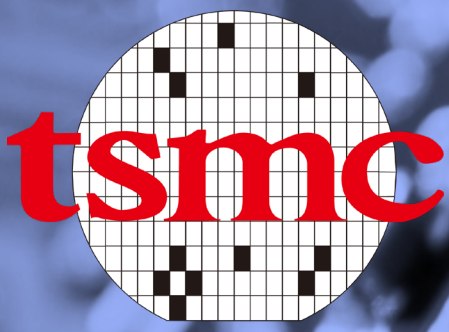
Benjamin Wang



Investment Recommendation

Contents

December 7, 2021

Investment Recommendation

Taiwan Semiconductor Manufacturing Company, Ltd. (TSMC)

Benjamin Wang

Price Target: $128.5

Stock Rating:	Outperform
Symbol:	TSM (NYSE)
Price:	$122.32
Market Cap:	$566.8B
Dividend/Yield:	1.30%
Fiscal Year End:	December

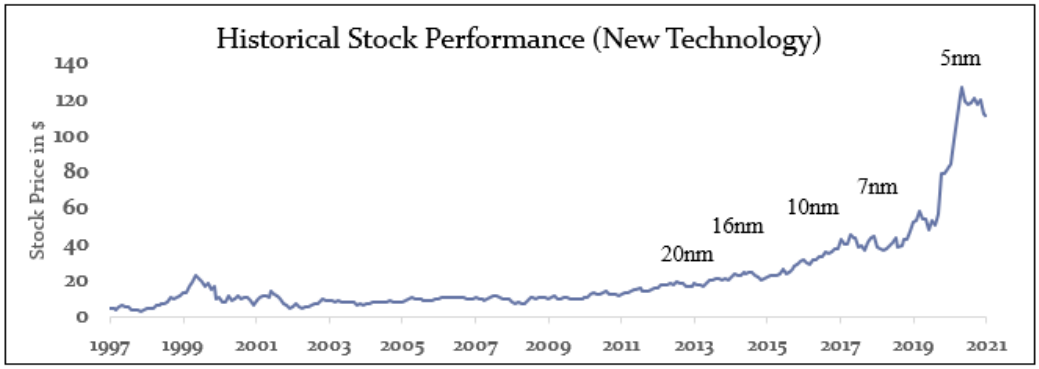
Valuation	2018A	2019A	2020A
Revenue	$33.6B	$35.7B	$54.3B
P/E	16.6x	26.1x	28.0x
P/B	3.7x	5.4x	7.7x
EPS (dil.)	$0.44	$0.44	$0.71
Debt	$5.9B	$6.4B	$13.1B

Trading Data	
Shares Outstanding (mil.)	519.0
Float (mil.)	486.0
Average Daily Volume (mil.)	5.45
Beta (5Y)	1.00

I believe TSMC stands to prosper from both the technology and investment communities' interests in manufacturing microchips to quench a never-ending thirst for more processing power. On a macro perspective, following the COVID-19 pandemic, demand for semiconductors has eclipsed pre-pandemic levels. The Company continues to reinvest profits directly into producing its next line of products. In the near term, TSMC's capital expenditure towards developing the 3nm fabrication facilities is estimated to cost upwards of $20B. Staying with industry trends, TSMC will likely be one of the first and only manufacturers to provide the 3nm technology, invoking high confidence for growth in revenue and market share.

In my view, TSMC's 5nm and 7nm process are a good distance away from being fully utilized in consumer technologies. Recently, NVIDIA (Nasdaq:NVDA) has announced that they will be using TSMC's 5nm process for their consumer Graphics Processing Unit (GPU) moving forward, away from their current supplier Samsung. This shift away from a diversified supply chain is incremental to understanding management decisions and partnerships for the semiconductor industry, as consolidation trends upwards, so will TSMC's share of the foundry market.

An overlooked catalyst for TSMC's growth prospects is the demand from less advanced mature technologies industries. As supply-chain delays rattle the global economy, demand for less advanced technologies continue to grow at a rapid pace, including power management ICs, fingerprint identification chips, and complementary metal-oxide-semiconductor (CMOS) image sensors. TSMC has an edge on its foundry competitors with the largest manufacturing network in the industry, allowing for the Company to meet demand for technologies that do not make the headlines, but supply significant diversification in revenue segments.



Company Overview

Taiwan Semiconductor Manufacturing Company known as TSMC (NYSE:TSM), is the world's first and largest silicon foundry, headquartered in HsinChu, Taiwan. TSMC was founded in 1987 by Morris Chang, a Taiwanese-American businessman. Founded on the principle of being a pure integrated circuit (IC) foundry, the Company ensures that it never competes with its customers. Thus, the key to TSMC's success has always been to focus on its customers' success. TSMC's foundry business model has enabled the rise of the global fabless industry, and since its inception TSMC has been the world's leading semiconductor foundry. The Company manufactured 11,617 different products using 281 distinct technologies for 510 different customers in 2020.

