

Asian and European Semiconductors and Equipment

TSMC & Semicap: IDM 2.0? Or ICF 2.0? Thoughts on Intel's New Strategy

Mark Li

+852-2918-5752
Mark.Li@bernstein.com

Edward Hou, CFA
+852-2918-5796
edward.hou@bernstein.com

Hanxu Wang, CFA
+852-2918-5703
hanxu.wang@bernstein.com

We summarize our quick thoughts on the new strategy announced just now.

Why can Intel Foundry Services (IFS) succeed this time when last time Intel had technology leadership but still failed? IFS is the most important element of Intel's "IDM 2.0" strategy, but it is not new. Intel (covered by Stacy Rasgon) tried foundry before (called Intel Customer Foundry (ICF)), but failed even though the company had a technology advantage then. Now Intel's behind, and will only have 7nm in 2023, but by then the smartphone chips from Apple, QCOM, & even MediaTek will need TSMC's 3nm (equivalent to Intel's 5nm). Why will these customers bother, when Intel may or may not deliver 7nm on time and, even if Intel delivers, they'll be at a disadvantage vs. rivals who use TSMC's 3nm? AMD & NVDA won't bother either, as Intel is a competitor. Without these customers, how can IFS gain meaningful traction this time?

So who will fill the two fabs that Intel is building with US\$20B? How can Intel address the business conflict that Samsung or all others can't solve? QCOM endorsed IFS today, but Intel's technology isn't good enough for QCOM. Amazon, Cisco, Ericsson, Google, IBM, Microsoft are small and their chips ironically actually compete with Intel's. DoC & DoD also endorsed, but the size of the demand that governments can sway is small too. Hence the 2 fabs likely will be mostly filled by Intel's own chips. "Dedicated capacity" is just a nice marketing spin, and who knows how Intel will allocate capacity amid supply tightness? Remember Samsung and all other IDM foundries offer the same "dedicated capacity" commitment but still get a limited share in the foundry market.

Technology & foundry business model will make TSMC eventually prevail. Intel claims its 7nm is "fixed" and 7nm "design" will be ready in 2021, but no one can validate that until 2023 when it enters production. Even IF (a big IF) it starts production on time in 2023, Intel will be still behind in technology vs. TSMC. We understand to regain technology leadership, the new Intel CEO has no choice but to invest more and IFS is an attempt to get more customers to share the cost. However, the inferior technologies will make IFS or whatever business adjustments very challenging. We believe with a deep pocket & governmental support, Intel's struggle will continue, likely for years, but outsourcing is inevitable & TSMC will still prevail eventually.

We reiterate our positive stance on TSMC and view any pullback an opportunity to add more. Intel's higher capex guide is also positive for ASML, Tokyo Electron and other equipment suppliers. On outsourcing, Intel's comment today offered no change – still majority internally, but more foundries will be used. This is identical to what Intel said a few months ago and is consistent with our assumption of 20% of CPUs outsourced to TSMC in 2023. Today's announcement may trigger a negative stock reaction, but it is just time to add more TSMC. In addition to the US\$20B that Intel budgets for the 2 new fabs, Intel also raised 2021's capex to US\$19-20B. This exceeds our expectation and is good for semicap suppliers broadly. Among them, ASML and KLA (not covered) are levered to logic spend and likely will benefit more.



