

Semiconductors

2Q Preview: Expect Better Results/Outlook; Constructive Setup For 2H21 and 2022 - Continued Tailwind For Stocks

We remain positive on semiconductor stocks entering into earnings as we continue to expect positive earnings revisions as we move through the remainder of 2021 and likely into 2022 as global semiconductor demand continues to expand FASTER than the rate of supply growth, resulting in pricing power, solid order/backlog visibility and Q/Q declines in customer/channel inventories. For the group broadly, we expect 2Q revenues/EPS to come in above consensus expectations with overall book-to-bill greater than one, record backlog, and disciplined supply growth that should drive Q/Q growth for the remainder of the year. On the 3Q outlook, we expect better than expected revenue/EPS on demand that continues to broaden (cloud datacenter and enterprise spending getting stronger into 2H) and tight supply chain dynamics as lead times remain extended. We anticipate the positive earnings revisions to be broad-based as demand across almost all end-markets remains strong (auto, industrial, compute, mobile, gaming, networking) and with previously weak end-markets (cloud/hyperscale and enterprise) picking up strength into the 2H. However, given the strength of the end markets, the supply/demand gap has continue to widen in most end-markets despite supply improvements and we believe companies are still shipping 15-50% below current market demand, extending the current semiconductor upcycle and positive Y/Y trends well into CY22 (we believe we are only 30-40% through the current upcycle). We believe it will take 3-4 quarters for supply to catch up with end-market demand and then another 1-2 quarters for value-chain inventory replenishment. We continue to see a constructive fundamental setup for semi industry revenues in 2H21 and more importantly into 2022 (semi industry revenues to grow 17-19% in CY21 and another 8-10% in CY22) on strong global GDP growth (up 6.4% Y/Y in 2021 and up 4.6% in 2022), top 4 US CSPs up 18% Y/Y, global 5G telco deployment up 35%+ Y/Y, auto production growth up 11% Y/Y, and 5G smartphone shipments likely to more than double Y/Y. Regarding stock performance the SOX index is up 18% YTD (and outperforming the S&P 500 and NASDAQ), and we expect continued outperformance in semi stocks this year on solid positive Y/Y revenue trends and positive EPS revisions into CY22 and as peak cycle fears begin to alleviate. Our top overall semiconductor pick is AVGO and MRVL (strong cloud networking/compute acceleration semiconductor exposure, 5G networking exposure via ASIC/optical segments, and strong storage trends), and our top semiconductor equipment pick is KLAC. We also favor Overweight-rated INTC, NVDA, and MU on outsized exposure to cloud data center spending trends. On the broad-based semi side, we favor OW-rated TXN and MCHP as global demand trends continue to drive improvements in industrial/auto demand. In smartphone and comms infrastructure markets, we favor OW-rated QRVO.

- **Continue to expect Y/Y revenue growth and positive earnings revisions into 2H21 on broad-based demand, global economic recovery, and strong pricing power – demand/supply gap continues to remain at elevated levels and customer inventories continue to remain at or below historical levels.** In line with our prior 2021 outlook, we expect continued positive EPS revisions as we move through 2Q21 and into 2H21, following four consecutive quarters of positive EPS revisions, which began in 2Q20 (i.e., 1Q21 EPS estimates revised higher by 7-9%). We anticipate another 15-20%+ upside in out-year EPS estimates. As we recently wrote in our May SIA report ([link](#)), 2Q21 is tracking to a 10% Q/Q growth and above seasonal trends. We believe the fundamental setup for 2H21 and into 2022 is quite constructive and see 2021 semi industry revenue growth of 17-19% and

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another 8-10% growth in semi industry revenues in 2022. Given recent industry data points and combined with our research efforts, we see our universe of companies delivering better 2Q results and better 3Q outlooks on a combination of continued recovery in global auto/industrial production, sustained PC / gaming strength, reacceleration in cloud / hyperscale spending and enterprise spending and as companies continue to exert strong pricing power amidst a tight supply environment. Partial offset is smartphone softness in 2Q led geographically by China and India especially for 4G phones, while demand for 5G phones remains solid (with 5G smartphones having significantly higher memory and RF content vs. 4G phones).

