



Taiwan Semiconductor Manufacturing Company

Technology, Scientific & Technical Instruments

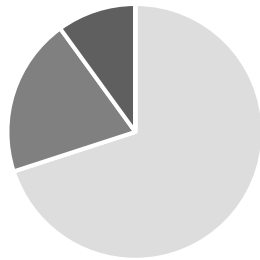
NASDAQ Symbol: TSM

Recommendation: Buy

Covering Analysts: Michael Haffner

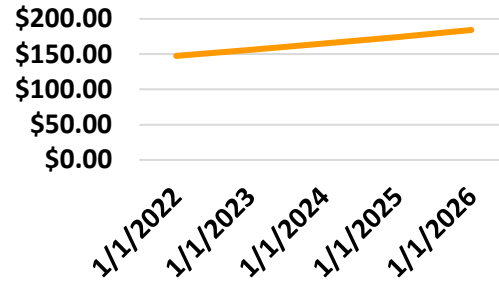
Intrinsic Value:

Valuation



- PGM
- EV/EBITDA
- EV/Sales
- RIM
- DDM
- GGM

Price Target



Capital Structure

Equity	490,649
Debt	1,653.4

CAPM Presumptions

Beta	0.77
Risk Premium	5.23%
Risk-Free Rate	1.7%
Terminal Growth Rate	3%

WACC Presumptions

Cost of Equity	5.7%
Cost of Debt	3.8%
Cost of Capital	6.49%

Intrinsic Value Margin of safety

**\$139.60** **10.4%**

Source: Company Data, Group Estimates

Executive Summary

This equity report provides an analysis and evaluation of the current and future performance of the **Taiwan Semiconductor Manufacturing Company** over a future period of five years. Our methods of analysis include the **discounted cash flows model (DCF)**, **dividend discount model (DDM)**, and **residual income model (RIM)**.

Results of data analyzed show that the company is fundamentally sound. The company generated increasing ROIC 3 years in a row, maintains a robust cash position, and recently announced significant plans to expand production capacity.

Our report finds that the prospects of the company in its current position **are positive**. The primary catalysts for long-term growth include:

- Industry-leading manufacturing techniques
- Strong partnerships with companies such as Apple, AMD, and Nvidia
- Emergence of 5G technology
- Failure of competitors to match capabilities

We feel as though this value accurately represents the fair value per share. We therefore recommend a **buy** for TSMC. We conclude that this company's stock was attractively **undervalued**, with an intrinsic price of **\$139.60**, and a **margin of safety of 10.4%**. Reasons that the market have possibly over-valued this stock include:

- The market has not factored in anticipated revenue growth.
- The market overestimates competitors abilities.
- The market overreacts to predictions regarding Moore's Law.

Key Stock Statistics:

52-Wk Range (\$)	42.70-134.65	Dividend Yield	1.38%	Book Value/Share (mrq)	9.98
Beta	0.91	Diluted EPS (ttm)	2.23	Operating Margin (ttm)	0%
Market Capitalization (\$BN)	\$548.077	P/E (ttm)	56.70	S&P Credit Rating	AA-
Forward Annual Dividend	1.74	P/B (mrq)	9.59	Institutional Ownership	19.09%

Source: Yahoo! Finance

## What are ADRs? Why is TSMC Different from Other Companies?

American Depositary Receipts (ADR) are a form of securities exchange in which a foreign company partners with an American depository bank to issue an ADR certificate share instead of a direct share of said company. The participating bank purchases and holds actual securities from the foreign exchanges. The bank then lists the receipts on US exchanges for US dollars. This provides a vehicle for investors to more easily purchased shares in companies traded on markets overseas, without also having to deal with currency exchange. Furthermore, companies represented by ADRs on US exchanges do not have to undergo the same rigorous process that traditionally accompanies listing and registration with the SEC.

TSMC is partnered with CIT in order to sell shares on the NYSE. Each receipt represents 5 shares of TSMC stock. This exchange accounts for the variation in “shares outstanding” in the workbook.

The ADR classification means financial reporting practices are different compared to most companies pitched for OSIG portfolios. Whereas companies that trade common shares on the US markets must disclose annual and quarterly financial reports through the SEC in the form of 10-K 10-Q filings respectively, ADR companies are only required to report annual documents through a 20-F document. Quarterly results are disclosed on their company page, but are not filed with the SEC. Additionally, these quarterly reports are disclaimed as “unaudited” – Deloitte, TSMC’s auditor, only audits the annual reports. However, the size and reputability of TSMC affords us the benefit of the doubt and means that its usually okay to use this data in our valuation.

- 10-K: 10-K reports are annual reports filed by publicly-listed companies that are traded on US stock exchanges. They are required by the SEC, and must include sections describing: business, risk factors, selected financial data, management discussion and analysis, and comprehensive financial statements. They are more detailed than a company’s annual report – the extra details required by the SEC are to ensure prospective investors have all of the relevant information available when deciding what to invest in.
- 10-Q: These reports are quarterly versions of the 10-K document required by the SEC. They are likewise mandatory for all publicly-traded companies within the US. They include much of the same information as 10-Ks, just on a quarterly level, and include comprehensive financial statements. In place of the fourth quarter 10-Q, the annual 10-K is instead submitted.
- 20-F: The annual reports TSMC submit to the SEC, 20-F reports, are required by foreign private issuers, such as TSMC, that have equity shares, such as ADRs, on US exchanges. The 20-F is essentially an audited version of the company’s annual report, and therefore is not required to include the same level of considerable detail that domestic companies must include in their 10-K. They must include audited records of their annual financials. Deloitte audits TSMC’s annual report/20F. Companies submitting 20-Fs must also release the report to their shareholders via their website, so companies often write their annual report in accordance to these guidelines and submit the same document to serve both purposes. In this, the 20-F serves its primary purpose: standardizing annual reports made by foreign-based companies, to the benefit of the investor.

The ADR classification causes irregularities in the valuation process – these are discussed in further detail later on in the report.

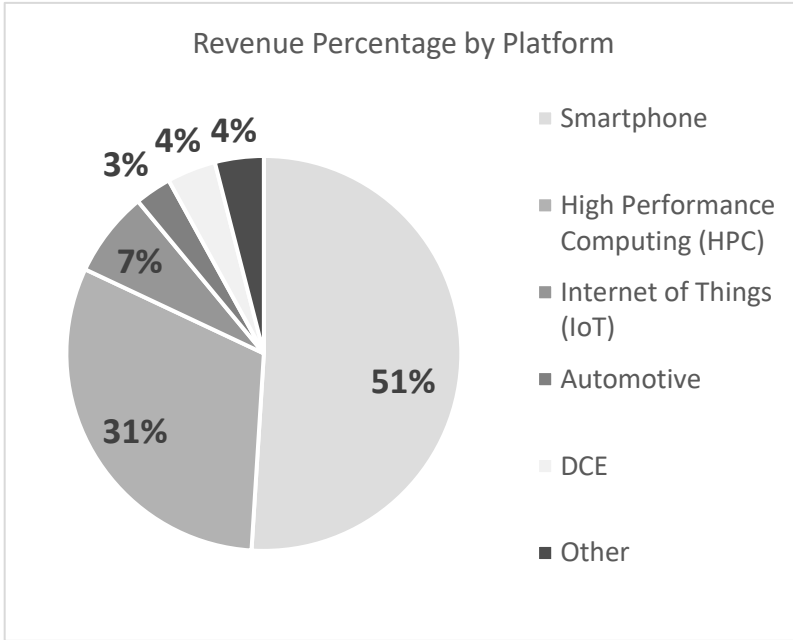
## Business Description

Founded in 1987 and based in HsinChu, Taiwan, the Taiwan Semiconductor Manufacturing Company is an industry leader in the production of Silicon wafers for use in the manufacturing of electronic devices. TSM is the world’s largest semiconductor foundry. They do not manufacture, design, or market their own products, instead operating solely as a manufacturing company for other firms since the company’s inception. This model enables other firms to adopt ‘fabless’ business models. (In example, AMD and Nvidia.) TSMC is considered the first company to adopt this model. They manufacture a wide range of semiconductors of varying sizes from .25um (micrometers) to 5nm (nanometers). These semiconductors are used across the Internet of Things (IoT), as well as in Automotive, DCE, High-Performance Computing (HPC) and Smartphone products, as well as other uses.



## Revenue Drivers

TSMC earns revenue from the fulfillment of customer orders through the manufacturing of semiconductor products across a range of sizes and industries. They do not design, manufacture, or market their own products or hardware and are therefore non-



competitive with customers. They do, however, provide over half of the world's semiconductors, for notable customers such as AMD, Nvidia, Qualcomm and Apple. Following delays in the own manufacturing process, Intel is in conversations with TSMC to outsource some of their manufacturing to Taiwan, although no deals have been made as of yet. An announcement from Intel is expected at the end of January announcing the company's decision moving forward. Furthermore, both Apple and Tesla are working with TSMC to produce chips for self-driving cars.

## Products or Services

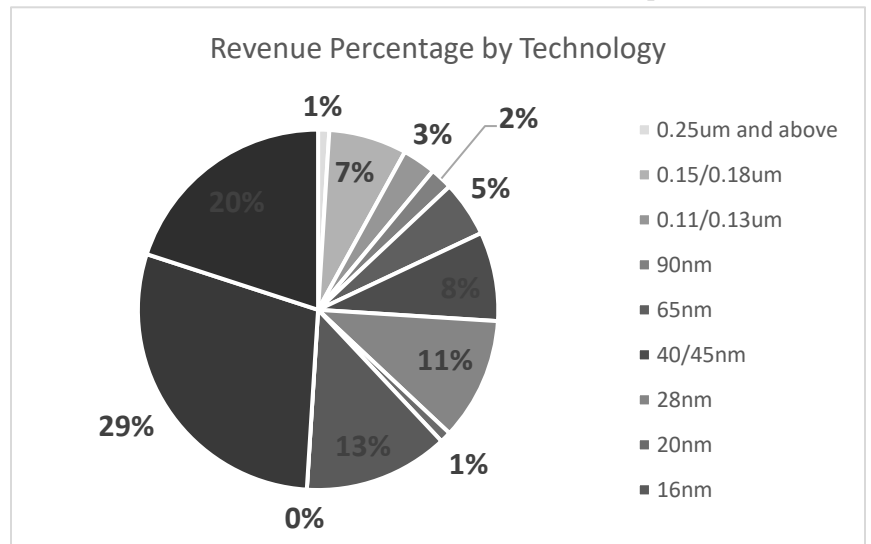
In 2019, TSM manufactured 10,761 different products across 272 technologies for 499 different clients. Revenue can be broken up through two categories: technology, and platform.