TSMC-made semiconductors serve a global customer base that includes a wide range of applications. These products are used in a variety of end markets including mobile devices, high performance computing, automotive electronics, and the Internet of Things (IoT). Diversification helps to smooth fluctuations in demand, which in turn allows TSMC to maintain higher levels of capacity utilization and profitability and generate healthy returns for future investment.

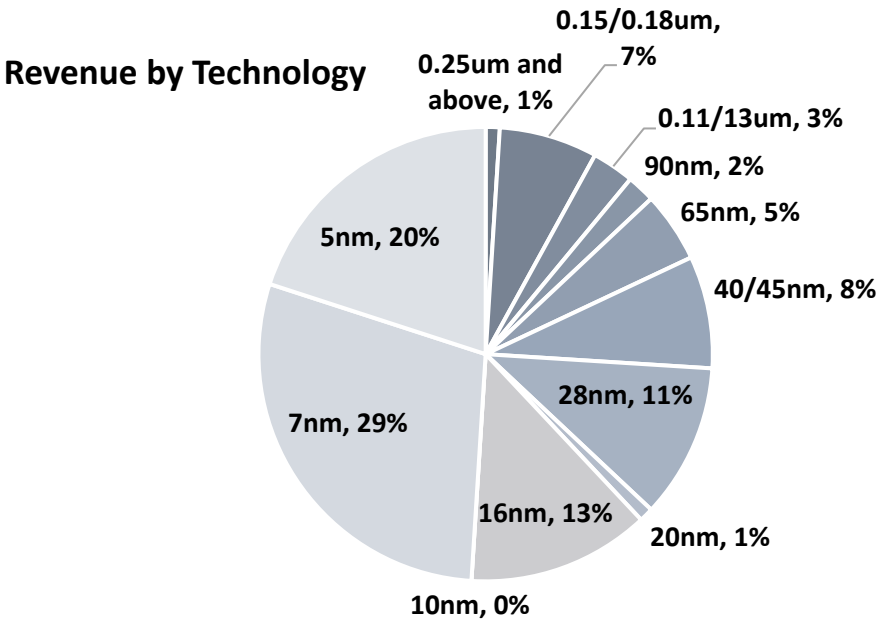
The annual capacity of the manufacturing facilities managed by TSMC and its subsidiaries exceeded 12 million 12-inch equivalent wafers in 2020. These facilities include four 12-inch wafer GIGAFAB® fabs, four 8-inch wafer fabs, and one 6-inch wafer fab – all in Taiwan – as well as one 12-inch wafer fab at a wholly owned subsidiary, TSMC Nanjing Company Limited, and two 8-inch wafer fabs at wholly owned subsidiaries, WaferTech in the United States and TSMC China Company Limited.

In May 2020, TSMC announced its intention to build and operate an advanced semiconductor fab in the United States, in order to better support customers and partners there as well as to attract global talents. This facility, to be built in Arizona, will utilize TSMC's 5-nanometer technology for semiconductor wafer fabrication and will have a capacity of 20,000 semiconductor wafers per month. Construction is planned to start in 2021 with production targeted for 2024.

Business Description

TSMC is structured as a pure-play foundry. This means that the Company's only objective is to manufacture semiconductors designed by their customers. The foundry business model prevents TSMC from ever competing in the same product markets as its customers, as well as leaving the financial burden of research & design up to chip design companies. This is not to say TSMC along with the foundry industry do not incur high research and development costs. The onus is on the manufacturer to be able to supply these high-tech chips efficiently which is why fabrication facilities are constantly being built.

TSMC supplies four main product end markets, including mobile devices, high-performance computing, automotive electronics as well as the internet-of-things (IoT).



Regarding TSMC's revenue streams, the Company generates nearly half of its revenue in the 5nm to 7nm semiconductor technology in the last fiscal year. 5nm stands for "5 nanometer", and 7nm stands for "7 nanometer", which has no relation to any physical feature of the semiconductor chip, it is a commercial term to refer to a new and improved generation of silicon semiconductor chips in terms of increased transistor density. The 7nm chip began production in 2016 and the 5nm process entered production in 2020. The new generation of 5nm chips claims to have a 15% speed improvement or 30% lower power consumption than the 7nm chips. This 5nm product services TSMC's high performance computing and smartphone customers such as Apple, Qualcomm, Huawei, Marvell and Nvidia.

