

BERNSTEIN

2 March 2021

Where have all the semis gone?

Stacy A. Rasgon, Ph.D. • Senior Analyst • +1-212-756-4403 • stacy.rasgon@bernstein.com

Mark Li • Senior Analyst • +852-2918-5752 • mark.Li@bernstein.com

Arndt Ellinghorst • Senior Analyst • + 44-207-170-5064 • arndt.ellinghorst@bernstein.com

Key Takeaways

- Shortages have begun to plague the semiconductor industry and its customers. But the automotive industry has borne the brunt of these constraints due to a perfect storm of supply-chain whipsaws, much faster-than-expected demand recovery, and a channel that runs lean
- Other end markets have held up more resiliently through COVID than automotive, but are beginning to be impacted as well due to strong demand and tight capacity
- While these dynamics will raise concerns around sustainability, we believe the auto semi recovery itself has legs. Within our US coverage we recommend NXPI in particular as a good way to play the trend
- Infineon is also recommended for our European semi coverage

Key Takeaways

- **Shortages have begun to plague the semiconductor industry and its customers. But the automotive industry has borne the brunt of these constraints, due to a perfect storm of supply-chain whipsaws, much faster-than-expected demand recovery, and a channel that runs lean**
- Other end markets have held up more resiliently through COVID than automotive, but are beginning to be impacted as well due to strong demand and tight capacity
- While these dynamics will raise concerns around sustainability, we believe the auto semi recovery itself has legs. Within our US coverage we recommend NXPI in particular as a good way to play the trend.
- Infineon is also recommended for our European semi coverage

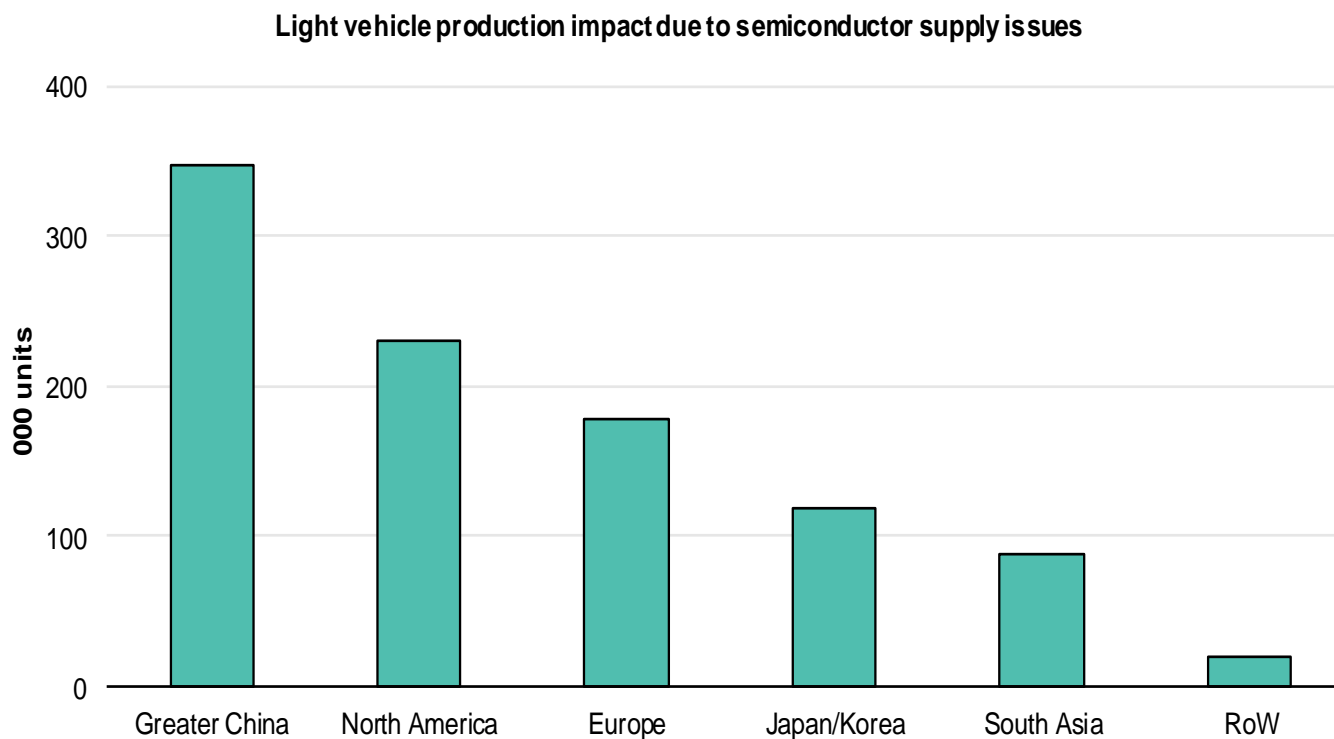
Many auto OEMs have pointed to semiconductor shortages impacting production

Company	Notes / Comments
GM	From an adjusted automotive free cash flow perspective, we estimate a 2021 impact from the Semiconductor shortage in the \$1.5 billion to \$2.5 billion range.
Honda	Honda is cutting production of its Civic and Accord sedans by roughly 2,200 cars this week in North America, down roughly a fifth from what had been originally scheduled
Ford	The situation is changing constantly, so it's premature to size what the shortage will mean for our full year results. However, right now, our current estimates from suppliers support a scenario, where we could lose 10% to 20% of our planned first quarter production. If that scenario is extended through the first half, this could adversely impact our full year adjusted EBIT by between \$1 billion and \$2.5 billion, net of reasonable cost recoveries and some production makeup in the second half of the year.
Nissan	Nissan lowered its target by 150,000 vehicles, or 3.6%, to 4.015 million units
Volkswagen	"It was hurting us already in December and we lost some 10,000 cars since then simply because we lost 50,000 cars in production in December because of some chips"
Daimler	Daimler will cut production and reduce working hours at a second factory , the latest automaker to suffer from a global shortage of semiconductors
Toyota	First of all, regarding semiconductors, I will explain about our situation. Semiconductors, there is a globally tight demand-supply situation. We are at a similar situation, but for the near term, we do not see any decrease in our production volume. Then, are we secured for the mid, long-term? No.
Chrysler	rationalizing its available semiconductor supply to build its most critical models. The company has delayed the restart of its Jeep Compass plant in Toluca, Mexico, and to idle the Brampton, Ontario plant where the Chrysler 300, Dodge Charger, and Dodge Challenger are built.

Source: Company reports, Bernstein analysis

Auto production will be impacted by 980K vehicles in Q1 due to semiconductor shortages

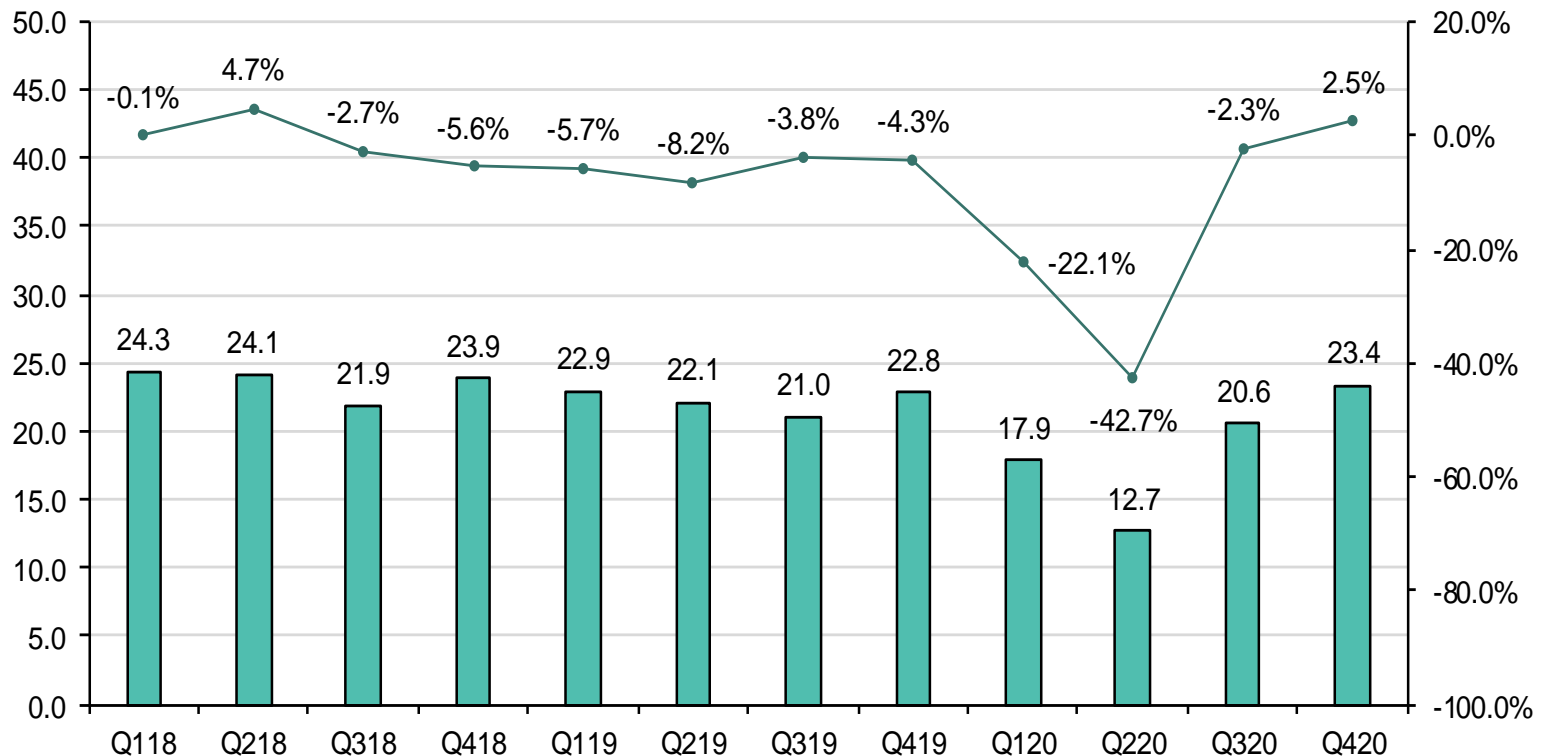
China appears to be the most impacted region, accounting for ~35% of global volume at risk, according to IHS Markit. It is followed by North America and Europe.