Analyst Page



Bernstein Events



Industry Page

BERNSTEIN TICKER TABLE

| | | | 23 Mar 2021 | | TTM | EPS Reported | | | P/B | | | |
|--------------------|--------|-----|---------------|--------------|------------|--------------|----------|----------|----------|-------|-------|-------|
| Ticker | Rating | | Closing Price | Target Price | Rel. Perf. | | 2020A | 2021E | 2022E | 2020A | 2021E | 2022E |
| ASX | O | USD | 7.65 | 6.70 | 63.5% | USD | 0.26 | 0.41 | 0.48 | 29.71 | 18.46 | 15.85 |
| 3711.TT (ASE) | O | TWD | 108.00 | 94.00 | 22.3% | TWD | 3.96 | 5.86 | 6.83 | 27.30 | 18.42 | 15.82 |
| ASML | M | USD | 558.87 | 520.00 | 64.9% | USD | 9.70 | 11.56 | 14.18 | 57.60 | 48.34 | 39.41 |
| ASML.NA | M | EUR | 472.50 | 435.00 | 74.8% | EUR | 8.50 | 10.13 | 12.42 | 55.60 | 46.66 | 38.04 |
| 1347.HK (Hua Hong) | M | HKD | 41.70 | 39.00 | 139.8% | USD | 0.13 | 0.04 | 0.08 | 3.08 | 2.94 | 2.84 |
| IFX.GR | O | EUR | 34.27 | 43.00 | 148.8% | EUR | 0.64 | 1.13 | 1.36 | 53.96 | 30.27 | 25.22 |
| 2454.TT (MediaTek) | O | TWD | 870.00 | 1,080.00 | 89.6% | TWD | 26.01 | 39.71 | 49.05 | 33.45 | 21.91 | 17.74 |
| 3034.TT (Novatek) | O | TWD | 533.00 | 535.00 | 155.3% | TWD | 19.42 | 32.87 | 31.55 | 27.45 | 16.22 | 16.89 |
| 981.HK (SMIC) | U | HKD | 25.35 | 14.90 | 32.6% | USD | 0.05 | 0.09 | 0.03 | 2.91 | 1.71 | 1.68 |
| TSM | O | USD | 114.89 | 149.00 | 79.1% | USD | 3.39 | 3.83 | 4.34 | 9.12 | 7.98 | 6.93 |
| 2330.TT (TSMC) | O | TWD | 594.00 | 800.00 | 45.5% | TWD | 19.98 | 21.61 | 24.49 | 8.33 | 7.31 | 6.35 |
| 8035.JP (Tokyo) | O | JPY | 42,120 | 46,000 | 54.6% | JPY | 1,155.86 | 1,504.59 | 1,776.68 | 36.44 | 27.99 | 23.71 |
| UMC | M | USD | 8.44 | 7.30 | 203.7% | USD | 0.13 | 0.34 | 0.37 | 2.88 | 2.63 | 2.58 |
| 2303.TT (UMC) | M | TWD | 48.50 | 41.00 | 173.6% | TWD | 0.82 | 1.92 | 2.10 | 2.75 | 2.66 | 2.62 |
| 5347.TT (Vanguard) | M | TWD | 108.50 | 105.00 | 14.8% | TWD | 3.58 | 3.75 | 4.59 | 6.02 | 5.99 | 5.56 |
| MSDLE15 | | | 1,705.02 | | | | 71.46 | 95.97 | 110.48 | 23.86 | 17.77 | 15.43 |
| MXAPJ | | | 683.46 | | | | 31.61 | 40.42 | 46.47 | 21.62 | 16.91 | 14.71 |
| MXJP | | | 1,199.57 | | | | 48.46 | 66.08 | 75.77 | 24.75 | 18.15 | 15.83 |
| SPX | | | 3,910.52 | | | | 137.10 | 170.56 | 196.84 | 28.52 | 22.93 | 19.87 |

O - Outperform, M - Market-Perform, U - Underperform, N - Not Rated

ASX,3711.TT,1347.HK,981.HK,UMC,2303.TT,5347.TT base year is 2019; IFX.GR eps type is EPS Adjusted; IFX.GR valuation type is P/E Adjusted;ASX,3711.TT,ASML,ASML.NA,2454.TT,3034.TT,8035.JP valuation type is P/E Reported;

INVESTMENT IMPLICATIONS

We rate **TSMC Outperform** with TP=NT\$800

We rate **ASML Market-Perform** with TP=€435

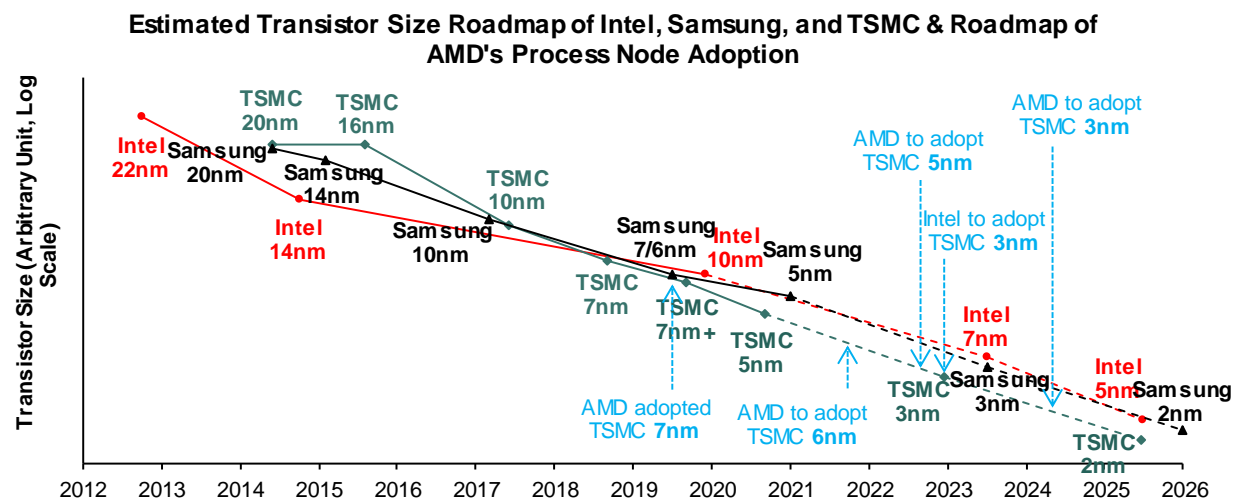
DETAILS

We summarize our quick thoughts on the new strategy announced by Intel (covered by our US semi analyst Stacy Rasgon) just now.

Why can Intel Foundry Services succeed this time when last time Intel had technology leadership but still failed?