TSMC has sixteen wafer manufacturing fabrication plants in the company. At the top, 12-inch GIGAFABs make up TSMC's largest and most efficient plant in terms of manufacturing capability as well as product quality. These GIGAFABs currently have the highest capacity of all fabrication facilities in TSMC's network, with the ability to produce >100,000 300mm wafers monthly. As semiconductors nodes get smaller, the demand for more advanced technology needed to fabricate these nodes is needed, resulting in exponential growth of capital expenditure on fabrication plants, with a single 12-inch GIGAFAB totaling $5.4 billion. These GIGAFABs are primarily located in Taiwan (4), with one additional GIGAFAB located in China (1).

	Function	Capacity	Number of Fabs
12-inch GIGAFABs	High-capacity fabrication facility, lowest operating cost and highest precision	>100K Monthly 300mm capacity (pcs)	4 GIGAFAB Facilities – Taiwan 1 GIGAFAB Facility – China
8-inch Fabs	Medium-capacity fabrication facility, medium operating cost and medium precision	~25K Monthly 300mm capacity (pcs)	4 8-inch Fabs – Taiwan 1 8-inch Fab – China 1 8-inch Fab – Washington St.
6-inch Fabs	Low-capacity fabrication facility, high operating cost and limited precision	~10K Monthly 300mm capacity (pcs)	1 6-inch Fab – Taiwan
Backend Fabs	Back-end of line (BEOL) is the portion of IC fabrication where individual devices get interconnected on the wafer	/	4 Backend Fabs – Taiwan

TSMC's 8-inch Fabs are the next line up fabrication facilities under TSMC's manufacturing network, primarily focused on less advanced mature technologies such as power management ICs, fingerprint identification chips, complementary metal-oxide-semiconductor (CMOS) image sensors etc. Demand for the newest and highest processing power chips is evident, with most of the industry focused on meeting demand where processing power is most needed, but as the world moves towards implementing smart systems in all aspects of life, so will demand rise for less advanced technologies. TSMC has noticed this demand early on and is investing in 8-inch fabrication facilities to meet this overlooked demand. TSMC's network of 8-inch fabrication facilities spans between Taiwan (4), and two wholly owned subsidiaries in China (1) and the United States (1).

Finally, backend fabs help integrate individual devices on to the wafer of the IC, with all backend fabs located in Taiwan (4).