Note: Estimate as of February 19, 2021
Source: IHS and Bernstein analysis

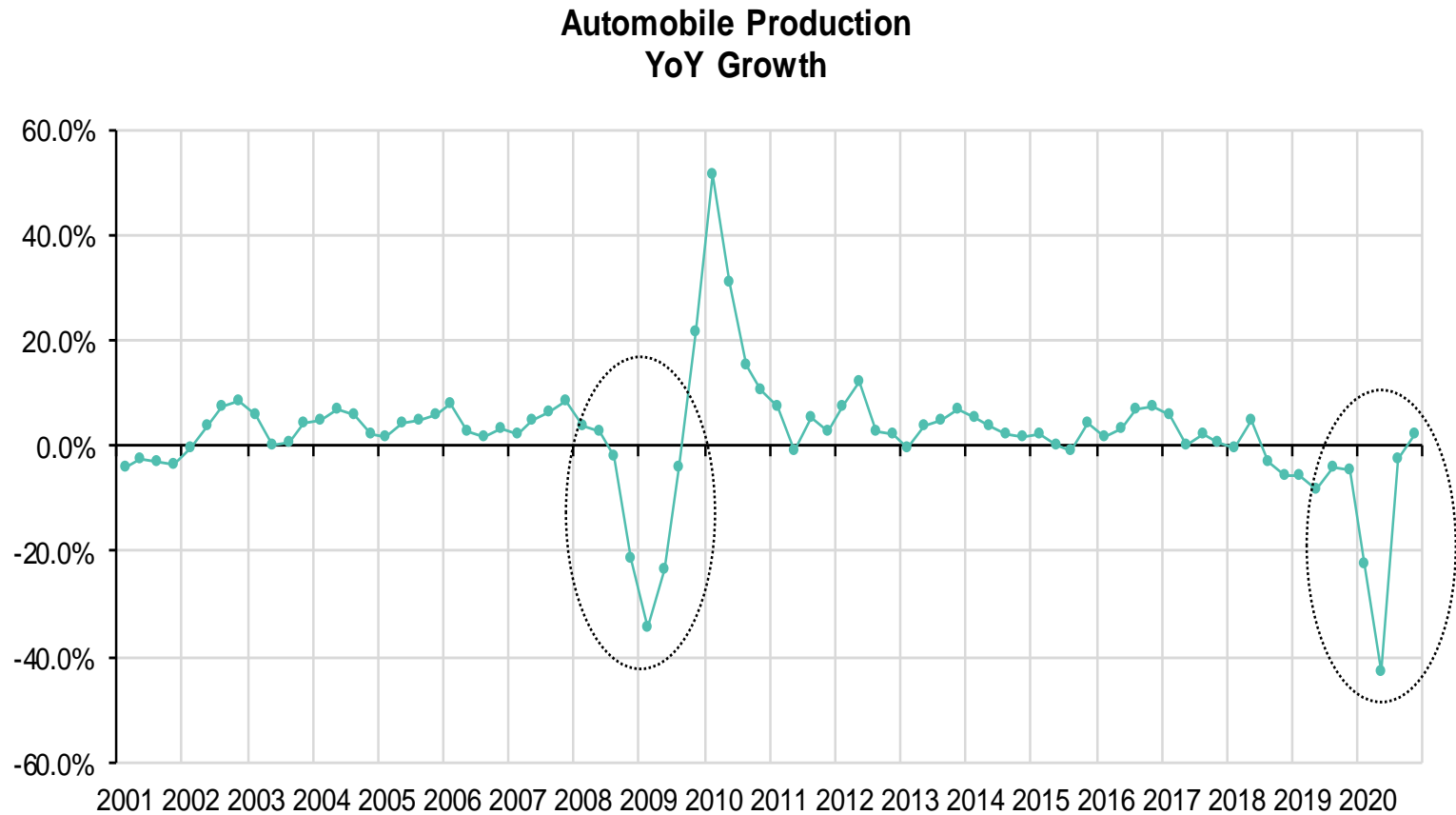
Automotive demand was sharply impacted in the midst of COVID...

Light Vehicle Production (Millions) and YoY Growth



Source: IHS, Bernstein analysis

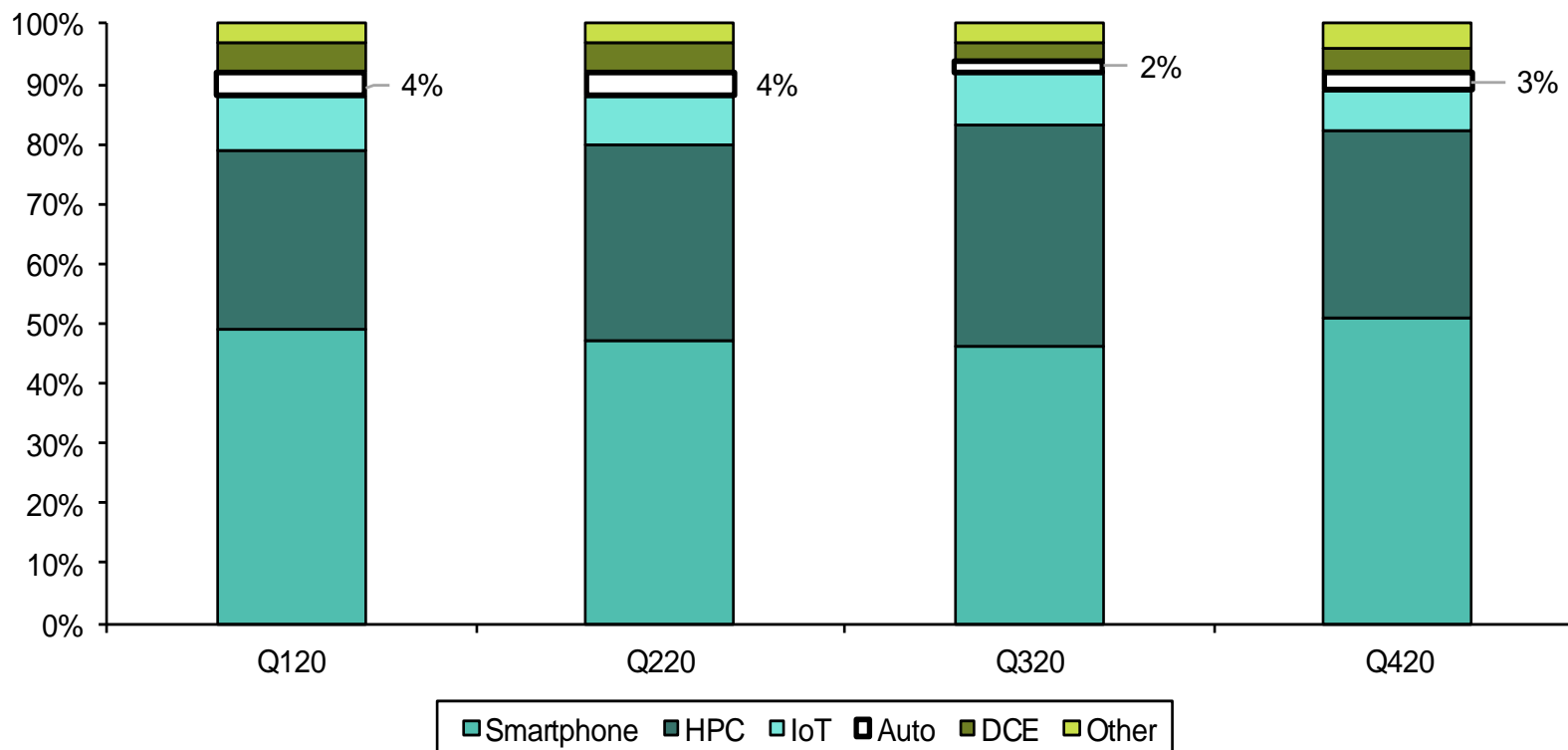
...falling more severely than what was seen in the global financial crisis, but also rebounding far more rapidly