The 7nm technology, notably used for AMD's new line of CPUs, is one of TSMC's fastest volume-production technologies. Comparatively, the 5nm FinField-Effect (FinFET) technology offers speed improvements of 15% and a 30% power consumption reduction. A 5nm FinFET Plus variant offers a 20% speed increase with a 40% power consumption reduction. Furthermore, TSMC is conducting research for the commercial development of 3nm, and 2nm chips, expected 2022 and 2023, respectively.

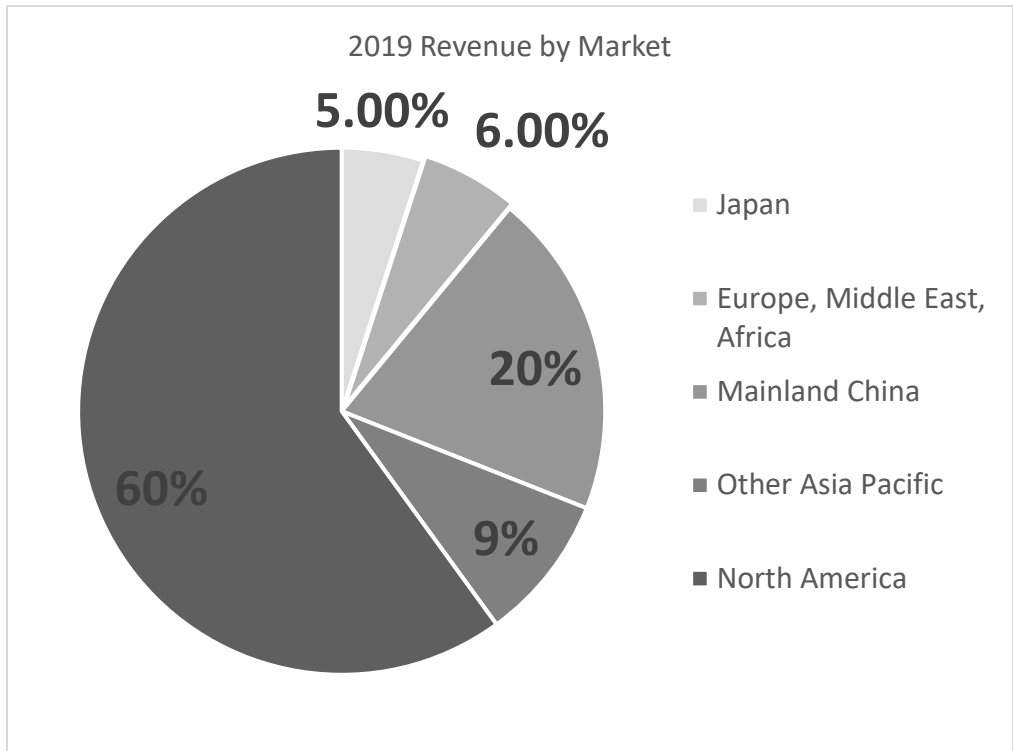
## Cost Drivers

### Research, Development, and Engineering Expenses (RD&E)

In 2019, TSMC's Research and Development costs accounted for roughly 8.5% of their revenue, a number they claim equals or exceeds the R&D investment of competing companies. This considerable investment in R&D reflects the competitive nature of the industry and race to develop smaller transistors under Moore's Law. This law, while currently met by TSMC's products, is becoming continually more difficult for manufacturing companies to achieve as the physical limits of silicon are approached. Although TSMC's 7nm technology is currently their fastest production-volume technology, their 5nm technology completed risk production in 2019. Furthermore, TSMC is currently developing 3nm and 2nm technologies, respectively. These new technologies, in addition to occupying the R&D line-item, are also observed through the substantial Capital Expenditures (CapEx) that TSMC makes each year. Reportedly, Samsung is also working on at 3nm technology, although they are using a GAAFET design, where



TSMC will continue to use FinFET designs. Only TSMC and Intel have announced 2nm technologies, although information is sparse and Intel’s timeframe should be scrutinized due to recent delays in their manufacturing capabilities.



**Selling, General and Administrative Expenses (SG&A)**

Only 2% of revenue comparatively, the General and Administrative expenses for TSMC are relatively consistent over the years. TSMC employs 51,000 people worldwide, and plans for new manufacturing campuses, including one in the United States, could possibly increase this expense.

The nature of the semiconductor manufacturing industry, as well as TSMC’s lack of consumer-oriented products, means that TSMC’s ‘Marketing’ expense is minimal. The need for marketing campaigns is likewise diminished due to TSMC’s dominant position in the

industry, along with their established presence. If you are looking to manufacture semiconductors, you already know about TSMC.

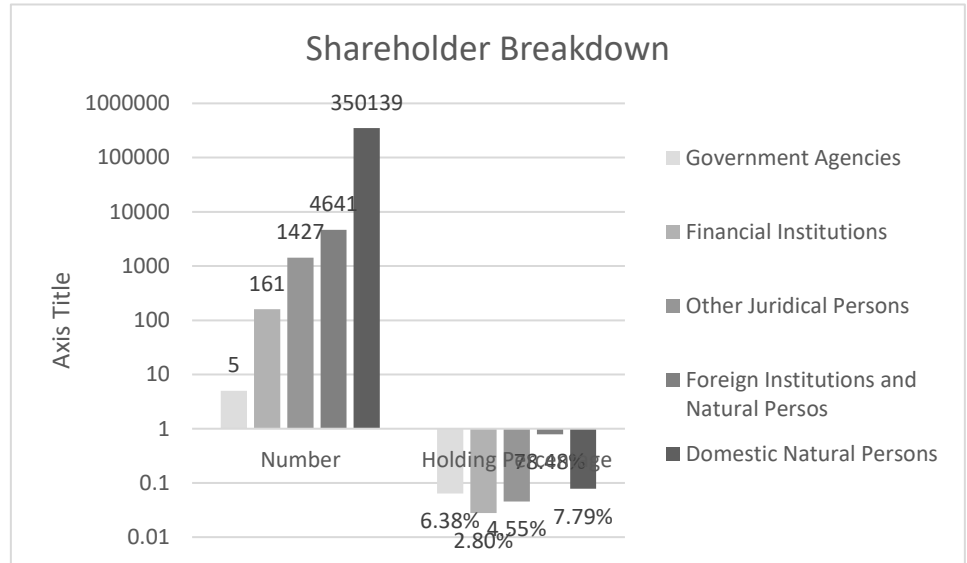
**Cost of Goods (COGS)**

The cost of revenue accounts for TSMC’s largest cost, accounting for approximately 50% of revenue. This reflects the expenses incurred in raw materials, including wafers, chemicals, and gasses. This significant proportion is expected of a manufacturing company and reflects the expensive nature of the technology industry. The MIT Technology Review estimates that the cost of fabrication for these increasingly-advanced chips rises approximately 13% a year, a figure that is realistic compared to TSMC’s financial records.



## Business Strategy

The industry metric for advance semiconductor production, TSMC aims to be the most trusted company and go-to supplier of semiconductor products worldwide. Aside from the extensively-discussed advanced manufacturing capabilities they possess, TSMC also offers a suite of quality assurance, design assistance, and other customer services. These services, while valuable, are being treated as vestigial for the purposes of this valuation. I do not consider them materially important compared to TSMC's manufacturing capabilities or capacities, although it's important to recognize these services as a mark of a mature, highly capable, customer-oriented brand.



TSMC focuses on technological innovation to consistently deliver the most advanced chips with the highest level of quality. They are adamant about remaining non-competitive with their customers, focusing solely on manufacturing technology to realize their customer's designs. They aim to be the trusted provider in the global logic IC industry through technology and capacity, while also remaining competitive with Integrated Device Manufacturing Companies, such as Samsung and Intel. A key aspect of the strategy are the investments TSMC makes in their manufacturing process. While R&D accounts for ~8% of their revenue, Capital Expenditures account for 35%, and hit a staggering \$15 billion dollars in 2019. There are no other foundries that can deliver as advanced chips with the same volume that TSMC can provide.

TSMC has a 18 different fabrication locations.

## Industry Overview

The semiconductor industry is highly cyclical. The rapid technology turnover combined with the number of companies in the industry result in volatile fluctuations over the years as constant advancements in manufacturing technology, as well as chip design, result in company earnings to vary significantly. The rate of technological advancement is demanding and rewards companies who successfully innovate.

99% of transistors manufactured are of MOSFET designed semiconductors. Technological advancements encompass the scalability of MOSFET – competition to reliably produce smaller semiconductors dictates the dominant players in the field. MOSFET is the most widely manufactured device in history. Since 1960, it is estimated that over 13 sextillion ( $1.3 \times 10^{22}$ ) MOSFET transistors have been manufactured. The widespread use of these semiconductors makes this industry the driving force behind the electronics industry as a whole.

Companies in the semiconductor *manufacturing* industry can be classified in three ways: IDM, Pure Play, and Fabless.

- Integrated Device Manufacturing Companies (IDM) manufacture both designs, and hardware. Notable examples include Samsung and Intel.
- Pure Play (also referred to as the 'foundry' model?) companies strictly manufacture products for customers and do not design, manufacture, or market their own products. TSMC is credited as the first company to adopt this model. Other notable examples include Global Foundries, previously a subsidiary to AMD before being rolled out as its own company during AMD's restructuring in 2014.

- Fabless companies do not manufacture their own products. They design their own chips and contract out foundries, such as TSMC and Global Foundries, to manufacture their products. Notable examples are AMD and Nvidia.