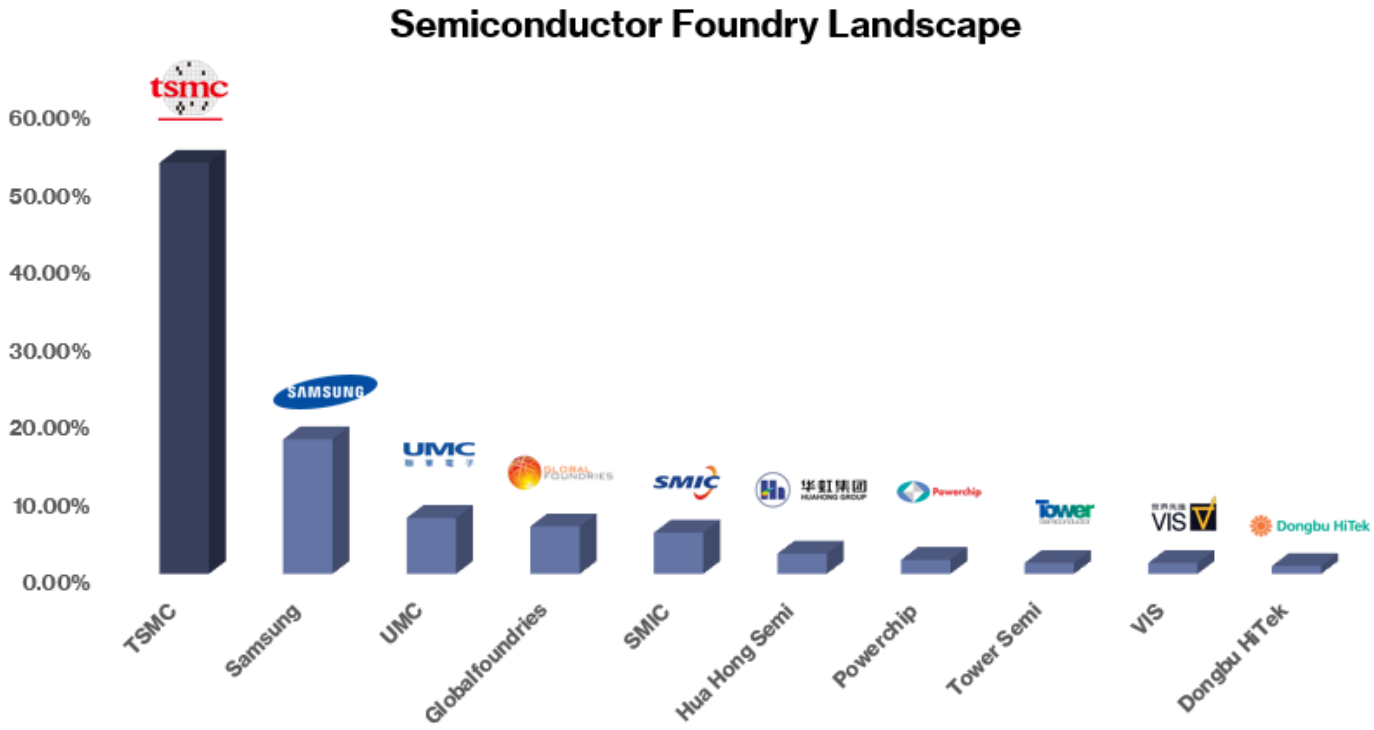
Management & Governance

Dr. Mark Liu is Chairman of Taiwan Semiconductor Manufacturing Co. Ltd. (TSMC). Prior to assuming this post, he was President and Co-CEO of TSMC from 2013 to 2018, where he oversaw TSMC's leading-edge technology development, and was Co-Chief Operating Officer from 2012 to 2013. Before that, he served in a number of executive positions at TSMC, including Senior Vice President of the Advanced Technology Business and Senior Vice President of Operations. Dr. Liu established TSMC's first 12-inch fab, and later TSMC's GIGAFAB® operations. He also served as President of Worldwide Semiconductor Manufacturing Corp prior to its merger with TSMC. Dr. Liu joined TSMC in 1993 as an engineering deputy director and established TSMC's first 8-inch fab.

Dr. C. C. Wei is Chief Executive Officer of Taiwan Semiconductor Manufacturing Co. Ltd. (TSMC). Prior to this appointment, Dr. Wei was TSMC's President and Co-CEO from November 2013 to June 2018 and Co-Chief Operating Officer from March 2012 to November 2013. From 2009 to 2012, he was TSMC's Senior Vice President of Business Development. Before that, Dr. Wei was Senior Vice President of Mainstream Technology Business.

Since its establishment, TSMC has not only strived for the highest achievements in its core business of dedicated IC foundry services but has also actively developed positive relationships with all stakeholders including employees, shareholders / investors, customers, suppliers / contractors, and society to fulfill its responsibility as a corporate citizen and pursue a sustainable future.

Analysis of Semiconductor Industry



TSMC holds over 55% of market share in the foundry market currently, benefitting from being the first-mover in the market three decades ago. TSMC has been able to maintain this share of the market as it continually reinvests profits back into the operations of the company.

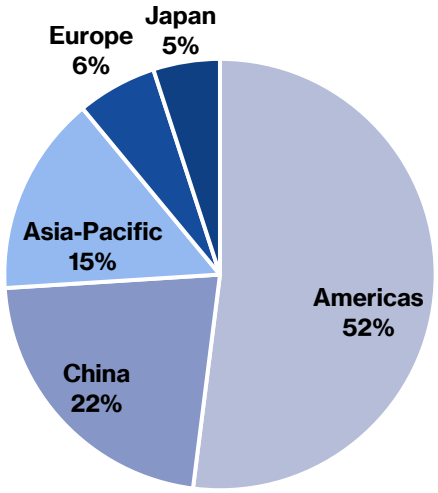
The pandemic has revealed that large companies with extended supply chains are more vulnerable to disruption in the past. As lockdown restrictions slowed economic activity, automakers idled factories amid waning demand. US orders for durable goods declined by an astounding 18.2% last April alone. As the US slid into recession, automakers' just-in-time cost-cutting inventory-management strategy, which helps control variable costs, seemed like a good idea given the sharp decline in demand. However, in the months that followed, demand for semiconductors reached a fever pitch alongside robust consumer tech spending on PCs, cell phones and other entertainment devices.

The ongoing microchip shortage emphasizes the vulnerability of the industry's supply chain, dominated by a few giant players like Taiwan Semiconductor Manufacturing Company (TSMC). Due to economies of scale, high barriers to entry and the global scope needed to compete effectively, a natural oligopoly has emerged.

Foundries are increasingly focusing on adopting automation, Machine Learning, and analytics. The benefits offered by these technologies, such as