Source: IHS, Bernstein analysis

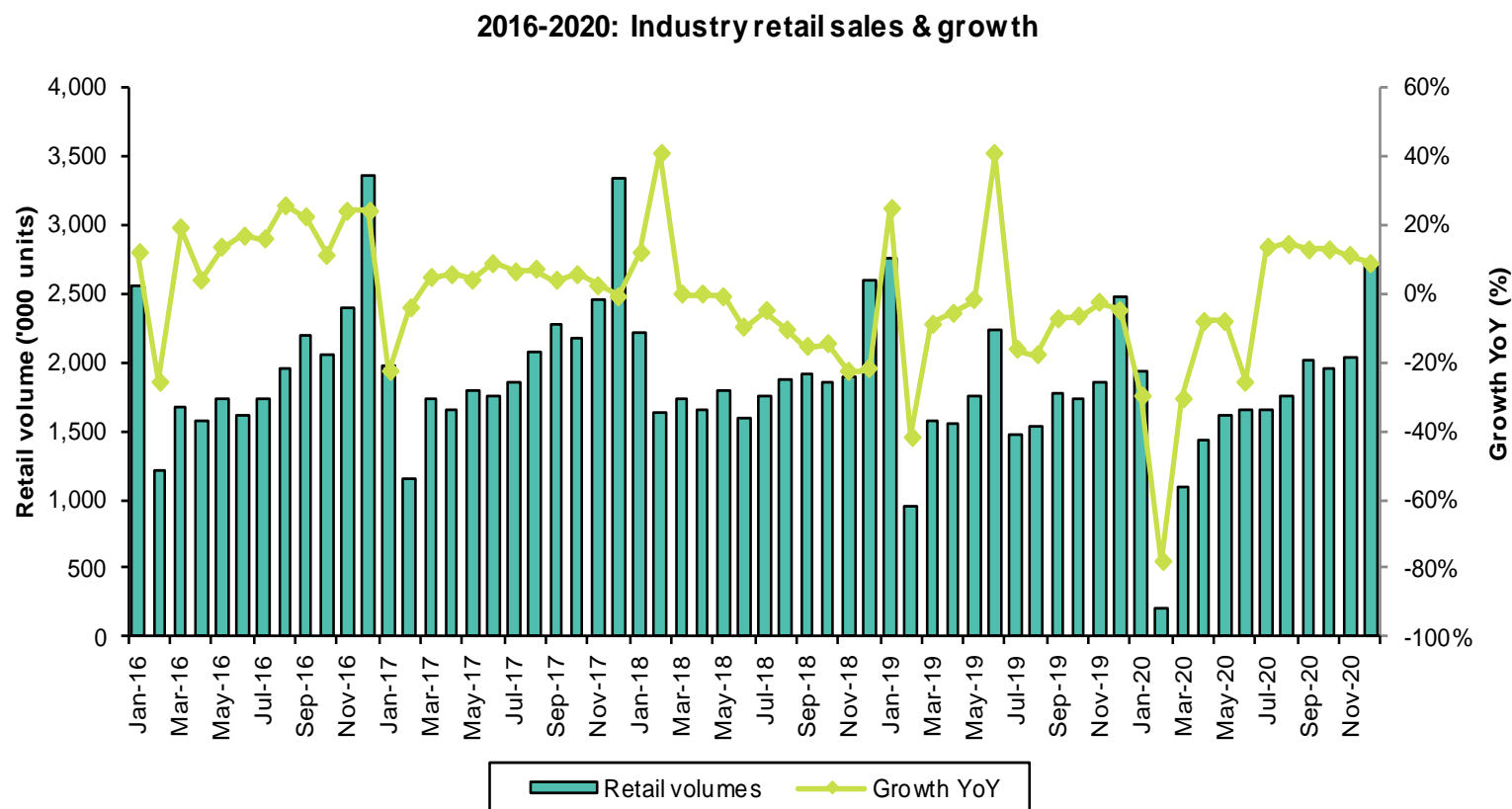
Automotive revenues at TSMC, not large to begin with, were pressured in 2020 amid COVID

TSMC Revenue Mix by End Market



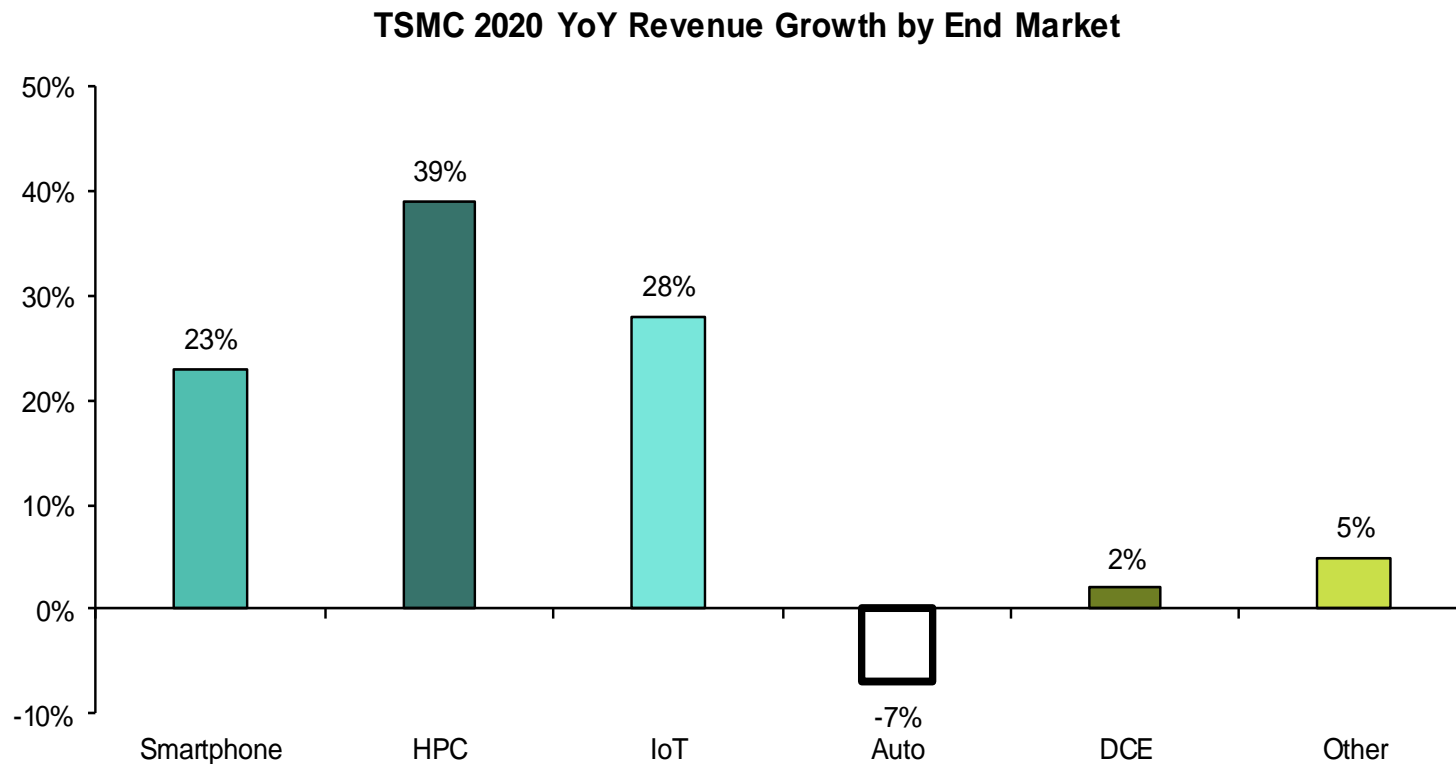
Source: Company reports, Bernstein analysis

Auto volumes especially in areas like China recovered strongly in 2H20



Source: C.A.D, Bernstein analysis

Other end markets quickly absorbed capacity surrendered by automotive at TSMC

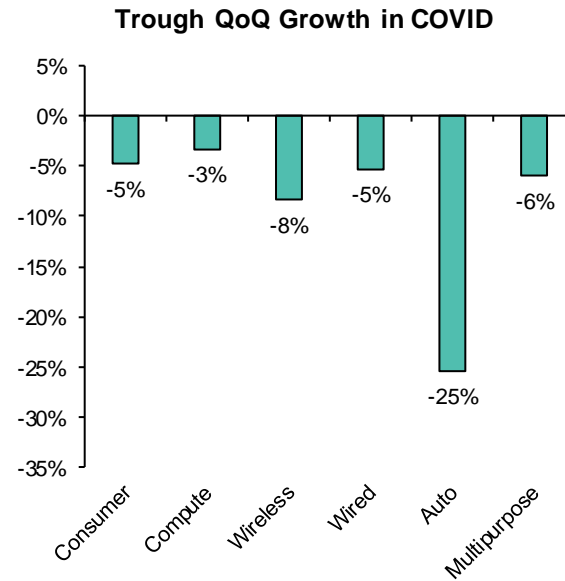
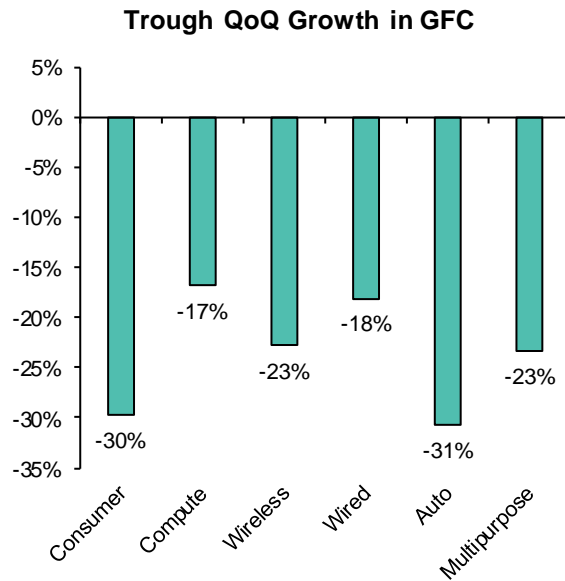


