$210 billion in 2021[8].Revenues from semiconductors are probably going to follow a trend line over the long term. Even still, as we begin a time of strong secular growth, that trend line appears steeper than ever. To understand the reason and the risk of investing in the semiconductor industry as well as to analyze the companies, investors need to understand the business model of the semiconductor company. Current Semiconductor chip industry has two main business models: IDM(Integrated Device Manufacturer) and Vertical Division.

IDM (Integrated Device Manufacturer) model: semiconductor companies that do everything from design to manufacturing, packaging and testing, and sales of its own brand ICs, are known as IDM companies, such as Intel and Texas Instruments.

Vertical division mode: some semiconductor companies only do IC design and do not have a chip processing factory (Fab), which is usually called Fabless, such as Huawei, ARM, NVIDIA, and Qualcomm. In addition, there are also companies that only do foundry, not design, called Foundry, representing companies such as TSMC[9].

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According to the two business models above, existing semiconductor companies can be divided into four forms: IDM, Foundry, Fabless and Fab-lite.In order to reduce the cost of operation, research and development, most enterprises are now trying to transform to the IDM model, because producing semiconductors requires a significant investment and has a high sunk cost. Especially with the evolution of the process, the investment cost is even higher. In order to achieve breakeven, the sales volume needs to be higher and higher, and the operational risk is also increasing. For example, the investment of a 28nm process integrated circuit production line is about 5 billion dollars, the 20nm process production line could be as high as 10 billion dollars, and the investment amount of the 7nm process is more than 10 billion dollars. [7]Once the two parameters of the wafer manufacturing line's process and silicon wafer size are determined, they generally cannot be changed, because if it is to be rebuilt, the investment scale is equivalent to building a new production line. The huge investment and the cost of operation makes such production business risky, not to mention that the annual maintenance and renewal cost of the production device and new technology development cost around 20% of the total investment, limiting small or new companies from development and expansion[8].

Currently, such risky industries become even more vulnerable due to the impact of the COVID pandemic. Many companies as well as the capitals experience financial hardships to operate, the supply chain could not provide enough raw material(silicon chips) for the semiconductor design company.This mismatch caused chip shortages that impacted both previously dependent businesses, such automotive, consumer white goods, and—rather infamously—dog-washing machines, as well as more typical end markets, like data centers and smartphones. And the device needed for production is in short supply, according the the report of ASML(world’s largest and only advanced stepper), they could only supply 55 EUV this year, nearly half of the orders, many companies experience financial crisis because they do not have resource for mass production, therefore there are no profits to maintain the cash flow.Therefore, the semiconductor industry is a field full of risk as well as opportunity because of the huge demand and potential, investors must understand and analyze the market of semiconductor industry in order to generate more profit and minimize the risk. At a general level, investors must understand that the prosperity of a semiconductor is periodic, following the growthing period is essential to maintain profit and lower the risk. For example, Around the 2010s, semiconductor advances due to the booming of smartphones, the second rising period(2017s) was caused by the universal use of 5G technology. Nowadays, the economy continues to grow because of the graphic cards and related technology innovation which is powered by machine learning and AI. Understanding which aspect is leading the current growth and investing in companies of that specific field could maximize the return for the investors. At a specific level, it is needed to analyze each company according to its characteristics. It is essential for investors to know whether the supply chain of a certain company is complete and well functioned, because it determines whether the company’s products have a market and its ability to continue producing to meet the demand. Individual or small capital should focus on the company of the low end market since it could generate return more quickly so investors could get the return easily. High end semiconductor companies require huge amounts of funds for researching and developing, individual investors should be more careful about investing in such companies because they are more vulnerable to risk. The final modeling is also an important tool for investment. Analyzing the company's return on assets is a good proof of the company's performance and expansion. Moreover, when targeting the high end market,whether the company’s products have core competitiveness or cutting edge technology is another standard to judge investment.

Besides, investors must understand that such industry is the field is filled with risk and uncertainty, huge amount of investment is more likely to result in zero return and even deficit, mathematical financial modeling could help predict the market and company performance but

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results are not 100% reliable, therefore taking actions to lower the risk or be less vulnerable to deficit is also a necessary factor of semiconductor invest,separate funds to invest several companies in different areas is the simplest way to reduce risk. However, objectively, such an argument is conclusive and general, detailed analysis and more specific strategies should be performed when investing certain semiconductors in reality, which the future research should focus on. Despite the current challenge facing, investors should still be optimistic towards this industry, the industry is still forecasted to grow rapidly in future decades due to the necessity of the semiconductor in human technologies.

3. Conclusion

All in all, semiconductors will be the most heated market for the next decades, it is an area full of opportunities and risks. Investors and entrepreneurs should be cautious and courageous, understanding the market and technology to make wise decisions. Semiconductors are unrivaled by any other industry as a triumph of engineering and human intellect in the modern world. From a financial investment standpoint, future researchers should develop more strategies and models to better analyze the behavior of semiconductors and quantify the risk and potentials which could be presented to investors transparently to improve and accelerate the process, which could greatly stimulate the semiconductor industry and technology booming.

Fortune will come when promoting the progress of human civilization by technology.

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