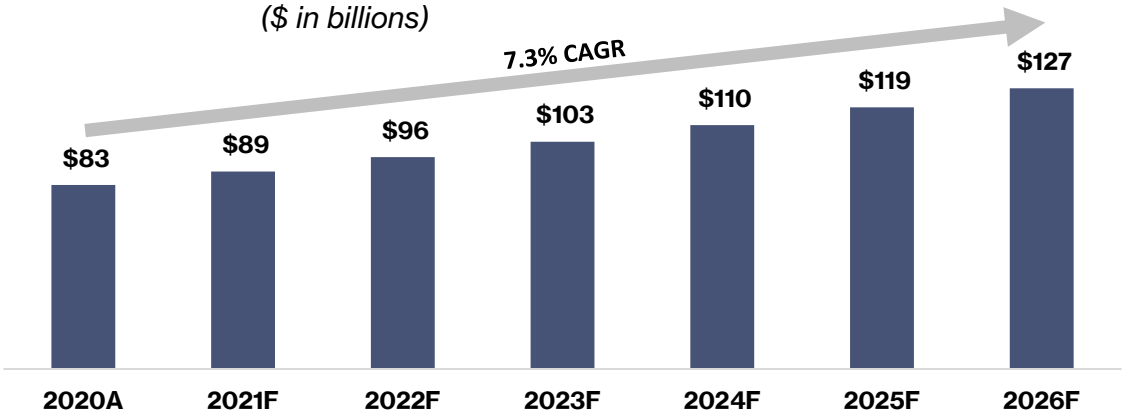
optimizing the production process and increasing the yield without compromising the quality, are driving their demand. With the high production capacities and reducing costs, vendors are expected to take up higher production contracts, resulting in significantly higher supplies.

2020F Pure-Play Foundry Sales by Region



By geography, the Americas are the primary end market for more than half of foundry sales in 2020. The trade tensions between China and the United States during the Trump administration are expected to continue under the Biden administration. Notably, China has grown from 8% of foundry sales in 2010 to 22% of sales in 2020, a 14% change in demand over the course of ten years. This represents the largest shift in demand of all end markets and is expected to grow considerably through this decade.

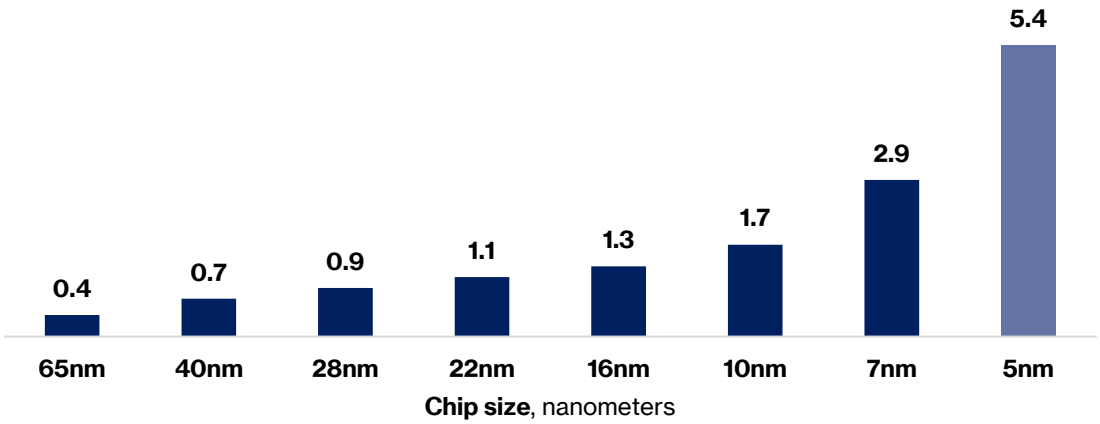
Semiconductor Foundry Industry Forecast
($ in billions)



The semiconductor foundry market is valued at $83.32 billion in 2020, and it is expected to reach $126.91 billion by 2026, registering a CAGR of 7.3%, during the period of 2021-2026. The semiconductor foundry sector witnessed strong revenue growth during the year 2020. Despite the effects of the COVID-19 pandemic, major vendors operating in this space observed significant revenue growth during the year, which is expected to further increase in 2021, owing to the growing demand for 5G smartphones and high-performance computing (HPC) products such as PCs, tablets, game consoles, servers, and 5G base station.

One of the more cyclical sectors in the market, the semiconductor industry enjoys increased spending on the corporate and consumer sides during times of economic prosperity. Increased sales are important to the industry because higher sales allow for improved fixed cost absorption. The foundry industry serves one of the most unique group of customers in the world, one which buys

Fab Module Construction Cost
($ in billions)