Source: Company reports, Bernstein analysis

Key Takeaways

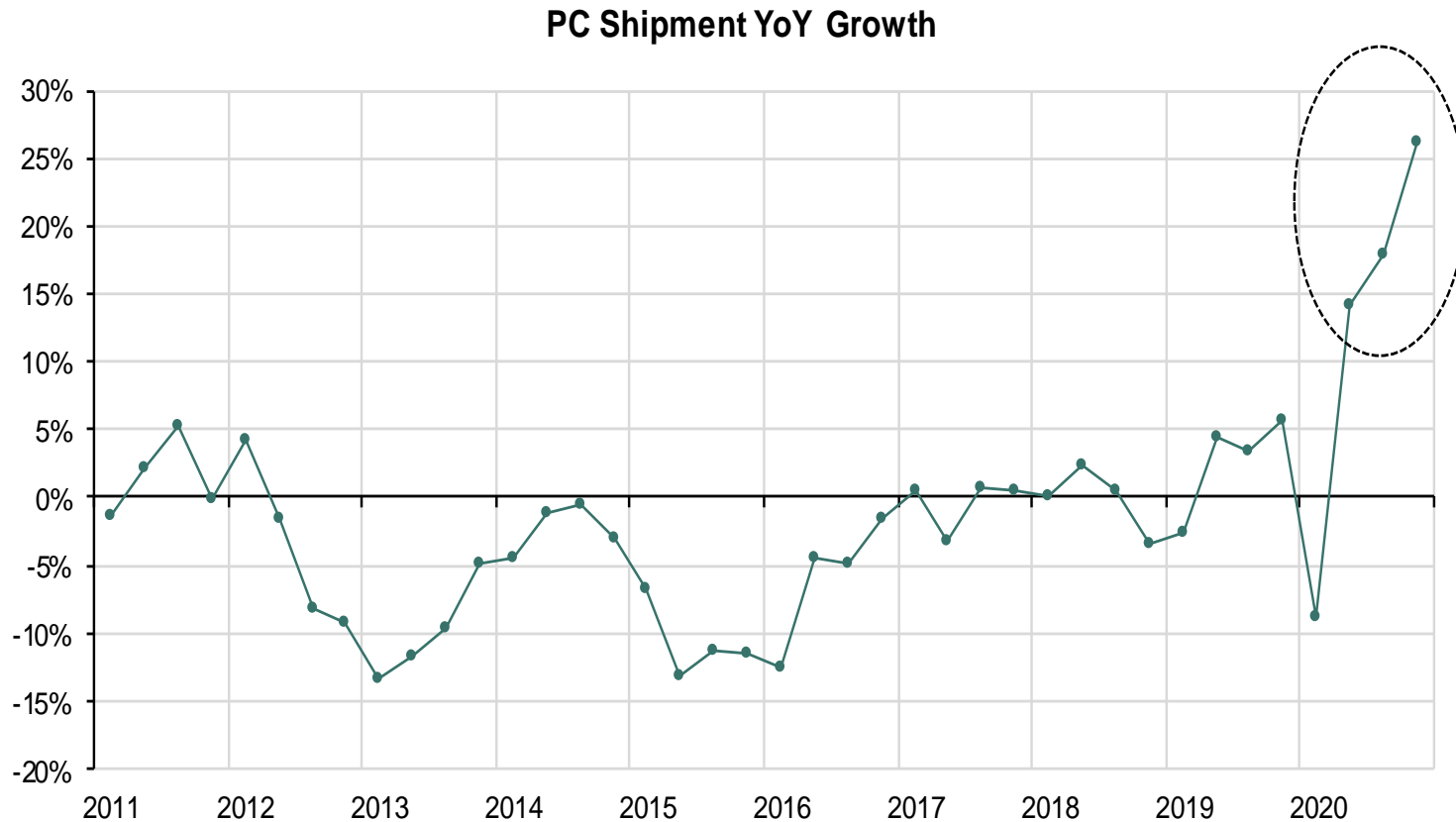
- Shortages have begun to plague the semiconductor industry and its customers. But the automotive industry has borne the brunt of these constraints, due to a perfect storm of supply-chain whipsaws, much faster-than-expected demand recovery, and a channel that runs lean
- **Other end markets have held up more resiliently through COVID than automotive, but are beginning to be impacted as well due to strong demand and tight capacity**
- While these dynamics will raise concerns around sustainability, we believe the auto semi recovery itself has legs. Within our US coverage we recommend NXPI in particular as a good way to play the trend
- Infineon is also recommended for our European semi coverage

Other end markets were less disrupted amid COVID vs automotive, but are starting to see the impact of shortages as well amid strong demand