## Industry Growth

Current 20 year annual growth rate is 13% In 2019, TSMC experienced a 1.3% YOY revenue increase, compared to the industry's 12% YOY decline. In an April 2019 report regarding the semiconductor industry, Deloitte projected the mean CAGR for the semiconductor industry to be 7.2% over the timeframe from 2017-2022. Deloitte arrived at this projected CAGR by averaging projections of semiconductor sub-categories.

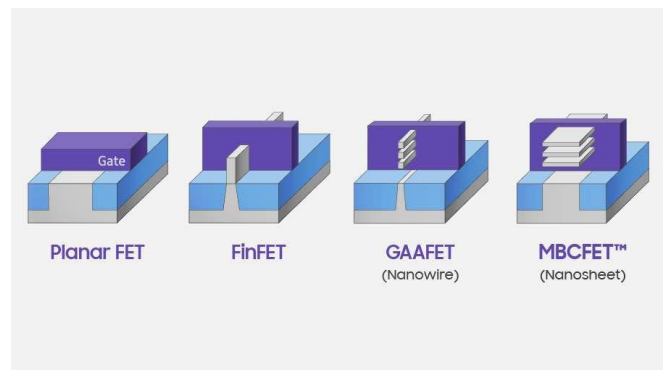
### MOSFET Scaling Timeline:

- |                 |                              |
|-----------------|------------------------------|
| • 10um – 1971   | • 90nm – 2003                |
| • 6um – 1974    | • 65nm – 2005                |
| • 3um – 1977    | • 45nm – 2007                |
| • 1.5 um – 1981 | • 32nm – 2009                |
| • 1um – 1984    | • 22nm – 2012                |
| • 800nm – 1987  | • 14nm – 2014                |
| • 600nm – 1990  | • 10nm – 2016                |
| • 350nm – 1993  | • <b>7nm – 2018</b>          |
| • 250nm – 1996  | • <b>5nm – 2020</b>          |
| • 180nm – 1999  | • <b>3nm – 2022 expected</b> |
| • 130nm – 2001  | • <b>2nm – 2023 expected</b> |

## Industry Disruptors

Changes to the industry come in the form of technological advancements in the scalability of transistors. Due to the widespread use of MOSFET semiconductors and the dependency of the current electronics economy on semiconductors, the need for chips will continue well into the future. How these chips are made – the semiconductor technology used – does strongly affect the industry, however.

The anticipated failure of Moore's Law, should it come to pass, will significantly hamper the rate of technological advancement on a global scale, affecting not just semiconductor manufacturers, but most semiconductor companies in general, including Apple, AMD, Nvidia, Intel, and all others. At the current moment, TSMC's 5nm technology upholds Moore's law. And, despite disagreements in the inevitability around the failure of Moore's Law, TSMC remains wholly optimistic in their ability to adhere to the pace postulated by Gordon Moore. As the physical limits of silicon and behaviors of electrons are pushed, causing difficulties in reliable manufacturing (re: Intel), research and industry experts alike are debating the end of performance improvement by scalability, and are looking for algorithmic approaches to improvements in computing power. Research on quantum computing, carbon nanotube transistors, and other technologies could provide computing advancements without necessarily increasing the number of components on an integrated circuit.



In addition to their recently-approved 5nm process, TSMC, along with Samsung, are working on 3nm processes. TSMC recently released information on this in-progress technology, which is supposed to be ready for volume production in 2022. [citation] Although smaller, and faster than the 5nm architecture, this new 3nm technology illustrates the diminishing returns associated with the death of Moore's Law. The innovation from 5nm to 3nm will theoretically bring with it only a 10%-15% performance increase along with a 25%-30% improvement in power consumption – both improvements, but smaller than the

improvement from 7nm to 5nm, not to mention the developments before that. All of this comes at exponentially higher costs, betraying an interpretive difference between TSMC and Moore's Law doomsday-ers. Furthermore, TSMC is manufacturing their products using FinFET designs, whereas Samsung is using GAAFET. (See image.)

Moore's Law, colloquially attributed to the rate of technological advancement via speed of computing power, energy efficiency, and cost, originally refers to the density of computer chips – that the number of transistors on a chip would double every two years. For much of the +50-year development history since, increasing density was met with considerable advantages in performance and cost... until recently.

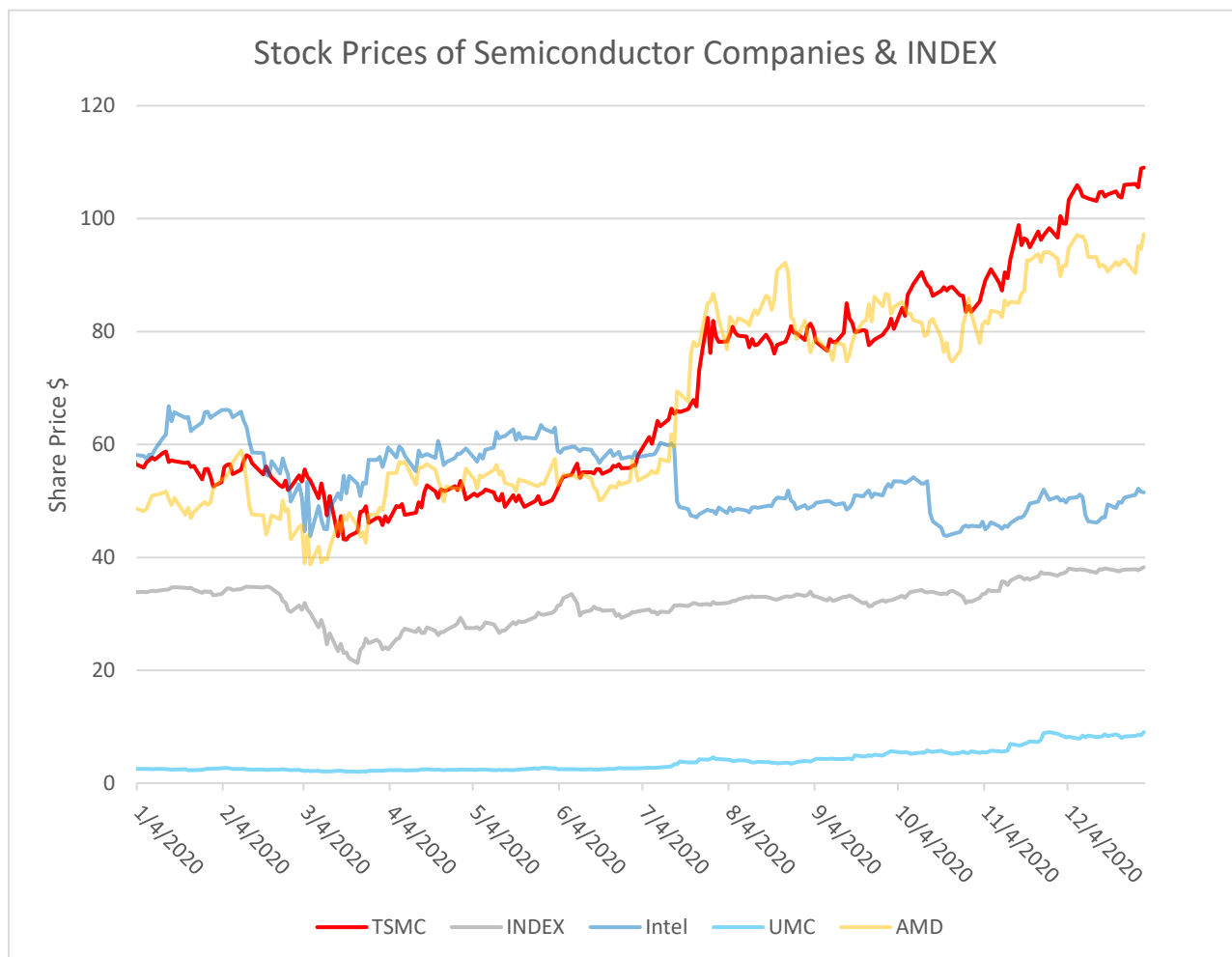
TSMC is actively researching additional technologies, such as carbon nanotubes, high mobility channels, nanosheets & nanowires, to improve the performance of chips. Compared to competitors such as Intel, TSMC is at the cutting edge of R&D in the manufacturing of semiconductors. Because of this, and because of TSMC's progress with 5nm and 3nm technologies, I do not foresee Moore's Law posing a threat to the valuation period calculated for TSMC.

## Market Share

As of 2019, TSMC leads the semiconductor manufacturing industry, maintaining 52% marketshare. [citation] Other notable companies in the semi-conductor industry include Samsung, Intel, SK Hynix, Micron, Broadcom, Global Foundries, and the United Microelectronics Corporation (UMC), among others. Only Global Foundries and UMC are Pure-Play foundry companies. However, Global Foundries is a privately held company, and UMC is considerably smaller. (It is likewise traded on the NYSE, and is therefore included in the relative comparison.) All of TSMC's other competitors are either Fabless - like Apple, AMD, and Nvidia, or IDM companies, - like Intel, Micron, or Samsung. Whereas Fabless companies do not realistically pose a threat to TSMC (and contrarily, can exhibit synergistic behavior with TSMC), IDM companies can threaten TSMC's success. For years, Intel was considered the world's largest semiconductor company. However, since Intel has many other products and sources of revenue, this is not exactly a fair comparison. Additionally, Intel's recent struggles has resulted in Samsung overtaking them in the semiconductor industry. Furthermore, these companies are categorized in a broad 'semiconductor' category, with is used to consider not just the manufacture, but also the design, marketing, and innovation of both semiconductors, and personal computing devices. TSMC's specificity and exclusivity to semiconductor manufacturing leaves them in a niche version of the market.

Global Foundries, a private, direct competitor to TSMC, reported a \$5.5 billion revenue in 2016. They have plans to become publicly-traded in 2022.





## Competitive Analysis

We analyzed TSMC’s competitive positioning by constructing a SWOT analysis and a Porter’s Five Forces model. These allowed us to evaluate the company’s potential for future growth.