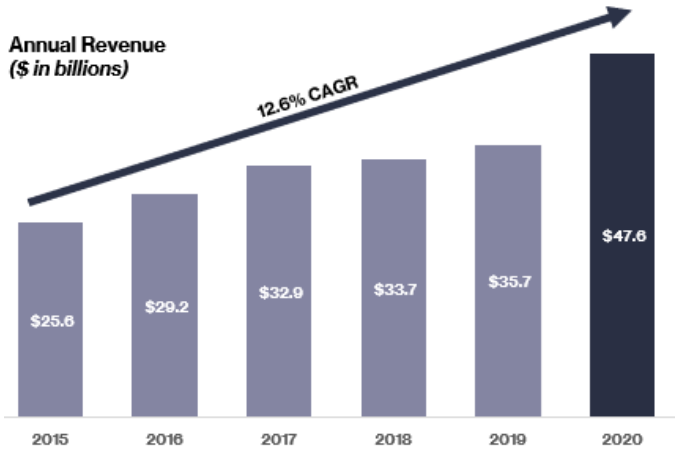


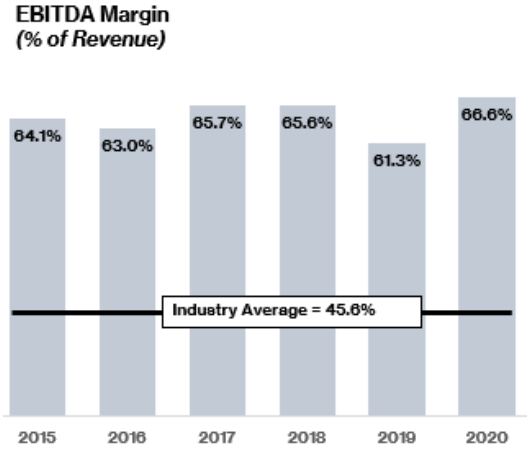
advanced new products long before the previous product has become dysfunctional.

The foundry industry has a low threat of disruption due to the highly capital-intensive operations that come with fabrication. Fabrication plants cost over $400 million to construct, with TSMC's GIGAFAB requiring over $9 billion in construction expenses. Construction also takes upwards of two years to build a fab, with a 3-month production time for any given integrated chip.

Financial Analysis

Historically, TSMC has experienced appreciation in the value of their stock directly associated with the announcement or anticipation of new technological processes. Most recently, the 5nm process began manufacturing in 2020, with implications of its technological advantages to previous generations seen in Apple's A14 Bionic chip (iPhone 12, iPad Air).





The effects of the pandemic have not slowed down TSMC's top line growth as revenues outpaced 5-year growth for a 33% YoY growth from FY2019. On a 5-year basis, compounded annual growth rate stands at 12.6%, aided by the Company's strong performance in 2020.

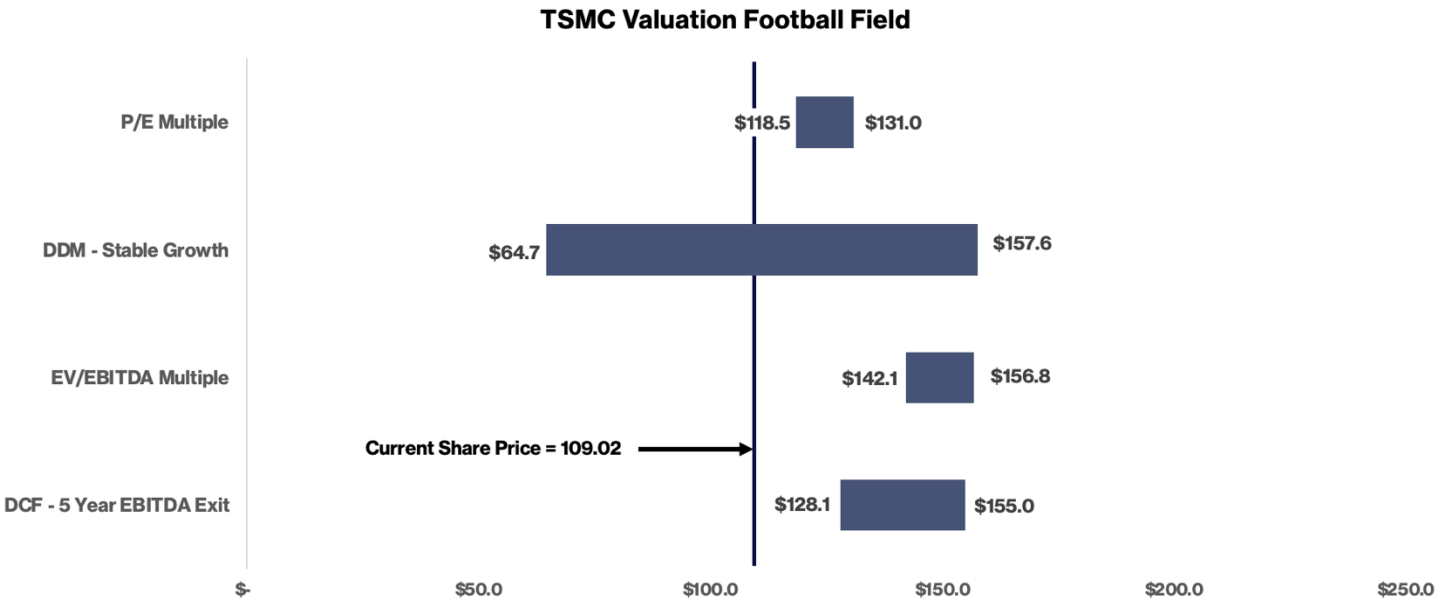
EBITDA margin for the Company remains around the mid-sixties, twenty percentage points above the industry average of 45.6%. TSMC is able to generate a substantial bump above peers in EBITDA margin due to its sustained position in the market given strong demand from significant global investments across 5G networks, high performance computing and electrical vehicles.