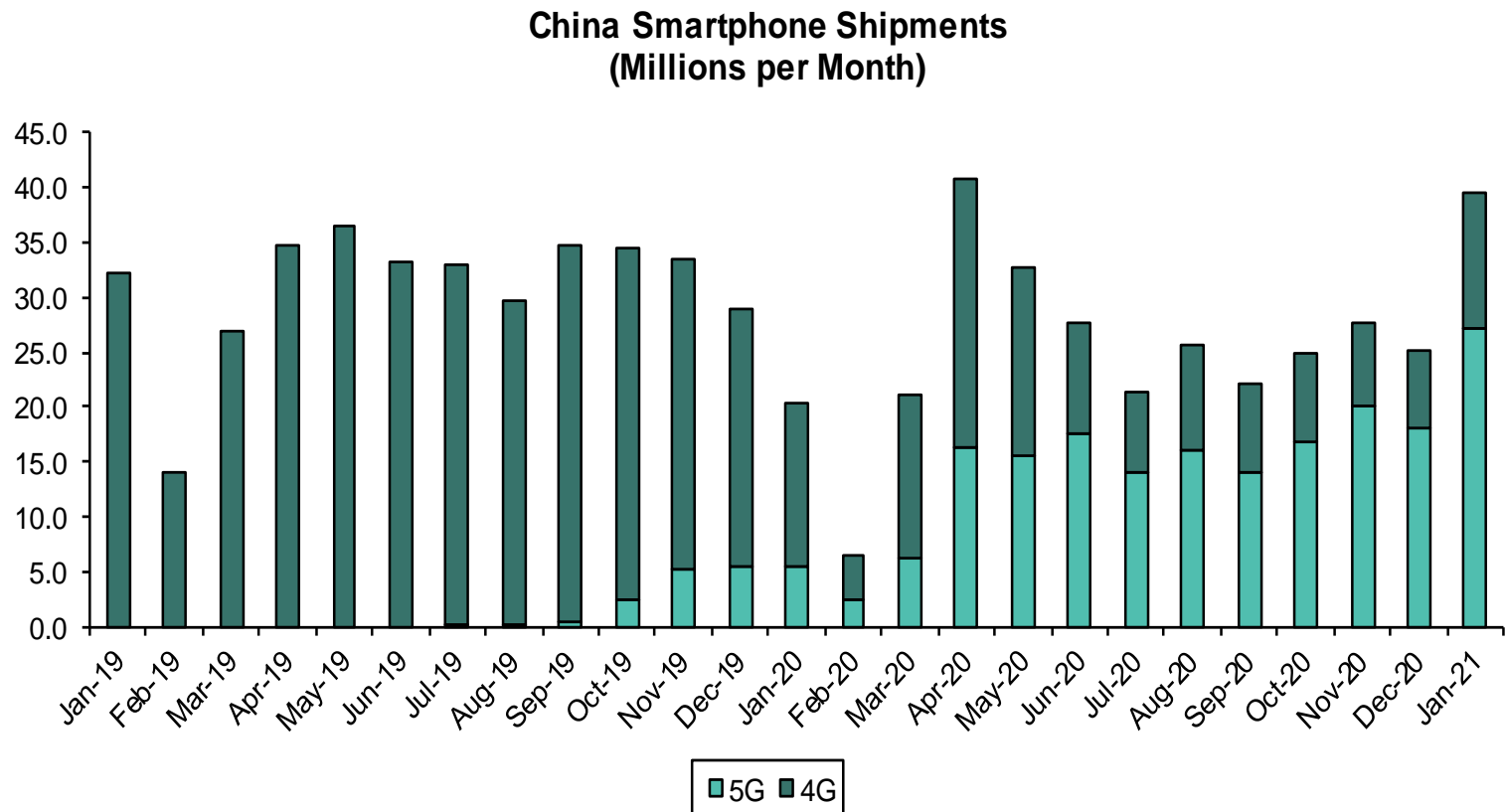
Source: WSTS, Bernstein analysis

PC demand has been off the charts



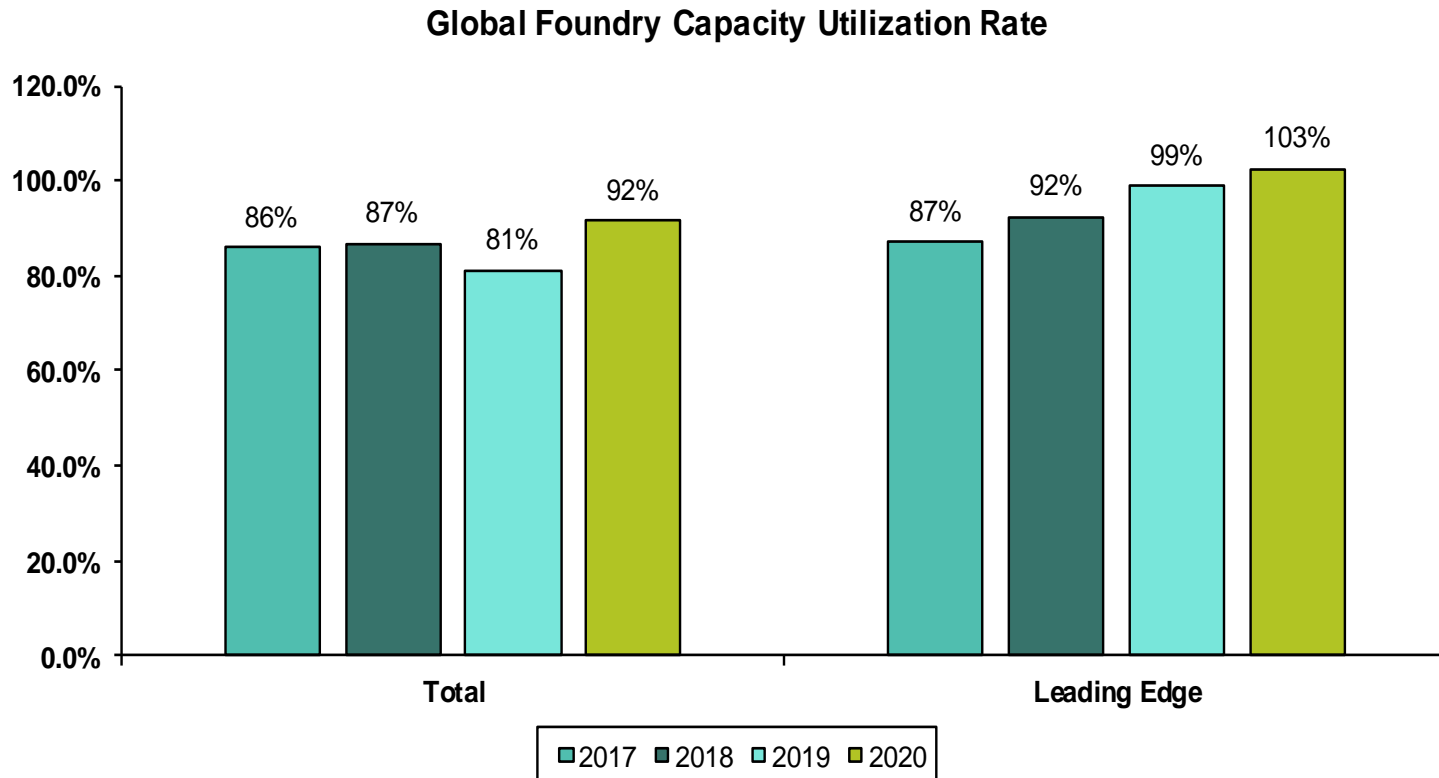
Source: IDC, Bernstein analysis

Smartphones bounced back in China, particularly 5G (with higher semiconductor content)



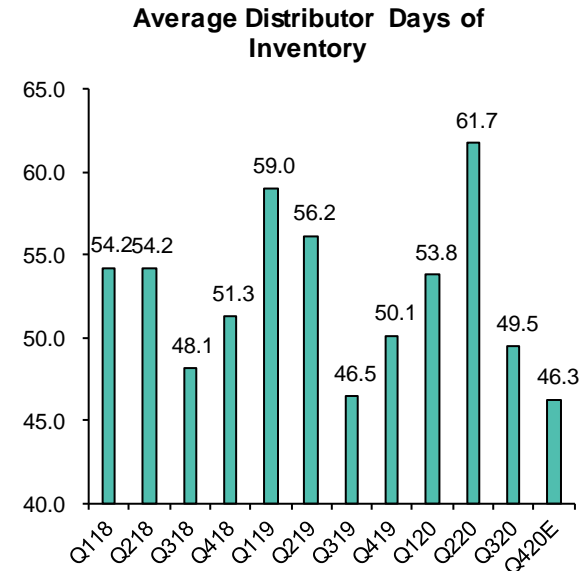
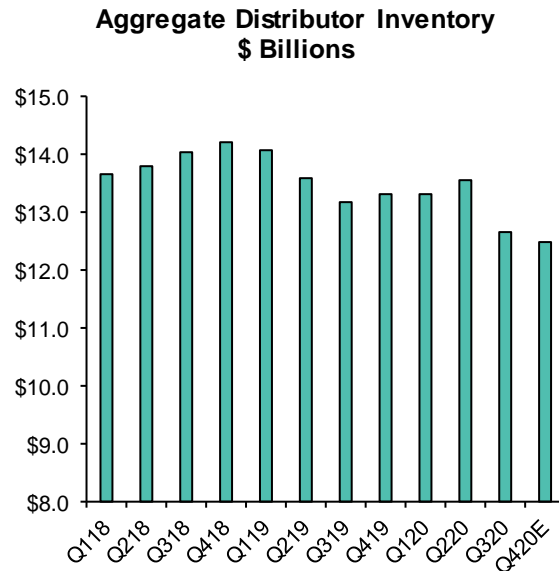
Source: China Academy for Telecommunication Research, Bernstein analysis

Overall foundry capacity utilization is high, and leading-edge capacity appears sold-out



Source: Gartner, Bernstein analysis

Channel inventories have generally become tighter in recent quarters



Not all distributors in the sample have reported CQ420 results yet; in that case inventories have been assumed to be unchanged from Q3 (hence this analysis likely overstates Q420 inventory levels in the channel, and hence represents a best-case situation)
Source: Company reports, Bloomberg, Bernstein analysis

Semiconductor companies have now begun to talk of strong demand exceeding supply more broadly

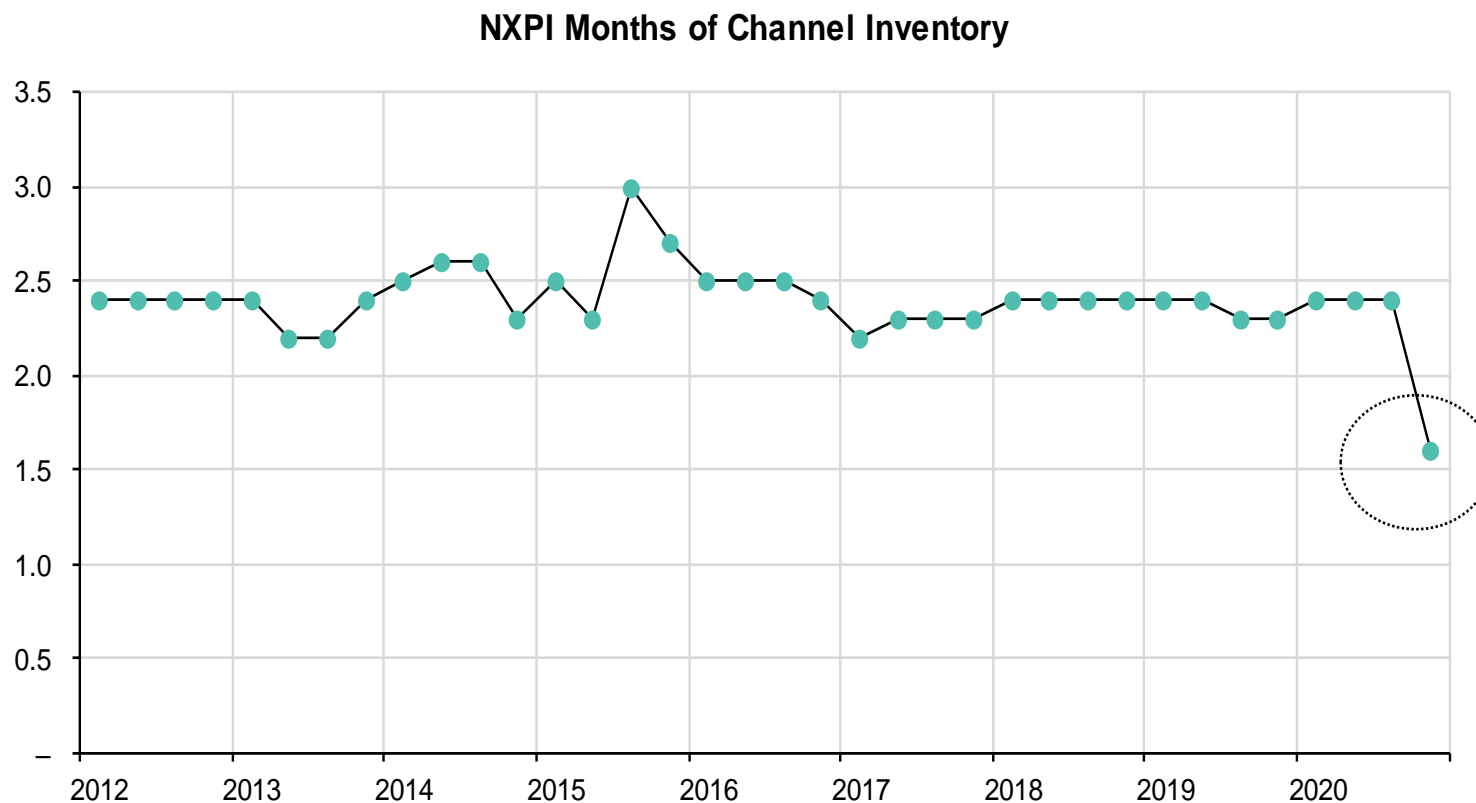
Company	Commentary
QCOM 2/4/2021 - Q121 Earnings	"Notably, our strong performance and outlook would have been even stronger had we not been supply constrained."
MCHP 2/5/2021 - Q321 Earnings	<p>"A robust overall business environment, accentuated by rising demand from the automotive, industrial and consumer markets combined with low levels of inventory in the distribution channel resulted in constraints in practically all of our internal and external factories."</p> <p>"We expect that the constraints we are currently seeing are likely to continue through much of calendar year 2021 and possibly into calendar year 2022. As a result, we have seen our lead time stretch out for many of our products where the constraints are most acute. We have also experienced increases in material and subcontracted manufacturing costs and have taken steps to secure capacity for 2021"</p>
NXPI 2/3/2021 - Q420 Earnings	<p>"I think at the moment from anything we can see, the supply chains through the auto world are empty. And I say that because I know that every single product we are shipping is immediately built into a car. And so there is just nothing going on the sideline. It all goes through into production immediately. That's why we also clearly said we are supply constrained for the first quarter."</p> <p>"We are also impacted by the tightness of supply in our industrial business."</p>
AMD 1/27/2021 - Q420 Earnings	<p>"It's fair to say that the overall demand exceeded our planning. And as a result, we did have some supply constraints as we ended the year. Those were primarily, I would say, in the PC market, the low end of the PC market and in the gaming markets."</p> <p>That being said, I think we're getting great support from our manufacturing partners. The industry does need to increase the overall capacity levels. And so we do see some tightness through the first half of the year, but there's added capacity in the second half."</p>
NVDA 1/13/21 - JPMorgan Tech/Auto Forum	<p>"So supply does remain tight at this time. We expect the overall channel inventories, meaning the inventories that are with our AIC partners as well as in our Etail and retail channels will likely remain lean throughout Q1. Our overall capacity has not been able to keep up with that overall strong demand that we have seen."</p> <p>We've seen in terms of constraints, constraints really from the overall global surge of compute and the overall capacity, capacity that may be necessary for assembly and test and/or substrates as well. But again, we remain focused on this and working each day to improve our overall supply situation."</p>
AVGO 12/13/2020 - Q420 earnings	<p>"...supply constraint continues from when we first touched on it 6 months ago"</p> <p>"Our lead times is now beyond 6 months to answer your question. So, and just to add a further thought, we have a policy in this company that [...] any orders placed on us we do not allow to be canceled."</p>