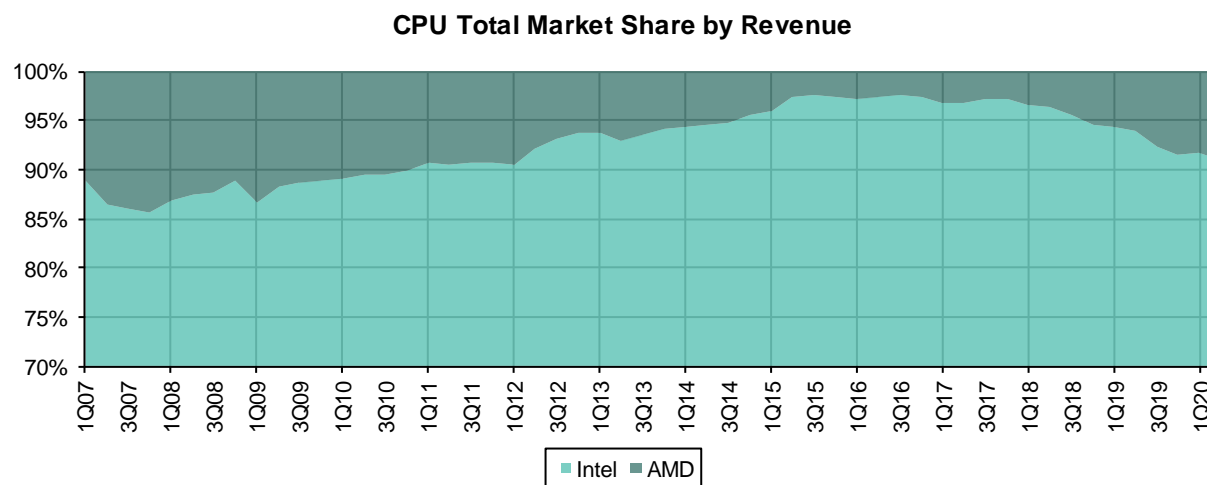
- Though named differently, Intel Foundry Services (IFS), is no different from the Intel Custom Foundry (ICF) that Intel began to offer as early as 2010. The rationale was similar - scale - and ICF even got Altera, once a loyal customer of TSMC, as a customer to share the rising cost of advanced technologies. Most importantly, Intel still commanded manufacturing technology leadership over any foundry then (**Exhibit 1**), and was actually in a process of gaining more share from AMD and solidifying its dominance in the CPU market (**Exhibit 2**). Mobile was also in early innings, and the market was still nascent & developing and ICF's technology was good enough to address the needs of even top-notch smartphones. Now Intel has lost its technology lead and IFS won't be offering 7nm until 2023. As TSMC will have 3nm (equivalent to Intel's 5nm) then, Intel's 7nm will be effectively 2-3 years old, certainly not good enough for high-end smartphones like iPhone, likely not even for low-end ones. AMD and NVIDIA may find Intel's 7nm suitable for part of their product portfolio then, but why AMD & NVDA will work with their primary competitor Intel? And without smartphone SoCs and GPU/CPU, how can IFS gain share?

EXHIBIT 1: Intel commanded advantage in process technology over TSMC but has lagged behind since 2018.



Source: Company reports, Bernstein estimates (2021+) analysis

EXHIBIT 2: Intel was gaining share continuously from AMD in CPU until 2016.



Source: Mercury and Bernstein analysis

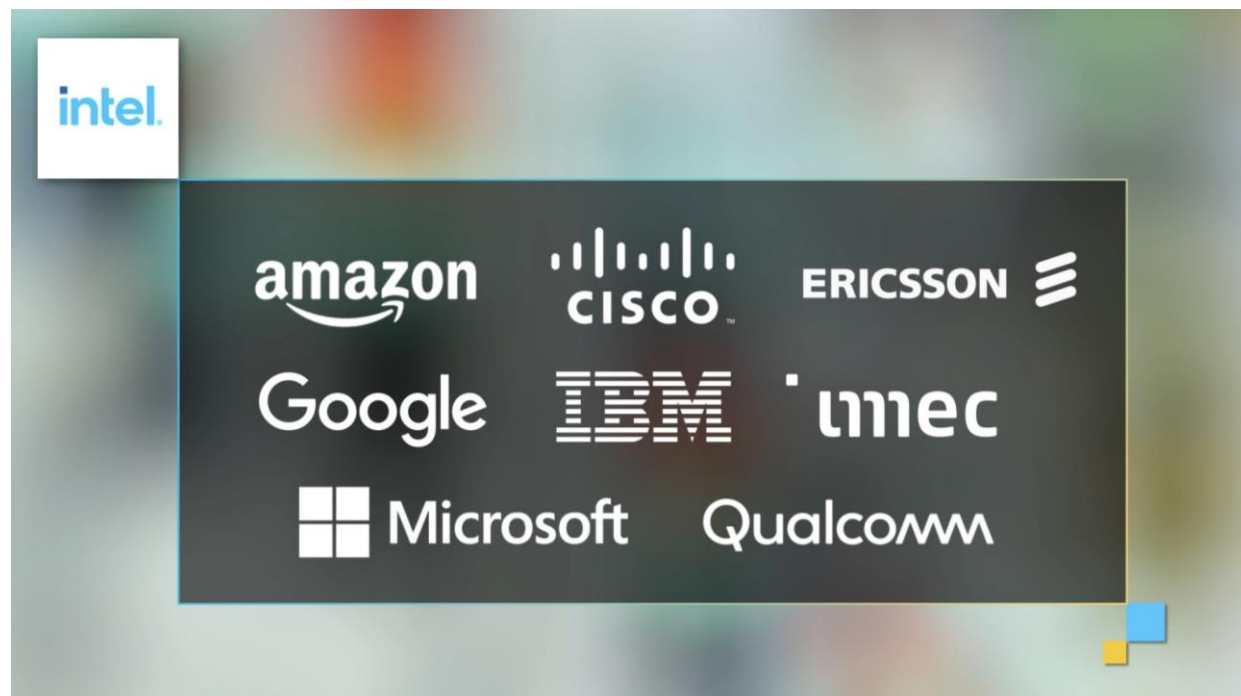
So who will fill the two fabs that Intel is building with US\$20B? How can Intel address the business conflict that Samsung or all others can't solve?