As of December 9th, 2021

Name	Ticker	Stock Price	Market Cap ($B)	EV ($B)	P/B	P/E	Dividend /share	Dividend Yield
Applied Materials, Inc.	AMAT	155.11	142.0	137.6	11.4x	23.7x	$ 0.96	0.6%
Intel Corporation	INTC	50.77	210.5	203.1	2.3x	9.8x	$ 1.39	2.7%
NVIDIA Corporation	NVDA	312.93	795.6	772.5	32.8x	95.0x	$ 0.16	0.1%
Tower Semiconductor Ltd.	TSEM	37.63	4.2	3.6	2.6x	31.5x	-	0.0%
Taiwan Semiconductor Manufacturing Company Ltd.	TSM	120.66	568.6	547.4	7.5x	27.3x	$ 1.55	1.3%
Texas Instruments Incorporated	TXN	195.38	181.4	178.1	14.8x	24.7x	$ 4.60	2.3%

Compared to industry peers, TSMC has the second largest market capitalization (568.6B), with a price-to-book multiple of 7.5x and a price-to-earnings ratio of 27.3x, fourth and third in class, respectively. TSMC also gives a healthy dividend at $1.55 a share, at a 1.3% yield.

Valuation



Four methods of valuation were considered for TSMC, including two comparable companies' analysis, price-to-earnings and enterprise value to EBITDA, respectively, as well as a dividend-discount model and discounted cash-flow model. A consensus value of TSMC is $128.5, providing an upside target of 18%.

With the comparable companies' analysis for price to earnings ratios in *Figure 1*, TSMC was benchmarked against Intel, STMicroelectronics, NVIDIA, Tower Semi and Texas Instruments.

Figure 1

	INTEL	STMICROELECTRONICS	NVIDIA	TOWER SEMI	TEXAS INSTRUMENTS	TSMC
	Nasdaq:INTC	NYSE:STM	Nasdaq:NVDA	Nasdaq:TSEM	Nasdaq:TXN	NYSE:TSM
Current Trading Multiples						
EV / LTM EBITDA	6.4x	12.7x	61.1x	7.3x	21.8x	14.8x
Price / LTM Sales	2.8x	3.2x	24.0x	2.3x	10.8x	10.4x
LTM P/E Ratio	**11.8x**	**23.8x**	**74.2x**	**29.9x**	**27.1x**	**27.1x**

TSMC Fair Value	**Low**	**Mid**	**High**
(TWD in millions)			
Benchmark LTM P/E Ratio	11.8x	27.1x	74.2x
Historical LTM P/E Ratio	15.5x	17.4x	28.0x
Selected P/E Multiple	27.9x	29.4x	30.9x
(x) LTM Net Income (TWD)	554,126	554,126	554,126
(=) Equity Value (TWD)	15,466,881	16,280,927	17,094,973
(/) Shares Outstanding	4,520.7	4,520.7	4,520.7
Implied Value Range	3,421.32	3,601.39	3,781.46
FX Rate: TWD/USD	28.1	28.1	28.1
Implied Value Range (USD)	121.79	**128.20**	134.61
Upside / (Downside)	10.7%	16.5%	22.3%

Three scenarios were used in this assumption, with low, mid and high projections of implied value. The average P/E multiple was taken from the field

of comparable companies, multiplied by LTM Net Income to find the equity value. Finally, the equity value is divided by shares outstanding, giving implied value in Taiwan dollars. Accounting for FX rates, TSMC is valued at $128.2 a share at time of valuation.

A comparable companies' analysis for EV/EBITDA was also done, with the same approach as the previous model. Taking the EV/LTM EBITDA average of all benchmarked companies, an intrinsic value range was derived at $148.74.