- 2Q21 book-to-bill for the industry continues to be greater than one and results should reflect continued strength in automotive/industrial/PC/gaming, incremental capacity additions, but continued supply chain constraints.** In aggregate, we expect overall group revenue/earnings results in 2Q21 will be better as we continue to see a sustained broad-based recovery in 2Q21. Starting with the SIA data, May industry Y/Y sales trends showed continued strong Y/Y growth on strong pricing power and modest units improvements. 2Q21 is tracking to 10% Q/Q (vs season trends of up 3% Q/Q). The global PMI in June was 55.5, the twelfth consecutive month of above 50 PMI (>50 signals expansion) since emerging out of the COVID-19 lockdowns in 2Q20 and at levels comparable to 2010 (recovering from the financial crisis). Given continued supply constraints and known fab shutdowns (i.e. Texas weather related and Renesas fire), auto production is expected to decline sequentially in 2Q21 but grow sequentially thereafter as we move through 2H21 (3Q up 9% Q/Q and 4Q up 11% Q/Q). Overall, we see strong/sustained demand trends in automotive/industrial/PC/gaming and reacceleration in datacenter spend and the enterprise spending recovery. While revenue upside could be capped by supply chain constraints, we continue to see our companies exercising good pricing power to drive earnings higher. Overall, we continue to expect the strong demand profile to be sustained well into 2022, in-line with continued global economic expansion.
- Expect better 3Q21 revenue/margin/EPS guidance across our semiconductor coverage as companies continue to exert strong pricing power in a demand environment that continues to expand.** In aggregate, we expect overall group revenue/earnings outlooks will be in-line to better as we continue to see sustained broad-based demand strength with continued supply constraints persisting across many end-markets. We anticipate the strength to be broad-based across the diversified analog/microcontroller companies, cloud/datacenter, with continued strength in PCs and gaming. In datacenter, we believe cloud/hyperscale customer spending trends began to reaccelerate here in the Jun-Qtr and should inflect solidly in the second half of the year (up 25%+ 2H vs 1H). Auto/industrial trends remain strong and continue to improve on incremental capacity additions. In 5G infrastructure, we anticipate investments to reaccelerate in the second half of the year and into next year driven by global 5G deployment (especially in North America). While demand is lumpy in China, tender activity has begun (i.e. China Mobile) and should lead to H/H growth (our JPM research colleagues is forecasting up 85%+ H/H in 2H) in the second half of the year. Bottom line, we anticipate continued positive earnings revisions to forward guidance for the majority of companies under coverage.
- Supply constraints across all end markets and companies continue to exert pricing power to drive earnings higher.** Supply-side indicators remain tight across all end markets and many of our covered companies have their disti inventories at/near historic lows. In addition, equipment lead times are stretched from 3-6 months to 5-9 months. We believe companies are shipping 15-50% below current end-market demand with more acute shortages in industrial/auto/gaming/compute/networking. That said, most of our covered



companies are executing well against the supply constraints and have expressed confidence in their ability to support Q/Q revenue growth in the second half of the year. We believe companies are able to pass along higher costs to customers and have generally better pricing power.