- + Among all that endorsed IFS today (**Exhibit 3**), QCOM is the only meaningful one, but Intel's technology likely won't be good enough for QCOM. Others like Amazon, Cisco, Ericsson, Google, IBM, Microsoft are small and won't move the needle even collectively.
- + We note that US Department of Commerce and Department of Defense also shared their endorsement today. Though Intel said the 2 fabs and the new strategy does not require a penny from the government, clearly Intel will be happy to get subsidies. Stressing the capacity on US soil, and maybe in Europe in the future, Intel highlighted the company is well positioned to make the sensitive chips that need to be made locally. We agree that despite TSMC is also building a fab in Arizona, Intel, as a US company, has an advantage in this segment, but does it matter given the limited size of the demand

that governments can sway (please see our dimension exercise in [Weekend Tech Byte: "Real men have fabs" again?](#))? Some worry that governments will pressure QCOM or even Apple to use a US foundry, but that will just allow MediaTek and Android OEMs to take advantage of TSMC's better technologies to gain share.

- + So except Intel itself who can fill the fabs and justify the US\$20B investment? Intel mentioned "dedicated capacity" for foundry customers, and that sounds particularly tempting amid the severe supply shortage now. However clearly Intel will be using the same fabs too as none of interested customers is big enough to fill them. And more interestingly these interested customers are trying to replacing Intel's CPUs with their own chips. That creates the same inherent conflict that keeps all IDM foundries small. This business model conflict is why Samsung's foundry is small, despite the company has technologies relatively better than Intel's and much closer to TSMC's.

EXHIBIT 3: **Potential customers for Intel's foundry services highlighted by Intel**



Source: Intel

Technology & foundry business model will make TSMC eventually prevail.

- + Intel claims its 7nm is "fixed" and 7nm "design" will be ready in 2Q21, but no one can validate that claim until 2023 when the technology according to Intel will enter production. Even if it is indeed fixed and starts production on time in 2023, Intel will be still behind in technology. We understand to regain technology leadership, the new Intel CEO has no choice but to invest more and the new foundry services is an attempt to get more customers to share the cost. However, the inferior technologies will fundamentally make IFS or whatever business adjustments very challenging.
- + This is why we advocate foundries, particularly TSMC, will eventually prevail. With a deep pocket and governmental support, Intel will surely make attempts, likely multiple of them, to regain the leadership. AMD went through a 10-year journey to become total fabless, and the journey for Intel can be even longer. However not being a pure foundry will always make Intel sub-scaled and hence uncompetitive vs. the combination of TSMC+AMD & many other fabless who strive to get a piece of the very lucrative CPU market.

We reiterate our positive stance on TSMC and view any pullback an opportunity to add more. Intel's higher capex guide is also positive for ASML, Tokyo Electron and other equipment suppliers.

- + On outsourcing, Intel's comment today offered no change. Majority will be made internally, but more foundries will be used. Some chips will be done with a mix-and-match approach, with different dies (Intel calls them "tiles") made by different manufacturers on different nodes, and Intel will package them together with chiplet technology. This is identical to what Intel said a few months ago and is consistent with our assumption of 20% of CPUs outsourced to TSMC in 2023.
- + In summary for TSMC, IFS won't be a meaningful threat and the outsourcing from Intel will still happen. The announcement will trigger a negative reaction from the Street, but we see that as an entry point and will recommend investors to accumulate more TSMC.
- + In addition to the US\$20B that Intel budgets for the 2 new fabs, Intel also raised 2021's capex to US\$19-20B. This exceeds our expectation and is good for semicap suppliers broadly. Among them, ASML and KLA (not covered) are levered to logic spend and likely will benefit more.

DISCLOSURE APPENDIX

VALUATION METHODOLOGY

Asian and European Semiconductors and Equipment

We use Price to NTM tangible book value to value foundries and Price to One-Year Forward Earnings to value design, OSAT & equipment companies.

RISKS

Asian and European Semiconductors and Equipment

The Asian & European Semiconductors & Semiconductor Equipment sector is exposed to general macroeconomic risks which ultimately influence end-market demand and can positively or negatively affect the entire electronics supply chain. In addition to the effects of macroeconomic factors, the semiconductor industry has historically been subject to seasonal and cyclical demand fluctuations for its products or services. These industry downturns have been characterized by diminished product demand, excess manufacturing capacity, subsequent erosion of average selling prices, etc. Any factors affecting the semiconductor industry can impose an upside or a downside risk to our forecasts. We highlight some important risks below:

FX Risk. Exchange rate fluctuation poses substantial risk to Asian semiconductor companies' revenue and profit. This is because their products and services are mostly denominated in US dollars but some of their cost components are denominated in NT dollars, Japanese yen or other domestic currencies. A strong domestic currency and a weakening US dollar will impose pressure on the company's revenue and profitability and hence would affect earnings on the downside.