### SWOT Analysis

#### Strengths

- Industry Leader
- Advanced manufacturing capabilities leading industry in semiconductor size
- Noncompetitive with customers
- Firmly established in the industry with a trusted, well-known brand.

#### Weaknesses

- Reliant on high RD&E spending to stay competitive
- High technology turnover makes older semiconductors quickly obsolete
- Dependent on requirements of other electronic and semiconductor companies.

#### Opportunities



- Ever expanding technological markets
- Emergence of EV semiconductor sector?
- Future markets for 3nm and 2nm semiconductors
- 5G emerging technology

### Threats

- Loss of revenues due to volatile foreign currency exchange rates
- Volatility of industry

### Porter's Five Forces

Porter's five forces, which provide a framework for industry analysis, were formulated by Michael E. Porter of Harvard Business School in 1979. Following are the five parameters on which we analyzed TSMC, and their position within the semiconductor industry.

#### Rivalry Amongst Sellers | High

While the number of companies in the industry is relatively low, competition between these companies is high. Differentiation in cost and manufacturing capabilities drives customer decisions.

#### Threat of Substitutes | Low

There do not exist realistic substitutes for semiconductors.

#### Pressure from Supplier Bargaining Power | Medium-Low

Suppliers are limited, enough to provide substitutes and prevent any singular company from gouging prices.

#### Threat of New Entrants | Low

This industry has high barriers to entry, involving excessive starting capital to produce results that compete with current market participants. This industry is saturated with intellectual property making it difficult to innovate without a competitive research and development budget. United Microelectronics Corporation (UMC) is the only publicly-traded direct competitor to TSMC. They are likewise a Taiwanese company, the first in Taiwan, and were spun off from a government-sponsored research institute. However, they are much smaller than TSMC, and therefore do not pose a serious threat.

#### Pressure from Buyer Bargaining Power | Medium

While a customer-oriented industry, technological limitations prevent buyers from preference of choice. Large companies can sway the entire industry through massive orders, but are limited by the firms who can manufacture products to desired level of technological advancement. This reinforces TSMC's strength of capabilities – they are consistently and industry leader in the advancement of semiconductor size.

## Financial Analysis

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Our financial analysis involves the use of a DuPont method and other financial ratios. These are especially useful in evaluating a company's ability to deploy, retain, and generate income. TSMC has solid fundamentals that allow the company capacity to innovate safely to maintain a competitive advantage in the semiconductor industry.

### DuPont Analysis

A DuPont analysis involves breaking down ROA, ROE, and ROIC into granular components for detailed analysis. As TSMC is not a financial institution, note that ROE is less relevant than ROIC and ROA in analyzing company performance.

## Return on Assets (ROA)

Return on assets is calculated using the DuPont method, breaking down the calculation into two separate ratios. Profit margin and asset turnover are calculated, and the product is ROA. Overall, TSMC performed well from FY 2015-19. The company had a high ROA of 18.5% for a FY 2016, which decreased ~3% by FY 2019 to 15.7%. Fluctuations in ROA should not be cause for concern given the volatility of the industry.

- **Profit Margin**

Profit margin is calculated as net income divided by total revenues. This indicates the percent of cash remaining after incurring all expenses. TSMC experienced relatively consistent profit margins from FY 2015-19, from 33.1% to 35.2%

## Return on Equity (ROE)

Return on equity (ROE) is calculated utilizing the DuPont method, breaking down the calculation into four separate ratios: debt burden, NOPAT margin, asset turnover, and leverage ratio—the product of these ratios results in ROE. TSMC's ROE consistently decreased from 2015 to 2019, from 25.3% to 21.9% ultimately. As a manufacturing company, ROE is not necessarily a reliable indicator of the company's ability to provide future returns. However, that is not to say that ROE should be discounted. The individual ratios that determine ROE are still useful in analyzing a company's ability to deploy equity to provide returns to shareholders.

## Return on Invested Capital (ROIC)

Return on invested capital (ROIC) is calculated utilizing the DuPont method, breaking down the calculation into two separate ratios: NOPAT to total revenues and total revenues to invested capital. The product of these two ratios produces ROIC. ROIC is of particular importance in determining a manufacturing company's health and ability to use invested capital to generate future cash flows wisely. TSMC has demonstrated steady downward trend in ROIC since 2015, climbing briefly in 2016, but ultimately dropping from a high of 23.2% to 20.6%.

## Other Financial Ratios

Other financial ratios include ratios not used in the traditional DuPont calculations. These ratios are supplemental in analyzing the company's current and potential ability to handle both macroeconomic and microeconomic events.

# Valuation

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## Discounted Cash Flow (DCF)

We employed a discounted cash flows analysis as one of our methods to derive a price target for TSMC. In our model, we forecasted future free cash flows through the FY 2024E. This time horizon appropriately captures several expected growth trends in TSMC's operating results while maintaining a reasonable level of predictability. In our final valuation, we gave this model a 50% weighting because it reflects the highest level of detail out of any other model used in our valuation process.

## Variations Due to ADR Classification

Due to the TSMC's arrangement as an ADR company, financial data is regularly released to the SEC at the end of every calendar year. As a result, although TSMC is being pitched January 15<sup>th</sup>, 2021, the most recent data on the EDGAR database ends December 31<sup>st</sup>, 2019. For initial valuations on the workbook, the DCF was therefore discounted by 1 year.

However, January 14<sup>th</sup>, 2021 marks the release of TSMC's fourth-quarter 2020 data. Summing all four quarters of data, we can approximate TSMC's 2020 annual financial data, and use it to create a second valuation. Updating the DCF by substituting the 2020E (expected) data column with 2020A (actual) results will hopefully create a more accurate valuation. There is a marginal tradeoff of only forecasting out 4 additional years instead of 5, but we consider the tradeoff to be worth it.

A second adjustment made to the DCF model regards the figure used in 'shares outstanding.' TSMC consistently reports a value of 25,930 shares outstanding for use in their figures, such as EPS. However, due to the 1:5 exchange that's part of the ADR, the shares outstanding used to consider market cap is roughly 1/5<sup>th</sup> of this value. Originally discovering this discrepancy when entering the 25,930 figure into the PGM model, I adjusted down accordingly by calculating backwards from the market cap



value recorded on Yahoo! Finance. Dividing the current share price by the reported market cap, I arrived at a shares outstanding value of 4690. This figure is considerably less than 25,930, but materially less than a perfect 1/5<sup>th</sup> division of the 25,930 value. However, I decided to disregard this figure and use the perfect 1/5<sup>th</sup> division of 5186 for my calculations due to the level of certainty surrounding the figure.

## Revenue

Revenue was projected using a year-over-year growth rate based on management guidance, provided with a hyperlink. The year-end 2020 resulted in revenue growth of over 30%, a figure that drops significantly the next year due to the loss of HiSilicon from US sanctions. Based on management guidance, the remaining 4 years are projected from 10% back up to 15%.

## Cost of Goods Sold (COGS)

We projected COGS as a percentage of revenue. This yields a growth rate of roughly 11%, in line with an industry estimation of 13% by the MIT Technology Review.

## Depreciation and Amortization

TSMC is primarily a manufacturing company, so D&A makes a more significant contribution to their financial positions compared to technology companies like AMD or Facebook, which are software focused. With the high rate of technological advancement, manufacturing equipment constantly has to be refitted, and is often rendered obsolete. This is reflected in the depreciation expense relative to revenue, and why it is modeled as a percentage of revenue. Amortization is a considerably smaller percentage, indicating that TSMC pays in full when acquiring new equipment, instead of amortizing the costs over several years. This behavior is also indicated by the considerable CapEx expenditures each year.

## Operating Expenses

Operating expenses were projected as a percentage of revenue. The two primary operating expense segments are research, development, & engineering (RD&E) and selling, general, and administrative (SG&A). Marketing is also included, but plays a much smaller role. We projected these expenses in line with ranges offered by management, which align with the historical growth rates calculated in the workbook. Per management, R&D is roughly 8% of revenue. SG&A is also expected to increase slightly as TSMC prepares for the opening of new manufacturing facilities, including a campus in Arizona.

## Net Working Capital

Total current assets were projected using a median value for YoY of 7.5 %. This is the most appropriate technique for projection for several reasons. TSMC holds vast cash and short-term investment positions under current assets. These assets are not directly associated with revenue—therefore projections made as a percentage of revenue would be utterly disproportionate. Furthermore, due to the abnormally large asset increase in 2020, a median was used to help diminishing the effect of this outlying year.

However, total current liabilities, minus short-term debt, are significantly associated with revenue. Liabilities such as payables to contractors and equipment suppliers, dividends, and income tax are associated with revenue which is why liabilities are projected as a percentage of revenue using historical growth rates.

## Capital Expenditures

Capital expenditures were projected as a rate based on historical percentages of revenue due to the close association. TSMC has high levels of capital expenditures relative to revenue (around 35%). TSMC's capital expenditure are what help them remain leaders in the semiconductor manufacturing industry. In addition to the 18 fabrication locations in Taiwan, as well as several other plants, TSMC has announced a new plant in Phoenix, Arizona.

With the global adoption of 5G networks and the advancement of smartphones, TSMC increased their CapEx in 2019 to almost \$15 billion, to help the company remain competitive. However, with the recent Q4 2020 financial reports, TSMC announced it planned to spend a staggering \$28 billion dollars in 2021 to help them seize production capabilities and market share from competitors who were failing, such as Intel.



## Beta

Beta was estimated by performing a regression of TSMC's historical returns against the S&P 500. Three periods were used for the regression: 5-year monthly returns, five-year weekly returns, and five years' daily returns. Of the three-time regressions, we selected the one that resulted in the highest R-Squared value - the 1-year daily regression with an R-Squared of 0.404. The value of beta from this regression was 0.77.

## Terminal Value Calculations

For the PGM, a terminal growth rate of 3% was used to reflect TSM's growth trend into perpetuity following the terminal year. 3% is the OSIG standard terminal growth rate, this adequately reflects the maturity of TSMC and their leading position in the industry.