- Strong demand trends across most end markets.....longer term we continue to be positively biased on the cloud datacenter/5G end market and look for companies levered to data center trends to outperform across compute, networking, and storage/memory as spending reaccelerates and should inflect solidly in the second half of the year (OW AVGO, MRVL, INTC, NVDA, MU).** Following a cloud digestion cycle for the last few quarters, cloud datacenter spending is reaccelerating here in the Jun-Qtr and inflecting solidly in the second half of the year. In fact, at our 49th annual TMT conference (see takeaway note [here](#)) Intel noted that 1Q21 was likely the bottom and expects enterprise, government and cloud customer demand improving, driving Y/Y revenue growth in 2H21 in datacenter. On top of this spending reacceleration, we expect a strong cloud networking upgrade cycle to 200G/400G optical connectivity in 2H21 and into 2022. We believe Facebook (to 200Gbps) is starting to upgrade now with Microsoft (to 400Gbps) towards the latter part of this year. As we have recently written (see note [here](#)), Broadcom is seeing strong demand for its Tomahawk 3 and Jericho 2 switching/routing products while Marvell/Inphi is seeing strong demand for its Polaris and Porrima PAM4 200G/400G DSP chips for optical transceivers and is seeing strong demand for its Vega and Alaska PHY chipsets for 200G/400G switching line-cards. In-line with this view, our JPM research expects a 25%+ H/H spending increase in 2H21 (see note [here](#)) and 18% Y/Y increase in 2021 from the top 4 US hyperscalers. Dell'Oro forecasts 100G/200G/400G/800G switch port shipments to grow at a 20% CAGR over the next 4 years.
- Mixed smartphone demand with resilient iPhone and 5G smartphones offsetting weaker 4G demand; content gainers such as QRVO, SWKS and AVGO will continue to fair well with 2H iPhone launch.** While investors have pointed to weaker demand in Asia (e.g. China and India), we believe much of the demand weakness has been in legacy 4G phones, while demand for 5G and for iPhones in general has remained resilient. For companies under coverage – Qorvo, Skyworks, and Broadcom, we believe demand for RF components remains relatively strong as the companies are far more exposed to 5G as compared to 4G and with significant content growth in 5G phones, broadly. Recall, Qorvo maintained its expectation for the June quarter at our TMC conference ([link](#)) and described the demand environment as strong and stable with relatively low channel inventory. We believe RF suppliers backlog remains strong despite fears of oversupply and, as such, we think the setup is favorable for companies to report in-line to better June quarter results and provide in-line to better September quarter guidance, with our expectations of solid September guidance supported by our view of next-generation iPhones launching in September this year as compared to the late launch last year. Overall, we anticipate generally seasonal Sep-qtr guidance and for 2H21 overall with solid revenue growth from a H/H perspective (2H21 vs. 2H20). Moreover, we believe demand for RF in non-mobile applications such as Wi-Fi, broadband, automotive and defense remains strong and we continue to expect a reacceleration of RF component demand for wireless infrastructure by the December quarter.
- Semi stocks are 18% higher YTD and we expect continued outperformance in Semi stocks at least through the end of this year on continued positive Y/Y revenue trends and positive EPS revisions (another 15-20%+ potential upside in out-year EPS estimates) amid a cyclical upswing.** We continue to favor semiconductor companies with cloud data center, 5G networking, and gaming



exposure. Our top overall semiconductor pick is AVGO and MRVL on strong cloud networking/compute acceleration semiconductor exposure, 5G networking exposure via ASIC/optical segments, and strong storage trends. We also favor OW-rated NVDA, INTC, TXN, MCHP, MU and QRVO. Neutral-rated AMD and WDC should also fare relatively well on sustained PC demand and reacceleration in data center trends here in the second half of the year. In semiconductor equipment, our top pick remains KLAC, which should continue benefitting from strong Foundry/Logic spending, strong EUV adoption, and technology migrations.

- Renesas (6723 JT) is covered by J.P. Morgan analyst Masashi Itaya



Expect Better Results/Guide; Sustained Auto, Industrial, PC/Gaming Strength ... Datacenter/Networking And Enterprise Picking Up Strength Into The 2H

PC / Datacenter Compute

According to IDC and Gartner, PC shipments in 2Q21 increased ~13% Y/Y and increased ~5% Y/Y, respectively, (note: Gartner does not include Chromebooks in its definition of PCs while IDC does). From a Q/Q perspective, 2Q21 shipments were flattish Q/Q (Gartner) on sustained strong consumer PC demand and Chromebooks (Chromebooks grew 70% Y/Y) but held back by continued supply constraints.