Demand Risk. Macroeconomic environment will seriously affect the semiconductor industry as the industry is more volatile and cyclical in general. This risk mostly manifests itself in a change in end market demand first and then gradually ripples throughout the electronics supply chain and eventually impacts the upstream players such as foundry, OSAT or fabless companies. This can be either an upside or a downside risk to our forecasts.

Supply Risk. Disruption and imbalance in the electronics supply chain - either on a semiconductor company, on its suppliers/distributors, or on its customers - will create a chain effect and impact the company's ability to fully utilize its capacity and deliver its financial performance as planned. This risk can be shown in the raw material supply as it sometimes accounts for a large portion of the manufacturing costs and any supply shortage can lead to reduced shipments or increased costs.

Technology Risk. Delay or acceleration in the development and commercialization of new technologies will impact the competitive landscape of the semiconductor industry. For instance, some companies may lose or gain market share; the price premium or discount vs. competitors may narrow or widen.

Competition Risk. Competition, especially any accelerated capacity expansion, will lead to spare capacity in the semiconductor industry. As competitors may cut price in order to grab demand to fill idle capacity, a company might suffer lower price and margin as a result. On the other hand, if the capacity expansion from competitors takes place more slowly than expected, the company is likely to enjoy better price and margin, leading to an upside risk to our forecasts and target price.

Product Risk. Any major delay in the company's new product launches can result in a downside risk to our forecasts. This risk is especially remarkable for IC design companies as the market window for them is often very narrow. Missing the market window due to product delays can result in much smaller market share and inferior pricing.

REQUIRED REGULATORY DISCLOSURES

- Separate branding is maintained for "Bernstein" and "Autonomous" research products. Each brand operates as a separate business unit within the regulated entities referenced herein namely: Sanford C. Bernstein & Co., LLC, Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司 and Bernstein Autonomous LLP. For information relating to "Autonomous" branded products (including certain Sales materials) please visit: www.autonomous.com. For information relating to Bernstein branded products please visit: www.bernsteinresearch.com. Recommendations contained within one type of research product may differ from recommendations contained within other types of research products, whether as a result of differing time horizons, methodologies or otherwise. Furthermore, views or recommendations within a research product issued under any particular brand may differ from views or recommendations under the same type of research product issued under another brand. The Research Ratings System for the Autonomous brand and the Bernstein brand and other information related to those Rating Systems are below.
- On and as of April 1, 2019, AllianceBernstein L.P. acquired Autonomous Research. As a result of the acquisition, the research activities formerly conducted by Autonomous Research US LP were assumed by Sanford C. Bernstein & Co., LLC, which continues to publish research under the Autonomous Research US brand and the research activities formerly conducted by Autonomous Research Asia Limited were assumed by Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司, which continues to publish research under the Autonomous Research Asia brand.
- On and after close of business on December 31, 2020, as part of an internal reorganisation of the corporate group, Sanford C. Bernstein Limited transferred its business to its affiliate Autonomous Research LLP. Subsequent to this transfer, Autonomous Research LLP changed its name to Bernstein Autonomous LLP. As a result of the reorganisation, the research activities formerly conducted by Sanford C. Bernstein Limited were assumed by Bernstein Autonomous LLP, which is authorised and regulated by the Financial Conduct Authority (FRN 500498) and now publishes research under the Bernstein Research Brand.
- Please note that all price targets, recommendations and historical price charts are unaffected by the transfer of the business from Sanford C. Bernstein Limited and have been carried forward unchanged to Bernstein Autonomous LLP. You can continue to find this information on the Bernstein website at www.bernsteinresearch.com.
- References to "Bernstein" or the "Firm" in these disclosures relate to the following entities: Sanford C. Bernstein & Co., LLC, Bernstein Autonomous LLP, Sanford C. Bernstein Limited (for dates prior to January, 1, 2021), Autonomous Research LLP (for dates between April 1, 2019 and December 31, 2020), Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司, Sanford C. Bernstein (Canada) Limited, Sanford C. Bernstein (India) Private Limited (SEBI registration no. INH000006378) and Sanford C. Bernstein (business registration number 53193989L), a unit of AllianceBernstein (Singapore) Ltd. which is a licensed entity under the Securities and Futures Act and registered with Company Registration No. 199703364C.
- Analysts are compensated based on aggregate contributions to the research franchise as measured by account penetration, productivity and proactivity of investment ideas. No analysts are compensated based on performance in, or contributions to, generating investment banking revenues.
- The Bernstein brand rates stocks based on forecasts of relative performance for the next 6-12 months versus the S&P 500 for stocks listed on the U.S. and Canadian exchanges, versus the MSCI Pan Europe Index for stocks listed on the European exchanges (except for Russian companies), versus the MSCI Emerging Markets Index for Russian companies and stocks listed on emerging markets exchanges outside of the Asia Pacific region, and versus the MSCI Asia Pacific ex-Japan Index for stocks listed on the Asian (ex-Japan) exchanges - unless otherwise specified. The Bernstein brand has three categories of ratings:
 - Outperform: Stock will outpace the market index by more than 15 pp in the year ahead.
 - Market-Perform: Stock will perform in line with the market index to within +/- 15 pp in the year ahead.
 - Underperform: Stock will trail the performance of the market index by more than 15 pp in the year ahead.
 - Not Rated: The stock Rating, Target Price and/or estimates (if any) have been suspended temporarily.
- For purposes of the Market Abuse Regulation (MAR) and the FINRA Rule 2241, 'Outperform' is classified as a Buy, 'Market-Perform' is classified as a Hold, and 'Underperform' is classified as a Sell
- As of 03/23/2021, Bernstein branded ratings were distributed as follows: 314 Outperform - 51.1% (0.0% banking clients); 236 Market-Perform - 38.4% (0.0% banking clients); 65 Underperform - 10.6% (0.0% banking clients); 0 Not Rated - 0.0% (0.0% banking clients). The numbers in parentheses represent the percentage of companies in each category to whom Bernstein provided investment banking services. All figures are updated quarterly and represent the cumulative ratings over the previous 12 months. These ratings relate solely to the investment research ratings for companies covered under the Bernstein brand and do not include the investment research ratings for companies covered under the Autonomous brand. This information is provided in order to comply with Article 6 of the Commission Delegated Regulation (EU) 2016/958.
- Accounts over which Bernstein and/or their affiliates exercise investment discretion own more than 1% of the outstanding common stock of the following companies 2303.TT / United Microelectronics Corp.
- This research publication covers six or more companies. For price chart disclosures, please visit www.bernsteinresearch.com/go/disclosures, you can also write to either: Sanford C. Bernstein & Co. LLC, Director of Compliance, 1345 Avenue of the Americas, New York, N.Y. 10105 or Bernstein