## Capital Asset Pricing Model (CAPM) & Weighted Average Cost of Capital (WACC) Presumptions

In calculating TSMC's cost of equity, we used the capital asset pricing model (CAPM). We used the equity risk premium of 5.6% in accordance to NYU Stern's database, along with risk-free rate data from the 30-year Treasury Bond; resulting in an 5.7% cost of equity. The calculated weighted average cost of capital (WACC) returned a value of 6.5%.

## Historical Model

The historical P/E model is essentially an analysis of past market premiums to company earnings at the highest and lowest price for the period FY 2015-2019. Based on average P/E for this period we projected the value per share based on estimated FY 2020E EPS. The average P/E ratio for the period was 43.63x and estimated FY 2020E EPS was 0.51, the resulting value per share was calculated to be \$41.85. While this value is reasonable considering the 2019 yearly data, the events and industry disruptions of this past year make this model ineffective and inappropriate to use in our valuation.

## Comparable Model

The publicly-traded comparable analysis was also used as a method of valuing TSMC. TSMC has few direct competitors. Furthermore, the only publicly-traded direct competitor with the same business model as TSMC is United Microelectronics Corp (UMC). Of the three Pure Play foundries that are competitive in the industry, Global Foundries is the third, but is a private company. However, TSM does compete with IDM companies such as Intel, Micron, and Samsung, who manufacture their own semiconductor products to varying degrees. All of the previous are included in the relative valuation with the exception of Samsung, which is not traded on the NASDAQ or NYSE. This limited number of competitors is primarily due to high barriers to entry to the semiconductor manufacturing industry, including high capital investment and R&D expenditures needed to maintain competitive manufacturing practices. Due to the lack of manufacturing, TSMC's primary revenue source, fabless companies such as AMD, Nvidia, and Apple are not considered. Ultimately, due to the lack of comparable companies with the same scale as TSMC, this model was not weighted in the valuation.

## Variations Due to ADR Classification

To account for the 1:5 exchange rate in accordance with the ADR classification, we multiplied TSMC and UMC's EV/EBITDA multiple by 5. Additionally, please see 'shares outstanding' adjustment discussed in the DCF valuation.

## Multiples

### P/E – 50%

All the comparable companies chosen to operate in high-growth industries that also require intense capital investment and therefore have high P/E multiples. Given the consistently high historical and forward P/E estimates for TSMC and the comparable companies, we gave this multiple a 50% weighting.

### P/S – 0%

TSMC and the comparable companies have high expenses, and their ability to minimize these expenses while effectively delivering cutting-edge technology largely determines their success. Because of this, P/S is not used as I do not consider it an appropriate metric.



### P/BV – 50%

All the companies selected operate in the manufacturing industry, we believe that P/BV is a good measure of whether companies are fairly valued based purely on the value of their net assets. The manufacturing process for semiconductors involves a considerable amount of equipment and real estate. Because of this high asset value, we consider the Price/Book Value multiple accurately represents TSMC. Therefore, we gave this multiple a 50% weighting.

### Price to Earnings Growth – 0%

### EV/EBITDA – 0%

EBITDA was not used due to the considerable amount of Depreciation that TSMC records. I felt it was important to include this expense in the valuation due to the effect it has on TSMC's financial wellbeing. Additionally, EV/EBITDA does not consider capital expenditures. (DOUBLE CHECK). Therefore, projections that consider these expenses, such as the price to earnings, which considers the EPS, and the price to book value, which considers assets, are used instead.

### Residual Income Model (RIM) – 20%

TSMC have offered a dividend consistently since 2015. The RIM model employs dividends per share (DPS) and earnings per share (EPS) to calculate a clean book value. This is then discounted by the company's cost of equity to achieve the present value of residual incomes. Due to uncertainty surrounding the terminal value of the DCF model, as well as speculation around future cash flows, the RIM model was likewise included to provide a more conservative valuation. The factoring of the book value importantly considers the asset value of TSMC. This model was included in the valuation and given a 20% weight.

### Dividend Discount Model – 10%

The dividend discount model forecasted the dividends paid since TSMC offered dividend in FY 2015. This model was included for similar reasons as the RIM model – to provide a conservative valuation to offset uncertainties in the DCF. This model was given a 10% weight.

## Catalysts for Long-Term Growth

In my research, I have identified several catalysts for long-term **GROWTH**:

- The recent delay's in Intel's manufacturing capabilities, as well as the rumors of their conversations with TSMC in outsource production, provide an opportunity for TSMC to gain additional market share while cannibalizing some of Intel's manufacturing process, further mitigating Intel's competitive nature. While rumors abound discussing Intel outsourcing production to TSMC for 5nm products, an announcement from Intel at the end of January should confirm any decision.
- The global adoption of 5G wireless services is posed to create substantial demand for new semiconductor products to utilize this technological advancement. Varying analysts predict substantial growth as a result of this development.
- Apple's new MacBook Air, Mac Mini, and 13" MacBook Pro all use a new chip architecture of Apples own design – the M1, based on ARM technology. This marks the beginning of the end of Apple's 15-year partnership with Intel, who supplied x86 CPUs for the aforementioned products, and still supplies the chips for Apple's higher-end computers. Apple has been investing heavily in their own chip department, aligning with the company's strategy of owning all of their core technologies. This indicates possible future terminations of business for the higher end chips Intel still currently supplies.  
TSMC, who manufactures ARM-based A-series chips used in the iPhone, manufactured the new M-series chips Apple designed. [citation]

## Risks to Projections and Expectations

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While I have identified catalysts for (growth or underperformance), there are risks to my assumptions that could affect TSMC's ability to provide returns in line with my projections and market expectations.

- Possible threat by Global Foundries if they go public in 2022. Global Foundries is a direct competitor to TSMC, and has an identical pure-play business model. While they have a considerably smaller market share than TSMC, an IPO could help them raise capital to expand and compete with TSMC.

I am confident that TSMC's asset value, combined with their advanced manufacturing capabilities and emergent dominance in the industry protect against the risk factors mentioned.

## Corporate Governance

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The Board of Directors of TSMC currently consists of ten board members, comprised of citizens from Taiwan, the United States, and Europe. Together these members draw on past experience from the Acer Group, Xilinx, Delta Electronics, as well as British Telecommunications, among others.

### Executive Members

- Dr. Mark Liu, Chairman,
- Dr. C.C. Wei, and Chief Executive Officer
- Ming-Hsin Kung
- F.C Tseng

### Independent Members

- Sir Peter L. Bonfield, former British Telecommunications CEO
- Mr. Stan Shih, Co-Founder, Chairman Emeritus of the Acer Group
- Ms. Kok-Choo Chen – Form Chairman of National Performing Arts Center, former Advisor of Executive Yuan
- Mr. Michael R. Splinter, former Chairman of Applied Materials, Inc
- Mr. Moshe N. Gavriellov, former CEO of Xilinx
- Mr. Yancey Hai, current Chairman of Delta Electronics, Inc.

## Environmental, Social, and Governance (ESG) Observations

TSMC made a purchase of wind farms in mid 2020. According to the Taiwan News, it was the largest order of its kind ever made.

## Investment Summary

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Our analysis leads us to conclude that the Taiwan Semiconductor Manufacturing Company is a fundamentally sound company. The company's potential for growth is greater than its peers in the semiconductor manufacturing industry. TSMC has built an image of quality and cutting-edge technology thanks to their ongoing and considerable investments in R&D and Capital Expenditures. Based on our findings we arrived at an intrinsic value of **\$96.30** and a margin of safety of **(16.7)%**. We feel as though this value accurately represents the fair value per share, **as of one year ago**. Until the most recent Quarterly Data is released, even though we anticipate increased demand for semiconductor products, we **cannot recommend a buy** at this time for TSMC.

*Disclosure: We have no positions in any stocks mentioned, and no plans to initiate any positions within the next 72 hours.*

*We wrote this report ourselves, and it expresses our own opinions. We are not receiving compensation for it. We have no business relationship with any company whose stock is mentioned in this equity report. This report is written explicitly for the Oregon State Investment Group; however, we hold the right to distribute this document to potential employers or for other educational purposes as a sample of our work.*

Signed:

Michael Haffner

[1/10/2021]



# References

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## 2019 Annual Report

[https://investor.tsmc.com/static/annualReports/2019/english/pdf/e\\_all.pdf](https://investor.tsmc.com/static/annualReports/2019/english/pdf/e_all.pdf)

## Intel in talks with TSMC

<https://finance.yahoo.com/news/intel-talks-tsmc-samsung-outsource-195812342.html>

## 2019 Letter to Shareholders

<https://investor.tsmc.com/static/annualReports/2019/english/index.html>

## Deloitte Semiconductor Industry Report, April 2019

<https://www2.deloitte.com/content/dam/Deloitte/cn/Documents/technology-media-telecommunications/deloitte-cn-tmt-semiconductors-the-next-wave-en-190422.pdf>

## SK Hynix

[https://en.wikipedia.org/wiki/SK\\_Hynix](https://en.wikipedia.org/wiki/SK_Hynix)

## Global Foundries

<https://en.wikipedia.org/wiki/GlobalFoundries>

## Global Foundries Goes Public, *Tom's Hardware*

<https://www.tomshardware.com/news/globalfoundries-public-ipo-2022-fab,40519.html>

## 10-K, About

<https://www.investopedia.com/terms/1/10-k.asp>

## 10-Q, About

<https://www.investopedia.com/terms/1/10q.asp>

## 20-F, About

<https://www.investopedia.com/terms/s/sec-form-20-f.asp>

## TSMC Third-Quarter 2020 Presentation

[https://investor.tsmc.com/english/encrypt/files/encrypt\\_file/qr/phase5\\_support/3Q20PresentationUpload%28E%29.pdf](https://investor.tsmc.com/english/encrypt/files/encrypt_file/qr/phase5_support/3Q20PresentationUpload%28E%29.pdf)





Bank of New York, Mellon – ADR Information

<https://www.adrbnymellon.com/directory/dr-directory>

Moore's Law, MIT Tech Review

<https://www.technologyreview.com/2020/02/24/905789/were-not-prepared-for-the-end-of-moores-law/>