Source: Company reports, Bernstein analysis

Key Takeaways

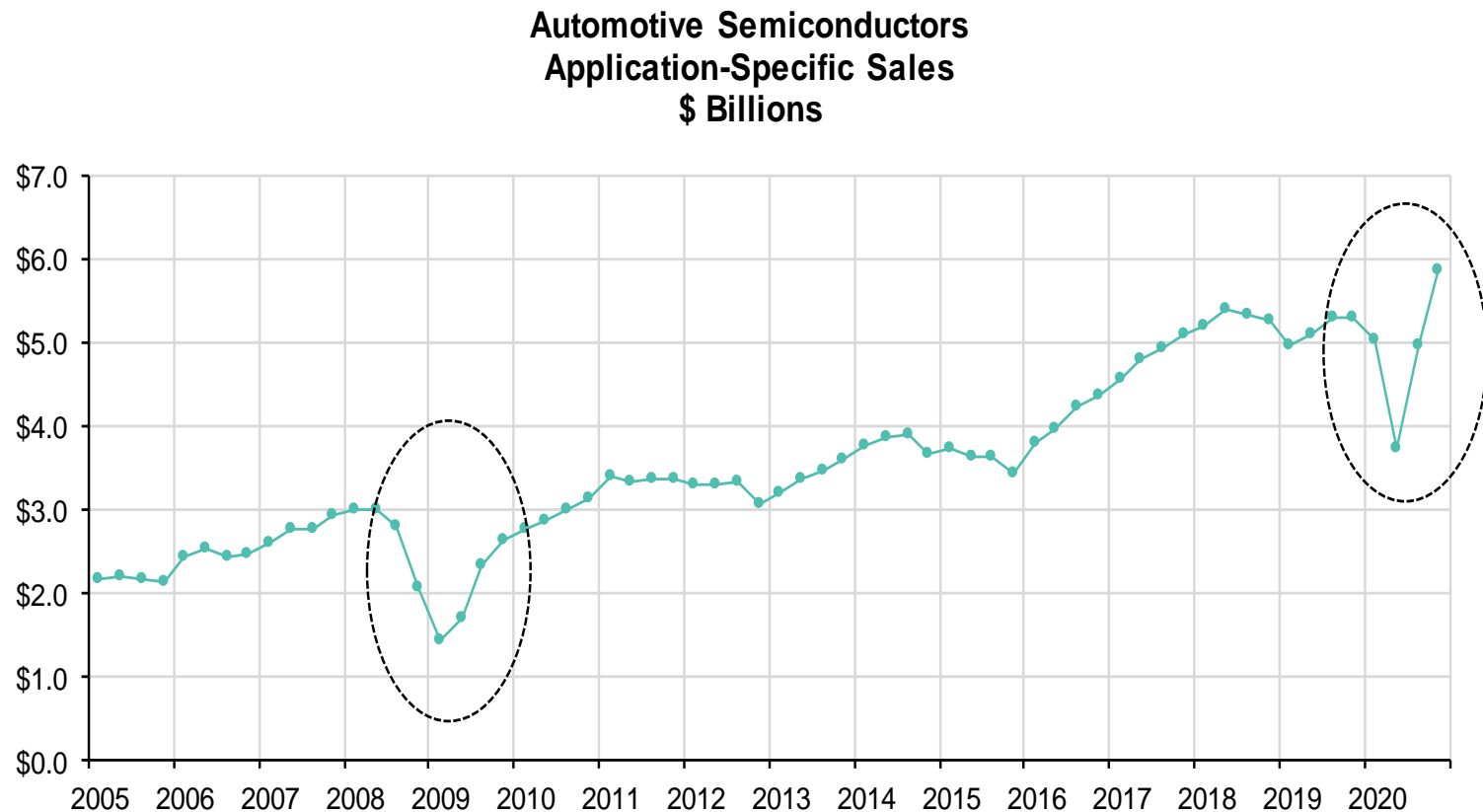
- Shortages have begun to plague the semiconductor industry and its customers. But the automotive industry has borne the brunt of these constraints, due to a perfect storm of supply-chain whipsaws, much faster-than-expected demand recovery, and a channel that runs lean
- Other end markets have held up more resiliently through COVID than automotive, but are beginning to be impacted as well due to strong demand and tight capacity
- **While these dynamics will raise concerns around sustainability, we believe the auto semi recovery itself has legs. Within our US coverage we recommend NXPI in particular as a good way to play the trend**
- Infineon is also recommended for our European semi coverage

The auto semi channel appears bone-dry



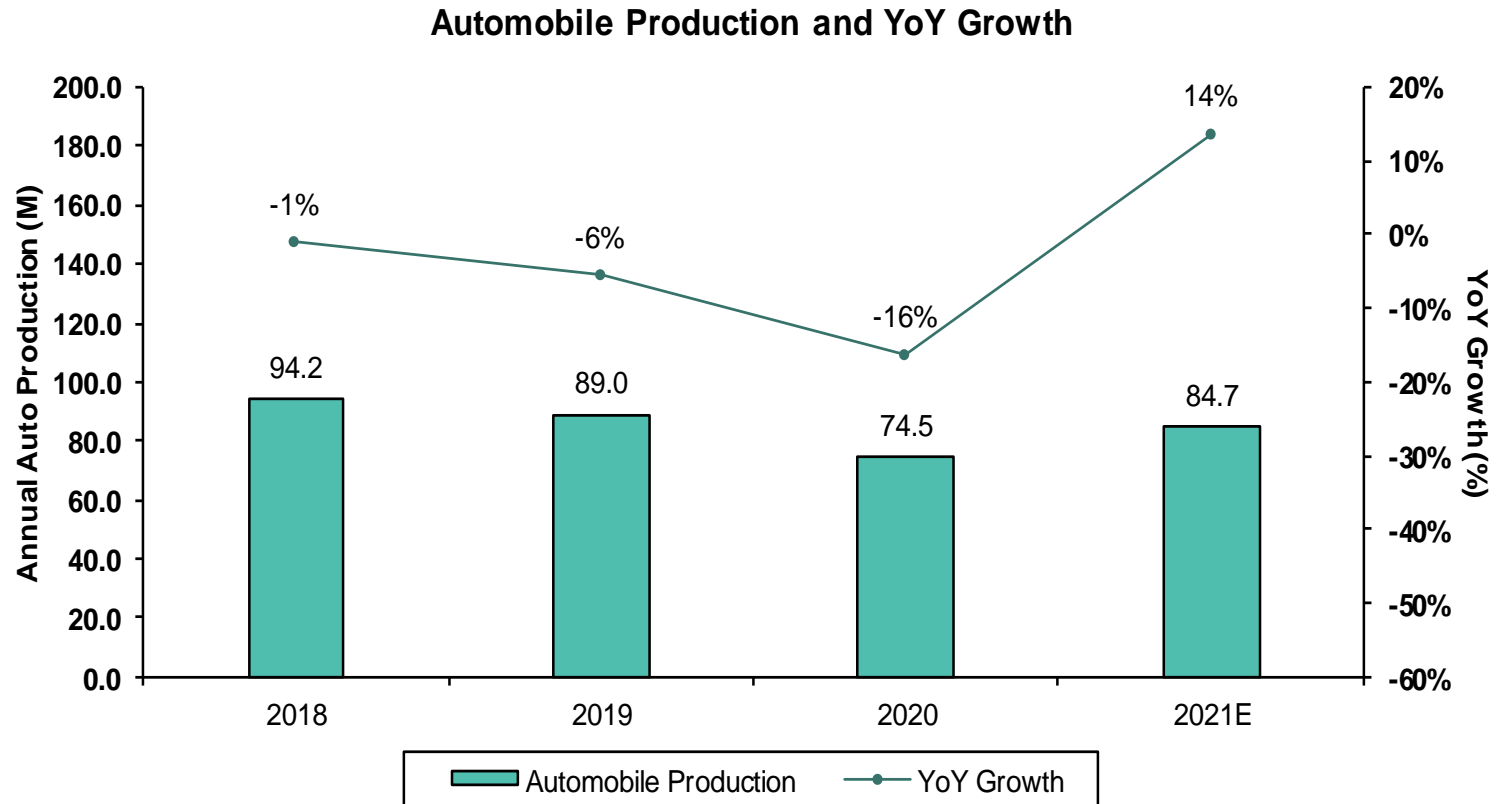
Source: Company reports, Bernstein analysis