Autonomous LLP, Director of Compliance, 50 Berkeley Street, London W1J 8SB, United Kingdom; or Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司, Director of Compliance, 39th Floor, One Island East, Taikoo Place, 18 Westlands Road, Quarry Bay, Hong Kong, or Sanford C. Bernstein (business registration number 53193989L), a unit of AllianceBernstein (Singapore) Ltd. which is a licensed entity under the Securities and Futures Act and registered with Company Registration No. 199703364C, Director of Compliance, One Raffles Quay, #27-11 South Tower, Singapore 048583.

12-Month Bernstein Rating History as of 03/22/2021

| Ticker | Rating Changes | |
|---------|----------------|--------------------------|
| 1347.HK | M (RC) | 04/03/18 |
| 2303.TT | M (RC) | 06/11/18 |
| 2330.TT | O (RC) | 01/12/21 M (RC) 01/30/12 |
| 2454.TT | O (RC) | 06/06/17 |
| 3034.TT | O (RC) | 03/14/18 |
| 3711.TT | O (IC) | 05/19/18 |
| 5347.TT | M (IC) | 11/17/15 |
| 8035.JP | O (IC) | 09/13/16 |
| 981.HK | U (RC) | 08/10/17 |
| ASML | M (RC) | 07/29/20 O (RC) 03/12/20 |
| ASML.NA | M (RC) | 07/29/20 O (RC) 03/12/20 |
| ASX | O (IC) | 05/19/18 |
| IFX.GR | O (IC) | 06/19/19 |
| TSM | O (RC) | 01/12/21 M (RC) 01/30/12 |
| UMC | M (RC) | 06/11/18 |

Rating Guide: O - Outperform, M - Market-Perform, U - Underperform, N - Not Rated

Rating Actions: IC - Initiated Coverage, DC - Dropped Coverage, RC - Rating Change

OTHER IMPORTANT DISCLOSURES

The Firm produces a number of different types of research products including, among others, fundamental analysis, quantitative analysis and analytics. Sanford C. Bernstein & Co., LLC, Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司, and Bernstein Autonomous LLP, each issue research products under the "Autonomous" publishing brand independently of the "Bernstein" and "Alphalytics" publishing brands. Recommendations contained within one type of research product may differ from recommendations contained within other types of research products, whether as a result of differing time horizons, methodologies or otherwise. Furthermore, views or recommendations within a research product issued under any particular brand may differ from views or recommendations under the same type of research product issued under another brand.

Where this material contains an analysis of debt product(s), such material is intended only for institutional investors and is not subject to the independence and disclosure standards applicable to debt research prepared for retail investors.

This document may not be passed on to any person in the United Kingdom (i) who is a retail client (ii) unless that person or entity qualifies as an authorised person or exempt person within the meaning of section 19 of the UK Financial Services and Markets Act 2000 (the "Act"), or qualifies as a person to whom the financial promotion restriction imposed by the Act does not apply by virtue of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005, or is a person classified as an "professional client" for the purposes of the Conduct of Business Rules of the Financial Conduct Authority.

This document may not be passed onto any person in Canada unless that person qualifies as "permitted client" as defined in Section 1.1 of NI 31-103.