Moore's Law, EE (Electronic Engineering) Times

<https://www.eetimes.com/moores-law-dead-by-2022-expert-says/#:~:text=PALO%20ALTO%2C%20Calif.,the%20Hot%20Chips%20conference%20here.>

Moore's Law, TSMC Company Blog

<https://www.tsmc.com/english/news-events/blog-article-20190814>

Moore's Law & TSMC, PC Games

<https://www.pcgamesn.com/tsmc-moores-law-not-dead-not-slowng-down-not-even-sick>

Moore's Law & John Carmack, PC Games

<https://www.pcgamesn.com/john-carmack-predicts-a-couple-nodes-cpu-silicon>

Global Foundries Patent Case, PC Games

<https://www.pcgamesn.com/amd/globalfoundry-sues-tsmc-nvidia-apple-7nm-patent>

First TSMC 5nm Customers

<https://www.eenewsembedded.com/news/report-names-first-seven-tsmc-5nmn-customers>

Apple's TSMC Chips

<https://www.cnbc.com/2020/11/10/why-apple-is-breaking-a-15-year-partnership-with-intel-on-its-macs-.html>

TSMC/Tesla Rumored Partnership

<https://electrek.co/2020/08/18/tesla-hw-4-0-self-driving-chip-tsmc-for-mass-production-q4-2021-report/>

Apple Car. TSMC

<https://appleinsider.com/articles/20/12/09/apple-tsmc-rumored-to-be-working-on-chips-for-a-tesla-like-apple-car>



### Apple Car

<https://appleinsider.com/inside/apple-car>

### Wafers, Chips, Transistors – Stack Exchange

<https://electronics.stackexchange.com/questions/272497/chips-vs-wafers-vs-transistors>

### Semiconductors, Transistors, and Integrated Circuits – HowStuffWorks

<https://computer.howstuffworks.com/moores-law1.htm>

### TSMC's 3nm and Smaller – Extreme Tech

<https://www.extremetech.com/computing/314204-tsmc-plots-an-aggressive-course-for-3nm-lithography-and-beyond>

### First Seven TSMC 5nm Customers

<https://www.eenewsembedded.com/news/report-names-first-seven-tsmc-5nm-customers>

### Samsung Manufacturing Qualcomm's Chips

<https://www.reuters.com/article/qualcomm-samsung/qualcomm-taps-samsung-to-make-new-flagship-5g-smartphone-chips-idUSL1N2IH042>

### Wind Farm Order, Taiwan News

<https://www.taiwannews.com.tw/en/news/3962736>

### TSMC Q3 2020 Management Report

[https://investor.tsmc.com/english/encrypt/files/encrypt\\_file/qr/phase5\\_support/3Q20ManagementReport.pdf](https://investor.tsmc.com/english/encrypt/files/encrypt_file/qr/phase5_support/3Q20ManagementReport.pdf)

### 2019 TSMC Corporate Social Responsibility Report

<https://csr.tsmc.com/download/csr/2019-csr-report/english/pdf/e-1-ourBusiness.pdf>

### TSMC Revenue Breakdown and 2021 Projections

<https://wccftech.com/tsmc-revenue-2021-huawei-orders/>

### TSMC 2020 Revenue Growth

<https://www.macrotrends.net/stocks/charts/TSM/taiwan-semiconductor-manufacturing/revenue>



### TSMC 2021 Revenue Growth Projections

<https://www.taiwannews.com.tw/en/news/4090900>

### ADR vs ADS

<https://www.investopedia.com/ask/answers/06/adrvsads.asp#:~:text=In%20other%20words%2C%20the%20ADS,the%20foreign%20company's%20home%20country.>

### TSMC Q4 Presentation Slides

[https://investor.tsmc.com/english/encrypt/files/encrypt\\_file/reports/2021-01/4Q20Presentation%28E%29.pdf](https://investor.tsmc.com/english/encrypt/files/encrypt_file/reports/2021-01/4Q20Presentation%28E%29.pdf)

### TSMC Q4 Earnings Release

[https://investor.tsmc.com/english/encrypt/files/encrypt\\_file/reports/2021-01/4Q20EarningsRelease.pdf](https://investor.tsmc.com/english/encrypt/files/encrypt_file/reports/2021-01/4Q20EarningsRelease.pdf)

### TSMC Q4 Management Report

[https://investor.tsmc.com/english/encrypt/files/encrypt\\_file/reports/2021-01/4Q20ManagementReport.pdf](https://investor.tsmc.com/english/encrypt/files/encrypt_file/reports/2021-01/4Q20ManagementReport.pdf)

### Real Money TSMC 2021 CapEx

<https://realmoney.thestreet.com/investing/technology/tsmc-big-2021-capex-budget-intel-15539873>

### Yahoo! Finance/Bloomberg TSMC 2021 CapEx

<https://finance.yahoo.com/news/tsmc-spend-28-billion-2021-064820722.html>

### 9to5mac TSMC 2021 CapEx

<https://9to5mac.com/2021/01/14/tsmc-credited-apple/>

### Bloomberg TSMC 2021 CapEx

<https://www.bloomberg.com/opinion/articles/2021-01-14/as-chip-rivals-struggle-tsmc-goes-in-for-the-kill>

### Intel CEO Replacement – NY Times

<https://www.nytimes.com/2021/01/13/technology/intel-ceo-swan-gelsinger.html>

### Intel Outsourcing - Nasdaq

<https://www.nasdaq.com/articles/intel-intc-reportedly-looking-to-outsource-chip-production-2021-01-11>



TSMC Sailed Through 2020 in Ship Shape – Wall Street Journal

<https://www.wsj.com/articles/tsmc-sailed-through-2020-in-ship-shape-11610625488>

5G Smartphone Market Share to Double in 2021, Says iPhone Supplier TSMC – Consumer Electronics Daily

<https://consumerelectronicdaily.com/news/2021/01/15/5g-smartphone-market-share-to-double-in-2021-says-iphone-supplier-tsmc-2101140029>

Strengths/Weaknesses of RIM

<https://ift.world/concept1/level-ii-concept-59-strengths-and-weaknesses-of-residual-income-models/>

BNY Mellon ADR Directory

<https://www.adrbnymellon.com/directory/dr-directory>



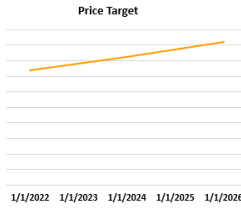
# Appendix

## TSM

Taiwan Semiconductor Mfg Co.

### Valuation

Valuation Method	Value	MoS	Weight	Current Price	Intrinsic Value	Price Target
PGM	148.04	17.1 %	70.0 %	96.45	139.66	1/15/2022 #####
EV/EBITDA	53.48	(57.7%)	0.0 %	106.45	139.72	1/15/2023 #####
EV/Sales	40.80	(67.7%)	0.0 %	116.45	139.77	1/15/2024 #####
RIW	138.38	9.4 %	20.0 %	<b>126.45</b>	<b>139.77</b>	1/15/2025 #####
DDM	82.97	(34.4%)	10.0 %	136.45	139.72	1/15/2026 #####
GGM	63.22	(50.0%)	0.0 %	146.45	139.66	#####
Relative	49.20	(61.1%)	0.0 %	156.45	139.60	#####
Historical	53.49	(57.7%)	0.0 %			
<b>Intrinsic Value Per Share</b>	<b>139.60</b>	<b>10.4 %</b>	<b>100.0 %</b>			
Market Price	126.45					
Cost of Capital	5.70 %					



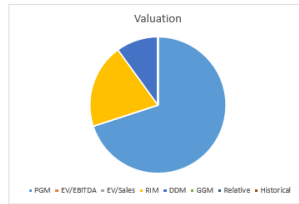
### Workbook Legend:

- Blue Cell with Italicized Font = Data transformation (calculation), usually summation or currency exchange.
- Green Cell = 2020 (Unaudited) Data Manually Entered.
- Faded Yellow Cell and Text = Projection that is no longer being used due to other information, 2020 data update.
- Hyperlink = Takes you to information source, especially if change to forecast.

### Recommendation

Portfolio	Global
Date of Pitch	1/15/2021
Analyst	Michael Haffner
Coverage Type	Initiation
Buy/Hold/Sell	Buy
Update Frequency	
Next Earnings Date (Q?)	Jan 14th, 2021

**Summary**  
With a price target of \$139.60 per share, I am recommending a Buy



## TSM

Taiwan Semiconductor Mfg Co.