Looking ahead into 2H21, our JPM research colleagues expect sustained strength (up 4% H/H) on robust consumer PC demand and healthy channel inventory levels but held back by supply constraints (see note [here](#)). Following PC shipments increase of 6% Y/Y in 2020 (excluding Chromebook on JPMe/Gartner estimates), our JPM colleagues expect continued strength in 2021 (up 9% Y/Y) before a decline in 2022 (down 5% Y/Y) with a mix shift from consumer to commercial PCs. INTC, NVDA, MU, and AMD are well-positioned to continue to benefit from sustained PC/gaming strength here in the June-Qtr and into the second half of 2021. We believe customer demand from Intel's new notebook CPUs (Tiger Lake) and AMD's Ryzen processors continues to be strong but held back by supply constraints.

Gaming demand (high-end PC systems) and fundamentals continue to remain solid in 2021 as people continue to spend time at home due to COVID-19, positive for AMD and NVDA, in our view. On top of that demand strength, the game console refresh cycle (PS5 and the Xbox Series X) and recent GPU product launches (NVIDIA GeForce RTX 30xx GPUs and AMD's Big Navi for 4K gaming) are driving further demand. NVIDIA continues to be supply constrained though the second half of the year but the team believes there's enough supply to support sequential revenue growth through the second half of the year.

Following muted datacenter spending trends for the last few quarters, datacenter spending is reaccelerating here in the Jun-Qtr and should inflect solidly in the second half of the year. In fact, at our 49th annual TMT conference (see takeaway note [here](#)) Intel noted that 1Q21 was likely the bottom and expects enterprise, government and cloud customer demand improving, driving Y/Y revenue growth in 2H21 in datacenter. Our JPM colleagues expect a 26% H/H increase in 2H21 (see note [here](#)). Overall, we anticipate 2021 spending will accelerate strongly in cloud datacenter infrastructure spending on compute-intense applications (AI-based workloads, IoT, Deep learning) supported by CPU server upgrade cycles from Intel and AMD. We believe overall compute fundamentals, led by cloud datacenter demand, to remain constructive in 2021, which is a net positive for OW-rated INTC, OW-rated NVDA, and Neutral-rated AMD.

Memory and Storage

According to data from InSpectrum, 8Gb DDR4 DRAM contract pricing increased by ~25% Q/Q in C2Q21 after a ~3% Q/Q increase in C1Q21. In NAND, 128Gb TLC contract pricing increased by 11% after a 2% Q/Q increase in C1Q21. In Micron's recent earnings results and guidance ([link](#)), the company discussed broad-based demand strength across most end-markets. As a result, the team increased its 2021 industry DRAM and NAND bit growth outlook to above 20% and mid-30%



range, respectively. Given the stronger demand outlook and limited supply, the team expects supply to remain tight through CY21 and into CY22, supportive of favorable pricing for the remainder of the year and into CY22. This is in-line with our view and we continue to remain positive on the strong pricing uptrends against the backdrop of normal/below-normal channel inventory. We expect DRAM bit demand growth in 2021 to be higher than that of 2020 (bit demand growth of 26% growth in 2021 vs. 17% in 2020) driven by server (31% bit growth), mobile (30% bit growth), and notebook (31% bit growth). Based on historical trends, upcycles in memory typically last approximately 5 quarters with pricing rising by 50%+. DRAM market entered into an upcycle in 1Q21 and we believe the cycle will likely last through 2021, if not longer, with pricing increasing. With Micron's solid execution on technology transitions for its transition from floating gate to replacement gate for 176L NAND and 1 α nm for DRAM and an improving product mix, we remain positive on OW-rated MU. We also expect N-rated WDC to benefit from improving demand trends in HDD and Flash. In addition, with BiCS5 achieving bit crossover later this year and BiCS6 initial ramp next year (with bit crossover likely in 1H23), we expect Western Digital to sustain cost leadership and driving mid-teens annualized cost reductions over the next several years.