To our readers in the United States: Sanford C. Bernstein & Co., LLC, a broker-dealer registered with the U.S. Securities and Exchange Commission ("SEC") and a member of the U.S. Financial Industry Regulatory Authority, Inc. ("FINRA") is distributing this publication in the United States and accepts responsibility for its contents. Any U.S. person receiving this publication and wishing to effect securities transactions in any security discussed herein should do so only through Sanford C. Bernstein & Co., LLC. Where this report has been prepared by research analyst(s) employed by a non-US affiliate (such analyst(s), "Non-US Analyst(s)") of Sanford C. Bernstein & Co., LLC, such Non-US Analyst(s) is/are (unless otherwise expressly noted) not registered as associated persons of Sanford C. Bernstein & Co., LLC or any other SEC-registered broker-dealer and are not licensed or qualified as research analysts with FINRA or any other US regulatory authority. Accordingly, reports prepared by Non-US Analyst(s) are not prepared in compliance with FINRA's restrictions regarding (among other things) communications by research analysts with a subject company, interactions between research analysts and investment banking personnel, participation by research analysts in solicitation and marketing activities relating to investment banking transactions, public appearances by research analysts, and trading securities held by a research analyst account.

To our readers in the United Kingdom: This publication has been issued or approved for issue in the United Kingdom by Bernstein Autonomous LLP, authorised and regulated by the Financial Conduct Authority and located at 50 Berkeley Street, London W1J 8SB, +44 (0)20-7170-5000.

To our readers in Ireland and the member states of the EEA: This publication is being distributed by Sanford C. Bernstein Ireland Limited, which is authorised and regulated by the Central Bank of Ireland.

To our readers in Hong Kong: This publication is being distributed in Hong Kong by Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司, which is licensed and regulated by the Hong Kong Securities and Futures Commission (Central Entity No. AXC846). This publication is solely for professional investors only, as defined in the Securities and Futures Ordinance (Cap. 571).

To our readers in Singapore: This publication is being distributed in Singapore by Sanford C. Bernstein, a unit of AllianceBernstein (Singapore) Ltd., only to accredited investors or institutional investors, as defined in the Securities and Futures Act (Chapter 289). Recipients in Singapore should contact AllianceBernstein (Singapore) Ltd. in respect of matters arising from, or in connection with, this publication. AllianceBernstein (Singapore) Ltd. is a licensed entity under the Securities and Futures Act and registered with Company Registration No. 199703364C. It is regulated by the Monetary Authority of Singapore and located at One Raffles Quay, #27-11 South Tower, Singapore 048583, +65-62304600. The business name "Bernstein" is registered under business registration number 53193989L.

To our readers in the People's Republic of China: The securities referred to in this document are not being offered or sold and may not be offered or sold, directly or indirectly, in the People's Republic of China (for such purposes, not including the Hong Kong and Macau Special Administrative Regions or Taiwan), except as permitted by the securities laws of the People's Republic of China.

To our readers in Japan: This document is not delivered to you for marketing purposes, and any information provided herein should not be construed as a recommendation, solicitation or offer to buy or sell any securities or related financial products.

For the institutional client readers in Japan who have been granted access to the Bernstein website by Daiwa Securities Group Inc. ("Daiwa"), your access to this document should not be construed as meaning that Bernstein is providing you with investment advice for any purposes. Whilst Bernstein has prepared this document, your relationship is, and will remain with, Daiwa, and Bernstein has neither any contractual relationship with you nor any obligations towards you

To our readers in Australia: Sanford C. Bernstein & Co., LLC, Bernstein Autonomous LLP and Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司 are exempt from the requirement to hold an Australian financial services licence under the Corporations Act 2001 in respect of the provision of the following financial services to wholesale clients:

- providing financial product advice;
- dealing in a financial product;
- making a market for a financial product; and
- providing a custodial or depository service.

To our readers in Canada: If this publication is pertaining to a Canadian domiciled company, it is being distributed in Canada by Sanford C. Bernstein (Canada) Limited, which is licensed and regulated by the Investment Industry Regulatory Organization of Canada ("IIROC"). If the publication is pertaining to a non-Canadian domiciled company, it is being distributed by Sanford C. Bernstein & Co., LLC, which is licensed and regulated by both the SEC and FINRA into Canada under the International Dealers Exemption. This publication may not be passed onto any person in Canada unless that person qualifies as a "Permitted Client" as defined in Section 1.1 of NI 31-103.

To our readers in India: This publication is being distributed in India by Sanford C. Bernstein (India) Private Limited (SCB India) which is licensed and regulated by Securities and Exchange Board of India ("SEBI") as a research analyst entity under the SEBI (Research Analyst) Regulations, 2014, having registration no. INH000006378 and as a stock broker having registration no. INZ000213537. SCB India is currently engaged in the business of providing research and stock broking services.

SCB India is a private limited company incorporated under the Companies Act, 2013, on April 12, 2017 bearing corporate identification number U65999MH2017FTC293762, and registered office at Level 6, 4 North Avenue, Maker Maxity, Bandra Kurla Complex, Bandra (East), Mumbai 400051, Maharashtra, India (Phone No: +91-22-68421401).

SCB India does not have any disciplinary history as on the date of this report.

The associates of SCB India or their relatives may have financial interest(s) in the subject company.