# of Years Discounted						0.00	1.00	2.00	3.00	4.00		Underlying Assumptions					
Forecast Ending	2015.0	2016.0	2017.0	2018.0	2019.0	2020 (Unaudited)	2021E	2022E	2023E	2024E		Growth	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
<b>Income Statement:</b>																	
<b>Statement (LineItems)</b>																	
NET REVENUE	25,617.02	29,310.25	32,977.30	33,697.30	35,773.50	45,505.00	50,955.50	55,811.88	63,346.49	72,848.46	Revenue Growth	10.00%	10.0%	11.50%	13.50%	15.00%	15.00%
COST OF REVENUE	13,053.78	14,627.54	16,282.60	17,428.60	18,300.80	21,342.00	25,271.69	28,177.94	31,981.98	36,779.25	% of Revenue	50.49%	50.49%	50.49%	50.49%	50.49%	50.49%
GROSS PROFIT BEFORE REALIZED (UNREALIZED) GROSS REALIZED (UNREALIZED) GROSS PROFIT ON SALES TO	0.00	(0.90)	(0.20)	(3.60)	0.10	0.10	(1.94)	(2.05)	(2.32)	(2.67)	% of Revenue	(0.00)%	(0.00)%	(0.00)%	(0.00)%	(0.00)%	(0.00)%
GROSS PROFIT	12,463.69	14,681.81	16,694.50		16,285.10	16,472.80	24,163.00	24,781.87	28,686.54	33,686.54							
<b>OPERATING EXPENSES</b>																	
Research and development	1,990.59	2,201.74	2,723.80	2,806.10	3,056.50	3,720.00	4,505.00	5,023.07	5,701.18	6,956.36	% of Revenue	9.00%	9.00%	9.00%	9.00%	9.00%	9.00%
General and administrative	524.10	612.08	715.10	862.10	726.70	1,209.00	1,103.92	1,230.87	1,397.04	1,606.59	% of Revenue	2.21%	2.21%	2.21%	2.21%	2.21%	2.21%
Marketing	172.04	182.45	201.50	195.60	212.20	297.77	332.02	376.84	433.37		% of Revenue	0.69%	0.69%	0.69%	0.69%	0.69%	0.69%
Total operating expenses	2,686.73	2,996.27	3,640.40		3,683.80	3,995.40	4,923.00	5,906.69	6,526.36	7,475.06							
OTHER OPERATING INCOME AND EXPENSES, NET	(57.10)	0.92	(45.00)	(69.70)	(16.60)	(24.00)	(65.03)	(72.50)	(82.30)	(94.55)	% of Revenue	(0.19)%	(0.19)%	(0.19)%	(0.19)%	(0.19)%	(0.19)%
INCOME FROM OPERATIONS	9,719.85	11,686.46	13,008.10	12,932.60	12,460.80	19,259.00	19,245.14	21,459.33	24,355.21	28,000.49	% of Revenue	38.45%	38.45%	38.45%	38.45%	38.45%	38.45%
<b>EBIT</b>																	
EBIT	3,718.05	11,696.46	13,008.10	12,532.60	12,460.80	18,280.00	18,810.25	20,880.00	22,880.00	27,375.57							
EBITDA	15,477.25	15,697.23	21,794.80	22,088.90	22,082.40	30,491.00	32,202.47	35,880.00	40,880.00	46,885.89							
<b>NON-OPERATING INCOME AND EXPENSES</b>																	
Share of profits of associates	127.44	106.92	101.70	101.00	95.70	122.00	143.13	159.59	181.13	208.30	% of Revenue	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%
Other income	144.28	193.59	324.20	495.20	555.20	236.00	562.32	626.99	711.63	818.38	% of Revenue	1.12%	1.12%	1.12%	1.12%	1.12%	1.12%
Foreign exchange gain (loss), net	75.36	35.91	(50.90)	79.70	70.00		46.36	51.69	58.67	67.47	% of Revenue	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%
Finance costs	(96.89)	(102.22)	(112.40)	(99.70)	(106.70)		(96.94)	(174.98)	(196.61)	(228.40)	% of Revenue	(0.31)%	(0.31)%	(0.31)%	(0.31)%	(0.31)%	(0.31)%
Other gains and losses, net	673.36	6.06	95.10	(114.40)	(38.50)	(253.00)	(156.44)	(174.98)	(198.61)	(228.40)	% of Revenue	(0.31)%	(0.31)%	(0.31)%	(0.31)%	(0.31)%	(0.31)%
Total non-operating income and expenses	924.15	246.24	357.70		454.60	573.70	610.00	437.94	488.30	594.22							
INCOME BEFORE INCOME TAX	10,644.00	11,932.70	13,365.80	12,987.40	13,034.50	19,869.00	19,683.08	21,938.63	24,840.42	28,645.64							
INCOME TAX EXPENSE	1,446.97	1,673.53	1,724.80	1,125.10	1,198.10	2,263.00	2,302.92	2,565.76	2,914.40	3,351.56							
NET INCOME	3,197.04	10,259.17	11,641.00		11,862.30	11,836.40	17,606.00	17,382.86	21,926.02	25,294.08							
<b>EARNINGS PER SHARE</b>																	
Basic earnings per share (per share)	0.35	0.40	0.45	0.46	0.46	0.68	0.67	0.75	0.85	0.98							
Diluted earnings per share (per share)	0.35	0.40	0.45	0.46	0.46	0.68	0.67	0.75	0.85	0.98							
American Depositary Shares (one represents five common shares)	1.77	1.80	2.26	2.30	2.30	3.39	3.36	3.74	4.24	4.88							
Basic/Diluted weighted average shares outstanding	25,930.00	25,930.00	25,930.00	25,930.00	25,930.00	25,930.00	25,930.00	25,930.00	25,930.00	25,930.00							
Cash dividend paid per common share	0.14	0.19	0.24	0.26	0.33												
<b>Balance Sheet:</b>																	
Cash and cash equivalents	17,088.86	16,735.57	18,670.40	18,676.70	15,225.70	23,496.00	25,882.40	28,858.88	32,754.83	37,868.05	% of Revenue	51.71%	51.71%	51.71%	51.71%	51.71%	51.71%
Financial assets at fair value through profit or loss	0.00	199.47	19.20	114.50	10.90		714.9	79.71	90.48	104.05	% of Revenue	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%
Financial assets at fair value through other comprehensive income	0.00	0.00	0.00	3,252.60	4,253.30		3,597.11	4,090.77	4,552.23	5,235.06	% of Revenue	7.19%	7.19%	7.19%	7.19%	7.19%	7.19%
Financial assets at amortized cost	0.00	0.00	0.00	466.40	10.00	4,673.00	1,461.78	1,629.68	1,843.91	2,127.40	% of Revenue	2.92%	2.92%	2.92%	2.92%	2.92%	2.92%
Hedging financial assets	0.00	0.17	1.20	0.80	0.90		142	159	180	2.07	% of Revenue	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total Financial Assets (Short Term Investments)	0.00	199.64	210.40	3,890.30	4,269.10	4,673.00	5,101.60	5,221.36	6,494.42	7,468.58							
Total current assets	22,678.62	25,284.18	28,320.60	31,090.50	31,090.50	38,872.00	41,788.69	44,924.24	48,295.05	51,918.79	YoY (Median)	7.50%	7.50%	7.50%	7.50%	7.50%	7.50%
Short-term loans	1,199.83	1,792.07	2,151.40	2,899.50	3,962.60	3,152.00	4,146.10	4,622.91	5,247.00	6,034.05	% of Revenue	8.28%	8.28%	8.28%	8.28%	8.28%	8.28%
Long-term liabilities - current portion	714.23	1,178.35	1,970.40	1,140.10	1,063.20	93.00	1,568.59	1,748.97	1,985.09	2,382.85	% of Revenue	3.13%	3.13%	3.13%	3.13%	3.13%	3.13%
Total current liabilities	7,281.88	10,769.00	13,053.00		11,657.50	20,005.50	21,965.00	22,320.83	24,897.72	28,247.57	% of Revenue	44.59%	44.59%	44.59%	44.59%	44.59%	44.59%
<b>Statement of Cashflows:</b>																	
Depreciation expense	6,660.24	6,805.03	8,630.10	9,412.80	9,408.60	11,271.00	13,161.14	14,674.67	16,655.75	19,154.12	% of Revenue	26.29%	26.29%	26.29%	26.29%	26.29%	26.29%
Amortization expense	97.25	115.75	146.60	144.50	183.00		231.08	257.85	292.43	336.30	% of Revenue	0.46%	0.46%	0.46%	0.46%	0.46%	0.46%
Acquisitions of property, plant and equipment	(7,820.79)	(10,143.16)	(11,653.40)	(10,309.80)	(15,393.60)	(17,235.00)	(28,000.00)	#####	(23,014.17)	(26,466.30)	% of Revenue	#####	#####	#####	#####	#####	#####



DCF										
<b>FCFF:</b>										
Sales	25617.0	29310.3	32977.3	33697.3	35773.5	45,505.00	50,055.50	55,811.88	63,346.49	72,848.46
EBIT	9719.9	11686.5	13008.1	12532.6	12460.8	19,210.00	18,810.25	20,973.43	23,804.84	27,375.57
EBITDA	16477.3	18607.2	21784.8	22089.9	22052.4	30,481.00	32,202.47	35,905.75	40,753.03	46,865.99
Non-Cash Working Capital	220.9	550.4	1298.5	761.6	(6983.5)	(8,017.00)	(5,831.64)	(8,172.44)	(11,969.68)	(17,385.65)
Δ Non-Cash Working Capital		329.5	748.1	(536.9)	(7745.1)	(1,033.50)	2,185.36	(2,340.80)	(3,797.24)	(5,415.97)
Cash From Operations	15156.0	16638.8	19358.1	21541.1	28652.1	29,326.56	27,816.31	35,792.66	41,765.10	49,079.02
Capital Expenditures	(7820.8)	(10143.2)	(11153.4)	(10309.8)	(15393.6)	(17,235.00)	(28,000.00)	(20,276.80)	(23,014.17)	(26,466.30)
Unlevered Free Cash Flow (FCFF)	7335.2	6495.6	8204.7	11231.3	13258.5	12,091.56	(183.69)	15,515.86	18,750.93	22,612.72
PV of FCFF						12,092	(174)	13,887	15,876	18,113
Growth Rate						(8.8)%	(101.5)%	(8546.9)%	20.9 %	20.6 %
<b>Capital Structure</b>										
MV of Equity	1.0	655,770								
Preferred Shares	0.0	0.0								
BV of Debt	0.0	1643.3								
Operating Leases	0.0	580.1								
Long-term debt	0.0	1063.2								
<b>CAPM Assumptions</b>										
Beta	0.77									
Equity Risk Premium	5.23 %									
Risk Free Rate for Local Currency	1.7 %									
<b>WACC Assumptions</b>										
Cost of Equity	5.7 %									
Cost of Preferred Shares	0.0									
Cost of Debt	0.0									
Credit Rating	AA									
Default Spread	0.0									
LT Credit Yield	4.17 %									
Cost of Capital	5.7 %									
<b>Valuation</b>										
Σ of PV of Future Cash Flows	59793.9									
Terminal Tax Rate	11.7 %									
Terminal Growth Rate	3.0 %									
Exit Multiple	n/a									
PV of Terminal Value	69005.4									
Enterprise Value	749849.4									
+ C&CE	15225.7									
+ Investments & Other	4281.1									
- Debt	1643.3									
- Minority Interests	2.6									
- Preferred Shares	0.0									
Equity Value	767110.2									
Shares Outstanding (Diluted)	5186.0									
Intrinsic Value Per Share	148.0									

## TSM

Taiwan Semiconductor Mfge Co.