Figure 2

Revenue and EBITDA Forecast

(TWD in millions)

Fiscal Years Ending	Dec-20	Dec-21	Dec-22	Dec-23	Dec-24	Dec-25
Unlevered FCF 5YR CAGR	17.8%	17.8%	17.8%	17.8%	17.8%	17.8%
Revenue	1,339,255	1,576,161	1,854,418	2,178,144	2,580,393	2,873,859
% Growth	*25.2%*	*17.7%*	*17.7%*	*17.5%*	*18.5%*	*11.4%*
EBITDA	892,158	1,061,342	1,288,054	1,567,319	1,866,161	**1,915,955**
% of Revenue	*66.6%*	*67.3%*	*69.5%*	*72.0%*	*72.3%*	*66.7%*

TSMC Fair Value

(TWD in millions)

		Low	Mid	High
Company LTM EBITDA Multiple		14.7x	14.7x	14.7x
Benchmark LTM EBITDA Multiple		5.4x	18.9x	126.0x
Historical LTM EBITDA Multiple		7.8x	9.0x	16.1x
Selected EBITDA Exit Multiple	**1,915,955**	10.3x	11.3x	12.3x
Terminal Value		19,733,439	21,649,394	23,565,349
Implied Fair Value		126.74	**139.83**	153.41
Implied Exit Revenue Multiple	2,573,859	7.7x	8.4x	9.2x
Implied Perpetuity Growth Rate	758,753	4.7%	4.6%	4.4%

A discounted cash-flow model was also used, projecting the 5-year EBITDA exit for the Company, shown above in *Figure 2*, concluding an implied fair value of $139.83.

Figure 3

PV of Discrete Dividends

Discounted to Present

(TWD in millions)

	Dividends	Low	Mid	High
Dec-21	207,169	207,069	207,074	207,079
Dec-22	460,636	431,539	433,022	434,518
Dec-23	594,181	510,101	514,211	518,373
Dec-24	772,397	607,651	615,366	623,215
Dec-25	847,640	611,084	621,691	632,532
PV of Discrete Dividends		2,367,443	2,391,363	2,415,717

PV of Terminal Value

	Low	Mid	High
Terminal Dividend	871,185	871,185	871,185
Perpetuity Growth Rate	4.8%	5.0%	5.3%
Cost of Capital	9.1%	8.6%	8.1%
Projected Terminal Value	20,858,666	25,234,334	31,892,959
(x) Terminal Discount Factor	69.0%	70.4%	71.8%
Present Value of Terminal Value	14,395,070	17,757,836	22,887,747

TSMC Fair Value

(TWD in millions)

	Low	Mid	High
Cost of Capital	9.1%	8.6%	8.1%
PV of Discrete Dividends	2,367,443	2,391,363	2,415,717
(+) PV of Terminal Value	14,395,070	17,757,836	22,887,747
Total Equity Value (TWD)	16,762,514	20,149,200	25,303,464
(/) FX Rate Adjustment	28.1	28.1	28.1
Total Equity Value (USD)	596,531	717,053	900,479
(/) Shares Outstanding	4,520.7	4,520.7	4,520.7
Implied Stock Price (Fair Value)	131.95	**158.61**	199.19
Upside / (Downside)	*18.3%*	*42.2%*	*78.5%*

Finally, a dividend-discount model assuming stable growth was used to project an implied fair value of $158.61 by taking the present value of discrete dividends and adding it to the present value of terminal value to derive total equity value, adjusted for the FX rate to arrive at total equity value in USD. Total equity value divided by shares outstanding results in the final implied stock value.

Investment Considerations

Risk: Geopolitical Tension

The first and most impactful risk to TSMC's operation and supply chain is political tension between Taiwan and China. Taiwan is where the majority of TSMC's operation is located and China's recent posturing to unify all of China, including Hong Kong and Taiwan is highly concerning for TSMC. Politically, China wants to assume Hong Kong and Taiwan to bolster the Chinese economy as well as push foreign powers out of areas of Chinese interest. Taiwan along with Japan, South Korea and the Philippines act as a proxy to the United States as a strategic ally over shared interests of political freedom.

Mitigants: TSMC has actively sought solutions to this geopolitical tension, which is ultimately out of their control, but has announced plans to the spend $100 billion in investment over to next three years to expand its fabrication network, including a GIGAFAB in Arizona, diversifying its core supply-chain by adding a flagship fabrication facility outside of Taiwan, as well as another wafer research lab in Japan.

Risk: COVID-19 and Pandemic Related Disruption

Further disruption due to the pandemic and physical operation closures pose a risk to the global supply-chain as TSMC produces products for end markets oceans away from Taiwan. As seen during 2020, TSMC had no major impact on their ability to function operationally because production has been automated pre-pandemic.

Mitigants: TSMC can create more automated fabrication facilities so that physical employees have less contact points in production. As mentioned previously, in an effort to diversify the Company's supply chain network, building fabrication facilities outside of Taiwan is crucial to mitigate supply-chain disruptions, and having a fab in the country that is the majority of TSMC's end market will solve a lot of demand related issues.

Risk: Loss in Innovation

Inability to lead the 3nm market and subsequently new technology markets will lead to loss of market share for the Company.

Mitigants: Increased capital expenditure to create facilities to facilitate fabrication of these new technologies will keep TSMC in its current position of market dominance.