SCB India or its associates do not have actual/beneficial ownership of one percent or more securities of the subject company. SCB India is not engaged in any investment banking activities, as such, SCB India has not managed or co-managed a public offering in the past twelve months. In addition, neither SCB India nor any of its associates have received any compensation for investment banking services or merchant banking services from the subject company in the past 12 months.

SCB India or its associates may have received compensation for brokerage services from the subject company in the past twelve months.

SCB India or its associates may have received compensation for products or services other than investment banking or merchant banking or brokerage services from the subject company in the past twelve months.

SCB India and its associates have not received any compensation or other benefits from the subject company or third party in connection with the research report.

The principal research analysts who prepared this report, a member of his or her team, are not (nor are any members of their household) an officer, director, employee or advisory board member of the companies covered in the report.

SCB India and its associate company(ies) may act as a market maker in the financial instruments of the companies covered in the report.

Sanford C. Bernstein & Co., LLC, Bernstein Autonomous LLP, Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司, Sanford C. Bernstein (Canada) Limited and AllianceBernstein (Singapore) Ltd., Sanford C. Bernstein (India) Private Limited are regulated, respectively, by the Securities and Exchange Commission under U.S. laws, by the Financial Conduct Authority under U.K. laws, by the Hong Kong Securities and Futures Commission under Hong Kong laws, by the Investment Industry Regulatory Organization of Canada, by the Monetary Authority of Singapore under Singapore laws, and Securities and Exchange Board of India, all of which differ from Australian laws.

One or more of the officers, directors, or employees of Sanford C. Bernstein & Co., LLC, Bernstein Autonomous LLP, Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司, Sanford C. Bernstein (India) Private Limited, Sanford C. Bernstein (Canada) Limited, Sanford C. Bernstein (business registration number 53193989L), a unit of AllianceBernstein (Singapore) Ltd. which is a licensed entity under the Securities and Futures Act and registered with Company Registration No. 199703364C, and/or their affiliates may at any time hold, increase or decrease positions in securities of any company mentioned herein.

The Firm or its affiliates may provide investment management or other services to the pension or profit sharing plans, or employees of any company mentioned herein, and may give advice to others as to investments in such companies. These entities may effect transactions that are similar to or different from those recommended herein.

All Bernstein branded research publications are disseminated to our clients through posting on the firm's password protected website, www.bernsteinresearch.com. Certain, but not all, Bernstein branded research publications are also made available to clients through third-party vendors or redistributed to clients through alternate electronic means as a convenience. For access to all available Bernstein branded research publications, please contact your sales representative or go to <http://www.bernsteinresearch.com>

The Firm and/or its affiliates do and seek to do business with companies covered in its research publications. As a result, investors should be aware that the Firm and/or its affiliates may have a conflict of interest that could affect the objectivity of this publication. Investors should consider this publication as only a single factor in making their investment decisions.

This publication has been published and distributed in accordance with the Firm's policy for management of conflicts of interest in investment research, a copy of which is available from Sanford C. Bernstein & Co., LLC, Director of Compliance, 1345 Avenue of the Americas, New York, N.Y. 10105, Bernstein Autonomous LLP, Director of Compliance, 50 Berkeley Street, London W1J 8SB, United Kingdom, or Sanford C. Bernstein (Hong Kong) Limited 盛博香港有限公司, Director of Compliance, 39th Floor, One Island East, Taikoo Place, 18 Westlands Road, Quarry Bay, Hong Kong, or Sanford C. Bernstein (business registration number 53193989L), a unit of AllianceBernstein (Singapore) Ltd. which is a licensed entity under the Securities and Futures Act and registered with Company Registration No. 199703364C, Director of Compliance, One Raffles Quay, #27-11 South Tower, Singapore 048583, or Sanford C. Bernstein (India) Private Limited, Chief Compliance Officer, Level 6, 4 North Avenue, Maker Maxity, Bandra Kurla Complex, Bandra (East), Mumbai 400051. Additional disclosures and information regarding Bernstein's business are available on our website www.bernsteinresearch.com.

This report has been produced by an independent analyst as defined in Article 3 (1)(34)(i) of EU 296/2014 Market Abuse Regulation ("MAR").

This publication is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of, or located in any locality, state, country or other jurisdiction where such distribution, publication, availability or use would be contrary to law or regulation or which would subject Bernstein or any of their subsidiaries or affiliates to any registration or licensing requirement within such jurisdiction. This publication is based upon public sources we believe to be reliable, but no representation is made by us that the publication is accurate or complete. We do not undertake to advise you of any change in the reported information or in the opinions herein. This publication was prepared and issued by Bernstein for distribution to eligible counterparties or professional clients. This publication is not an offer to buy or sell any security, and it does not constitute investment, legal or tax advice. The investments referred to herein may not be suitable for you. Investors must make their own investment decisions in consultation with their professional advisors in light of their specific circumstances. The value of investments may fluctuate, and investments that are denominated in foreign currencies may fluctuate in value as a result of exposure to exchange rate movements. Information about past performance of an investment is not necessarily a guide to, indicator of, or assurance of, future performance.

CERTIFICATIONS

- Each research analyst named on the front page of this research report certifies that all of the views expressed in this publication accurately reflect his/her personal views about any and all of the subject securities or issuers and that no part of his/her compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views in this publication.

Approved By: SU