The recovery itself is just getting started



Source: WSTS, Bernstein analysis

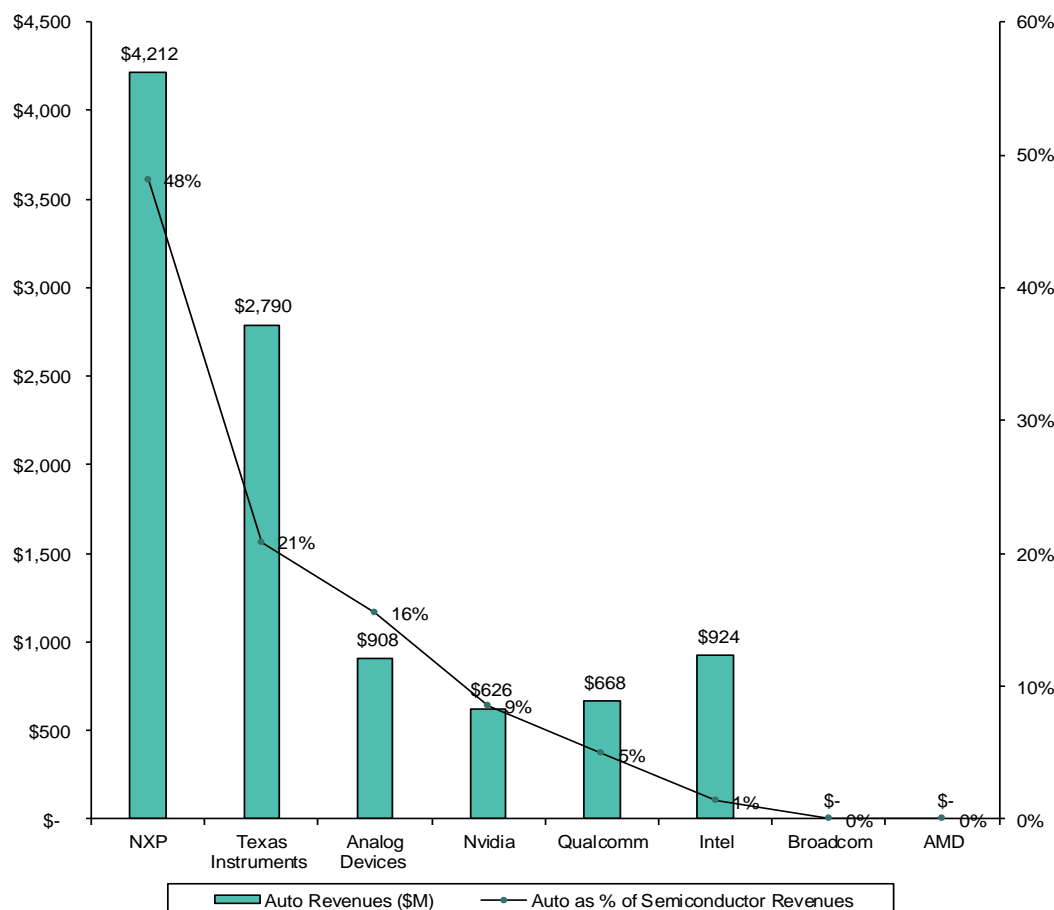
Auto recovery forecasts appear conservative, below pre-COVID levels



Source: IHS data and estimates, Bernstein analysis

In our US coverage, we recommend NXPI in particular as a good way to invest in this trend

Auto Exposure in our US Semiconductor Coverage
CY2019



- High automotive exposure (~ half of revenues)
- Extremely lean channel
- Emerging growth narrative, both in and out of auto
- Attractively valued vs peers

Source: Gartner, Bernstein analysis

Key Takeaways

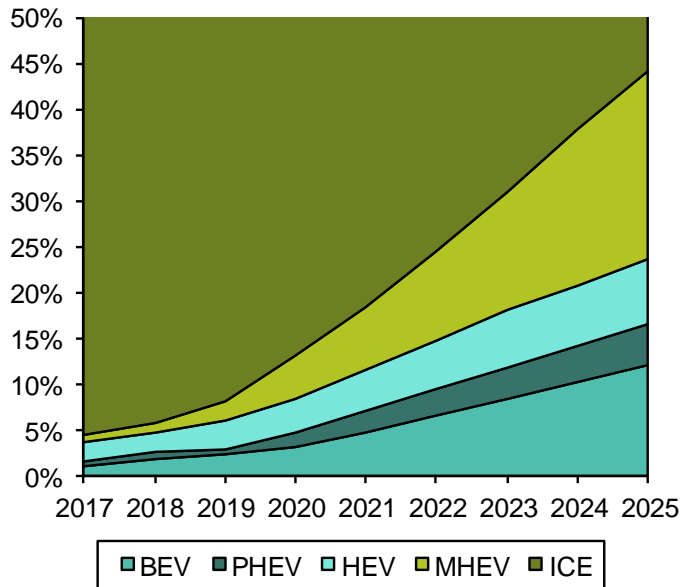
- Shortages have begun to plague the semiconductor industry and its customers. But the automotive industry has borne the brunt of these constraints, due to a perfect storm of supply-chain whipsaws, much faster-than-expected demand recovery, and a channel that runs lean
 - Other end markets have held up more resiliently through COVID than automotive, but are beginning to be impacted as well due to strong demand and tight capacity
 - While these dynamics will raise concerns around sustainability, we believe the auto semi recovery itself has legs. Within our US coverage we recommend NXPI in particular as a good way to play the trend
- **Infineon is also recommended for our European semi coverage**

Infineon will benefit because of internal capacity, accelerated EV adoption & Cypress merger

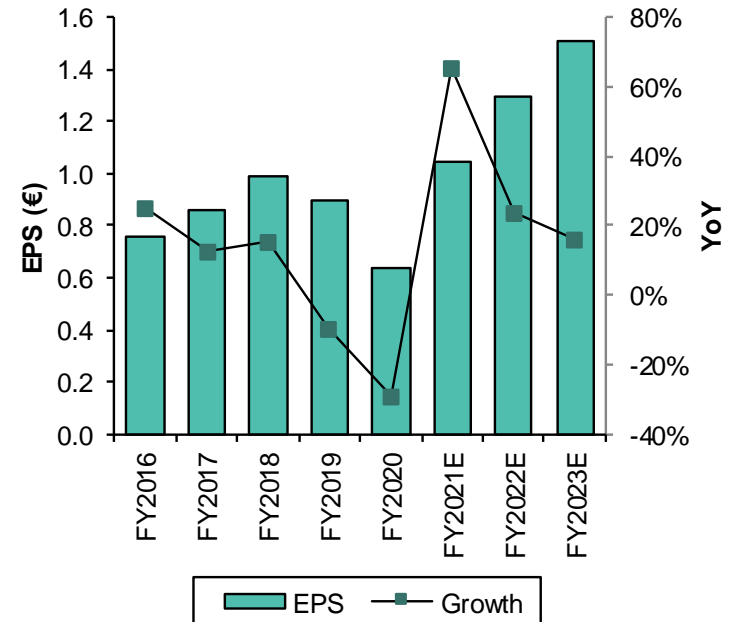
- Digital & MCU chips are more produced externally & hence have more supply shortage.
- Analog, RF, sensor & power semiconductors are mostly produced internally and are scaling up quickly to meet the swift recovery of end demands.
- With ~70% of the revenue from these chips, Infineon will enjoy higher revenue, and the margin expansion as internal fabs are being filled with these chips.
- Additionally, Infineon also benefits from accelerated secular transition to EV, and the merger with Cypress. EPS CAGR is 35% in the next 3 years.

We estimate a 35% EPS CAGR for Infineon in the next 3 years.

Global Auto Production by Powertrain



Infineon Adj EPS



Source: IHS, Company reports, Bernstein estimates and analysis

Foundry, OSAT & semicap won't see a notable swing

- As auto represents only a small part of the business (low single digits for TSMC), the shortage of auto semis can be addressed in 1-2 quarters with a mild re-allocation of existing capacity.
- Capacity expansion will be limited in the near term, but probably slightly more in the long term, as different regions/countries build safety capacity for redundancy.
- Hence for semicap companies, probably marginally positive in the long term.
- Smaller customers (e.g. FocalTech (3545 TT; not covered)) of foundry/OSAT may lose capacity or suffer a price hike.