Relative

Relative Model Inputs		Relative Model											
		Ticker	TSM	INTC	AVGO	MU	UMC	QCOM	Multiple	Value	Discounted	MoS	Weight
Discount Period	-	P/E (ttm)	31.9 x	9.3 x	69.2 x	29.8 x	28.6 x	33.7 x	19.3 x	65.40	65.40	(48.28)%	50.0 %
Sales (ntm)	45,505.00	P/S (ttm)	12.3 x	2.6 x	7.7 x	3.7 x	3.4 x	7.4 x	3.1 x	26.96	26.96	(78.68)%	
EPS (ntm)	3.39	P/BV (mrq)	8.9 x	2.9 x	7.5 x	2.0 x	2.6 x	28.4 x	2.6 x	32.99	32.99	(73.91)%	50.0 %
Book Value (ntm)	65,865.00	PEG (5 yr expected)	2.08	1.78	1.10	0.84	n/a	0.95	1.1 x	61.25	61.25	(51.56)%	
EPS Growth (5 yr exp.)	16.402 %	EV/EBITDA (ttm)	2.8 x	5.5 x	19.0 x	8.8 x	1.4 x	22.9 x	5.3 x	34.82	34.82	(72.46)%	
EBITDA (ntm)	30,481	EV/Sales (ttm)	0.4 x	2.7 x	8.9 x	3.6 x	0.1 x	7.5 x	2.3 x	23.69	23.69	(81.26)%	
Cost of Equity	5.7 %	Custom Ratio							0.0 x	-	-	(100.00)%	
Cost of Capital	5.7 %	Weight		50.0 %		25.0 %	25.0 %			Intrinsic Value Per Share	49.20	(61.09)%	100.0 %
Custom Ratio		<b>Additional Information</b>											
C&CE (mrq)	15,226	Ticker	TSM	INTC	AVGO	MU	UMC	QCOM					
Investments & Other (mrq)	4,281	Beta	0.77	0.73	1.03	1.36	0.80	1.36					
LT Debt (mrq)	1,063	Debt/Equity (mrq)	40.3 %	49.0 %	174.4 %	18.5 %	32.4 %	269.2 %					
Minority Interest (mrq)	3	Return on Equity	21.9 %	29.5 %	12.1 %	7.1 %	9.1 %	94.6 %					
Preferred shares (mrq)	-	Return on Assets	15.7 %	11.1 %	3.7 %	3.7 %	2.9 %	11.4 %					
Diluted Shares (mrq)	5,186	Market Cap (\$BN):	655.77	242.81	178.08	78.83	20.53	172.30					
4690?													



## TSM

Taiwan Semiconductor Mfge Co.

Historical

Year	2015A	2016A	2017A	2018A	2019A	2020E	Used in Average?		Average Period		Discounted MoS		Weight		
							Yes	Yes	3 Years	5 Years	Value				
Sales	25,617	29,310	32,977	33,697	35,774	45,505			P/S	6.25	5.55	51.77	51.77	(59.06)%	
EBIT	9,720	11,686	13,008	12,533	12,461	19,210			P/E	18.16	15.96	57.92	57.92	(54.19)%	50.0 %
D&A	6,757	6,921	8,777	9,557	9,592	11,271			P/B	4.04	3.68	49.05	49.05	(61.21)%	50.0 %
EBITDA	16,477	18,607	21,785	22,090	22,052	30,481			EV/EBITDA	9.00	7.84	54.01	54.01	(57.29)%	
Minority Interests	(1)	3	1	2	3	-			EV/Sales	5.78	5.03	51.92	51.92	(58.94)%	
Net Income	9,197	10,259	11,641	11,862	11,836	17,606			<b>Intrinsic Value Per Shar</b>		<b>53.49</b>	<b>(57.70)%</b>	<b>100.0 %</b>		
LT Debt	714	1,178	1,970	1,140	1,063	93									
C&CE	17,089	16,736	18,670	18,877	15,226	23,496									
Book Value	36,291	42,046	50,420	54,267	53,975	65,865									
Preferred Shares	-	-	-	-	-	-									
ADR Shares	5,186	5,186	5,186	5,186	5,186	5,186									
Sales/Share	4.94	5.65	6.36	6.50	6.90	8.77									
EBITDA/Share	3.18	3.59	4.20	4.26	4.25	5.88									
Minority Interest/Share	(0.00)	0.00	0.00	0.00	0.00	-									
EPS	1.77	1.98	2.24	2.29	2.28	3.39									
LT Debt/Share	0.14	0.23	0.38	0.22	0.21	0.02									
C&CE/Share	3.30	3.23	3.60	3.64	2.94	4.53									
BV/Share	7.00	8.11	9.72	10.46	10.41	12.70									
Preferred/Share	-	-	-	-	-	-									
High Price	25.77	31.62	43.02	46.57	59.71	109.7									
P/S	5.2 x	5.6 x	6.8 x	7.2 x	8.7 x										
P/E	14.5 x	16.0 x	19.2 x	20.4 x	26.2 x										
P/B	3.7 x	3.9 x	4.4 x	4.5 x	5.7 x										
EV/Share	22.61	28.62	39.80	43.15	56.98										
EV/EBITDA	7.1 x	8.0 x	9.5 x	10.1 x	13.4 x										
EV/Sales	4.6 x	5.1 x	6.3 x	6.6 x	8.3 x										
Low Price	17.32	20.45	28.98	35.22	34.21	42.7									
P/S	3.5 x	3.6 x	4.6 x	5.4 x	5.0 x										
P/E	9.8 x	10.3 x	12.9 x	15.4 x	15.0 x										
P/B	2.5 x	2.5 x	3.0 x	3.4 x	3.3 x										
EV/Share	14.16	17.45	25.76	31.80	31.48										
EV/EBITDA	4.5 x	4.9 x	6.1 x	7.5 x	7.4 x										
EV/Sales	2.9 x	3.1 x	4.1 x	4.9 x	4.6 x										

## TSM

Taiwan Semiconductor Mfge Co.

### Off-Balance Sheet Obligations

# of Years discounted	1	2	4	5	Total
	Less Than 1 Year	1-3 Years	4-5 Years	More than 5 Years	
Term debt	5,017	259	605	-	5,881
Operating leases	133	93	83	364	672
Manufacturing purchase obligations	10,238	227	-	-	10,465
Other purchase obligations	50	-	-	-	50
Total	15,438	578	688	364	17,068
PV of Operating leases	128	85	70	297	
<b>Σ of PV of Operating Leases</b>	<b>580</b>				



## TSM

Taiwan Semiconductor Mfge Co.

### Residual Income Model

# of Years Discounted						-	1.00	2.00	3.00	4.00
Period Ending:	2015A	2016A	2017A	2018A	2019A	2020 (Unaudited)	2021E	2022E	2023E	2024E
Book Value of Equity	\$ 36,291.24	\$ 42,046.43	\$ 50,419.90	\$ 54,266.80	\$ 53,974.80	\$ 65,865.00	74,668	83,358	93,048	104,045
Return on Equity	25.3 %	24.4 %	23.1 %	21.9 %	21.9 %	26.7 %	23.3 %	23.2 %	23.6 %	24.3 %
Net Income	\$ 9,197.04	\$ 10,259.17	\$ 11,641.00	\$ 11,862.30	\$ 11,836.40	\$ 17,606.00	17,380	19,379	21,995	25,294
Dividend Payout Ratio	38.5 %	46.9 %	52.5 %	57.1 %	72.8 %	50.0 %	50.0 %	50.0 %	50.0 %	50.0 %
Dividends Paid	3,544	4,811	6,108	6,775	8,622	8,803	8,690	9,689	10,998	12,647
Retained Earnings	5,653	5,449	5,533	5,087	3,215	8,803	8,690	9,689	10,998	12,647
Equity Cost	2,072	2,400	2,878	3,098	3,081	3,760	4,263	4,759	5,312	5,940
Excess Returns	7,125	7,859	8,763	8,764	8,755	13,846	13,118	14,620	16,683	19,355
PV of Excess Return						13,846	12,409	13,084	14,124	15,500

### Assumptions

Terminal Growth Rate	3.0 %
Cost of Equity	5.7 %

### Residual Income

Book Value of Equity	53,975
∑ of PV of Excess Return	68,963
PV of Terminal Value	594,683
Equity Value	717,621
Shares Outstanding	5,186
<b>Intrinsic Value Per Share</b>	<b>138.38</b>

## TSM

Taiwan Semiconductor Mfge Co.

### DDM & GGM

# of Years Discounted						-	1.00	2.00	3.00	4.00
Period Ending:	2015A	2016A	2017A	2018A	2019A	2020E	2021E	2022E	2023E	2024E
Earnings Per Share	1.77	1.98	2.24	2.29	2.28	3.39	3.35	3.74	4.24	4.88
Dividend Per Share	0.68	0.93	1.18	1.31	1.66	1.70	1.68	1.87	2.12	2.44
Growth Rate		35.748 %	26.967 %	10.923 %	27.258 %	2.1 %	(1.3)%	11.5 %	13.5 %	15.0 %
Payout Ratio	38.5 %	46.9 %	52.5 %	57.1 %	72.8 %	50.0 %	50.0 %	50.0 %	50.0 %	50.0 %
PV of Dividends						1.70	1.59	1.67	1.80	1.95
EPS CAGR						48.745 %	21.176 %	17.861 %	16.755 %	16.402 %

### Terminal Growth Rate Assumption

DCF

Terminal Growth Rate	3.0 %
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### Dividend Discount Model

∑ of PV of Dividends	8.70
PV of Terminal Value	74.27
<b>Intrinsic Value Per Share</b>	<b>82.97</b>

### Gordon Growth Model

Projected Dividend	1.71
Cost of Equity	5.7 %
Dividend Growth Rate	3.0 %
<b>Intrinsic Value Per Share</b>	<b>63.22</b>





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