Ticker Table

Mar 01, 2021						EPS Reported				P/E Adjusted		
			Closing	Target	Rel.							
Ticker	Rating		Price	Price	Perf.		2020A	2021E	2022E	2020A	2021E	2022E
ADI	M	USD	158.59	165.00	13.4%	USD	4.91	6.05	6.74	32.33	26.20	23.51
AMD	M	USD	86.39	90.00	57.9%	USD	1.28	1.95	2.24	67.41	44.39	38.49
AVGO	O	USD	489.58	480.00	47.5%	USD	22.15	26.10	28.23	22.11	18.76	17.34
INTC	U	USD	62.88	43.00	(18.8)%	USD	5.30	4.68	4.27	11.86	13.44	14.72
NVDA	O	USD	553.67	625.00	72.9%	USD	10.00	13.14	14.53	55.37	42.14	38.10
NXPI	O	USD	187.30	205.00	32.7%	USD	6.12	9.25	10.31	30.62	20.25	18.16
QCOM	O	USD	139.49	175.00	46.1%	USD	4.19	6.94	7.42	33.28	20.11	18.79
TXN	M	USD	177.67	165.00	23.6%	USD	5.96	6.67	6.98	29.81	26.62	25.47
IFX.GR	O	EUR	35.78	43.00	82.9%	EUR	0.64	1.13	1.36	56.34	31.61	26.33
2330.TT (TSMC)	O	TWD	606.00	800.00	56.2%	TWD	19.98	21.61	24.49	8.50	7.46	6.48
TSM	O	USD	129.13	149.00	107.8%	USD	3.39	3.83	4.34	10.25	8.97	7.79
2303.TT (UMC)	M	TWD	54.20	41.00	216.7%	TWD	0.82	1.92	2.10	3.08	2.98	2.93
UMC	M	USD	10.06	7.30	273.6%	USD	0.13	0.34	0.37	3.43	3.13	3.08
981.HK (SMIC)	U	HKD	26.75	14.90	37.1%	USD	0.05	0.09	0.03	3.08	1.81	1.78
1347.HK (Hua Hong)	M	HKD	52.60	39.00	167.8%	USD	0.13	0.04	0.08	3.89	3.71	3.59
5347.TT (Vanguard)	M	TWD	116.00	105.00	18.1%	TWD	3.58	3.75	4.59	6.44	6.40	5.95
3711.TT (ASE)	O	TWD	103.50	94.00	8.9%	TWD	3.96	5.86	6.83	26.16	17.65	15.16
ASX	O	USD	7.71	6.70	35.5%	USD	0.26	0.41	0.48	29.94	18.61	15.98
ASML.NA	M	EUR	480.95	435.00	86.5%	EUR	8.50	10.13	12.42	56.59	47.49	38.72
ASML	M	USD	583.55	520.00	78.8%	USD	9.70	11.56	14.18	60.15	50.47	41.15
8035.JP (Tokyo)	O	JPY	44,460	46,000	63.9%	JPY	1,155.86	1,504.59	1,776.68	38.46	29.55	25.02
BMW.GR	O	EUR	72.06	90.00	15.8%	EUR	8.94	6.23	9.98	8.06	11.57	7.22
DAI.GR	O	EUR	66.65	90.00	70.0%	EUR	4.72	8.24	9.49	14.11	8.09	7.02
RNO.FP	O	EUR	37.64	42.00	34.7%	EUR	(0.52)	(27.74)	1.79	(73.01)	(1.36)	21.02
VOW.GR	M	EUR	195.30	190.00	21.7%	EUR	29.89	15.78	25.42	6.53	12.38	7.68
MSDLE15			1,632.51				68.22	94.35	109.58	23.93	17.30	14.90
MXAPJ			706.00				31.26	39.54	45.82	22.59	17.86	15.41
MXJP			1,168.56				47.38	64.75	74.56	24.67	18.05	15.67
SPX			3,901.82				133.38	164.89	192.58	29.25	23.66	20.26

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

2303.TT,UMC,981.HK,1347.HK,5347.TT,3711.TT,ASX,BMW.GR,RNO.FP,VOW.GR base year is 2019;NVDA base year is 2021;.

ADI,AMD,AVGO,NVDA,NXPI,QCOM,IFX.GR,BMW.GR,DAI.GR,RNO.FP,VOW.GR eps type is EPS Adjusted;.

2330.TT,TSM,2303.TT,UMC,981.HK,1347.HK,5347.TT valuation type is P/B;INTC,TXN,3711.TT,ASX,ASML.NA,ASML,8035.JP valuation type is P/E Reported;.

2330.TT,2303.TT,5347.TT,3711.TT close date is 02/26/2021;.



Disclosure Appendix

Disclosure Appendix - Valuation Methodology

U.S. Semiconductors

We value companies in our coverage using a combination of Enterprise Value to Sales, Enterprise Value to EBITDA and Price to EPS multiples.

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.

Asian Autos

We value Chinese automotive companies based on one/two year forward multiples. Based on the point in the cycle, these can vary between PE, EV/Sales and EV/EBITDA. In some cases we will also use sum-of-the-parts valuations.

European Autos

We value EU automotive companies based on one/two year forward multiples. Based on the point in the cycle, these can vary between PE, EV/sales and EV/EBITDA. In some cases we will also use sum-of-the-parts valuations. Our EV multiples are for the industrial (autos) operations and we value captive Financial Services operations separately with their book value. Truck makers and super sport niche makers are valued with respect to their industrials and luxury goods peer groups.

Disclosure Appendix - Risks

U.S. Semiconductors

The greatest sector-wide risk that could affect all of the stocks in our coverage is the macroeconomic environment. Upside risk to our targets exist if global GDP growth is quicker than we currently anticipate, which would result in stronger semiconductor industry growth than we currently forecast. Conversely, if GDP growth is slower than expected, this would result in slower growth for the industry and semiconductor companies. Recent increasingly negative rhetoric around trade and tariffs, and of course the coronavirus pandemic, represent further potential risks to our broad coverage.

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.

Disclosure Appendix - Risks

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.

Asian Autos

The risks to our views on our Chinese auto OEM stocks and our share price targets are mainly macroeconomic in nature. Auto sales in China correlate well with liquidity growth and earnings, and equity value could be severely tested in the event of economic contractions in major end markets like China, the US, Europe, and emerging markets. The individual companies are at risk of specific product and project failure, while the ability of financial services businesses to remain viable could also be tested in an environment where liquidity becomes very scarce, and/or access to the capital markets becomes restricted.

European Autos

The risks to our views on our European auto stocks and our share price targets are mainly macroeconomic in nature. Earnings, liquidity and equity value could be severely tested in the event of economic contractions in major end markets and a slowdown in vehicle demand. The individual companies are at risk of specific product and project failure, while the ability of financial services businesses to remain viable could also be tested if the global financial system deteriorates, restricting capital market access. Our forecasts are also sensitive to moves in the euro versus the US dollar and the UK sterling as well as Latin American and Asian currencies.

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 03/01/2021, Bernstein branded ratings were distributed as follows: 311 Outperform - 50.7% (0.0% banking clients) ; 236 Market-Perform - 38.4% (0.0% banking clients); 67 Underperform - 10.9% (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.
- All statements in this report attributable to Gartner represent Bernstein's interpretation of data, research opinion or viewpoints published as part of a syndicated subscription service by Gartner, Inc., and have not been reviewed by Gartner. Each Gartner publication speaks as of its original publication date (and not as of the date of this report). The opinions expressed in

- Gartner publications are not representations of fact, and are subject to change without notice.
- Eunice Lee, CFA maintains a long position in Taiwan Semiconductor Manufacturing Co Ltd (TSM).
- Accounts over which Bernstein and/or their affiliates exercise investment discretion own more than 1% of the outstanding common stock of the following companies NXPI / NXP Semiconductors NV, QCOM / Qualcomm Inc, 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 03/01/2021

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
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		
ADI	M (RC)	03/25/19		
AMD	M (RC)	09/20/16		
ASML	M (RC)	07/29/20	O (RC)	03/12/20 M (IC) 06/19/18
ASML.NA	M (RC)	07/29/20	O (RC)	03/12/20 M (IC) 06/19/18
ASX	O (IC)	05/19/18		
AVGO	O (IC)	10/04/16		
BMW.GR	O (IC)	09/08/20	M (DC)	02/28/20
DAI.GR	O (IC)	09/08/20	M (DC)	01/13/20
IFX.GR	O (IC)	06/19/19		
INTC	U (RC)	07/24/20	M (RC)	03/26/20 U (RC) 06/26/18
NVDA	O (RC)	02/18/20		
NXPI	O (RC)	07/27/18		
QCOM	O (RC)	08/03/20	M (RC)	06/30/16
RNO.FP	O (IC)	09/08/20	M (DC)	02/28/20
TSM	O (RC)	01/12/21	M (RC)	01/30/12
TXN	M (RC)	03/25/19		
UMC	M (RC)	06/11/18		
VOW.GR	M (RC)	12/15/20	U (IC)	09/08/20 O (DC) 02/28/20

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.

Copyright 2021, 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 and AllianceBernstein (Singapore) Ltd., subsidiaries of AllianceBernstein L.P. ~1345 Avenue of the Americas ~ NY, NY 10105 ~212/756-4400. All rights reserved.