Communications Infrastructure / Networking

As we have recently written (see note [here](#)), we expect a strong cloud networking upgrade cycle to 200G/400G optical connectivity in 2H21 and into 2022 on top of a strong re-acceleration in cloud capex spending in the 2H. Broadcom is seeing strong demand for its Tomahawk 3 and Jericho 2 switching/routing products and initial shipments of its next-gen Tomahawk 4 switching chipset. Marvell/Inphi is seeing strong demand for its Polaris and Porsima PAM4 200G/400G DSP chips for optical transceivers and is seeing strong demand for its Vega and Alaska PHY chipsets for 200G/400G switching line-cards. Google and Amazon started the networking upgrade cycle in 2018 and 2019, respectively, and we believe Facebook (to 200Gbps) is starting to upgrade now with Microsoft (to 400Gbps) towards the latter part of this year. China's cloud players are well-positioned to ramp strongly to higher optical speeds, with Baidu and Tencent in 2021. In optical, we believe Broadcom, Marvell, and Intel are well positioned to lead the \$1.1B market opportunity in silicon photonics (see primer [here](#)) - future generations of switching chips that would integrate the optical transceiver (module) functionality directly onto the switching chip - providing significant power consumption and cost savings for next-gen switching/routing platforms. In datacenter connectivity, NVDA through the completed acquisition of MLNX (25/50/100G NIC cards), and AVGO are benefitting from 25G switch port deployments that are driving strong demand for 25/50G NIC cards (servers) and 100G optical modules (rack-to-rack connectivity).

Specific to datacenter networking, Dell'Oro forecasts 100G/200G/400G/800G switch port shipments to grow at a 20% CAGR over the next 4 years. We believe optical demand (long haul / metro) in China will continue to be muted in 2021 due to the export restriction ban on Huawei. Early deployments today, primarily in backhaul RF, access, and interconnect suppliers and applications geared toward radio, massive MIMO, cable, and radar in geographies primarily in Korea, China, and North America are contributing to meaningful revenue and will likely continue to become more meaningful as we move through 2021 as 5G gets more fully built out and benefit companies like Marvell.

Regarding 5G basestations, we expect the buildout to reaccelerate in the second half of 2021 as North America activity picks up late in the year followed by Europe in 2022, while visibility in China buildout remains low. Global 5G basestations



deployment continues to be led by China and our research colleagues forecast 660k BTS in 2021 (up modestly Y/Y) for China with H/H growth (up 85%+ H/H in the second half) in the second half of the year. Broadband access continues to remain strong in 2021 as bandwidth usage at consumer premises remains strong due to work from home and we also see the upgrade of bandwidth from consumers as an indication of the longer-term need for broadband service providers to invest more in services at consumer premises. Within communications infrastructure and networking, we see net positive benefits for OW-rated AVGO, MRVL, and NVDA (through Mellanox acquisition), QRV0 and and MTSI.

Mobile Devices / Consumer

In the near-term, we anticipate some pockets of softness in 2Q led geographically by China and India especially for 4G phones, while demand for 5G phones remains solid. Our research colleagues have pointed to iPhone demand (e.g. iPhone 12 series) remaining resilient in the recent quarter ([link](#)). Looking ahead, the setup for 3Q and 2H is positive taking into account a typical iPhone launch cycle with fairly seasonal demand trends. Supply and demand in the smartphone segment is relatively more balanced compared to other end-markets where we continue to see supply constraints. Our research colleagues (see note [here](#)) had recently moderated overall 2021 unit volume growth to 7% Y/Y (from prior expectations of 9% Y/Y) but maintained its 4% Y/Y growth outlook for 2022. While overall units may come in lower than prior expectations, 5G smartphone demand remains strong and companies under coverage (Broadcom, Qorvo and Skyworks) will continue to benefit from content gains as 5G adoption rate continues to increase.

Specific to 5G, 5G smartphone volumes are on track to more than double to 525M units in 2021 and then increase by 38% Y/Y to 725M units in 2022 providing a positive mix benefit for content gainers. On the content side and consistent with our prior research (see note [here](#)), we expect blended RF content to increase from \$9-\$10 per phone on average to ~\$13 of content by 2022 reflecting an increased mix of 5G and associated RF complexity. We expect the RF available market for mobile devices to grow from ~\$13B 2019 to \$17B-\$18B in 2022E (10%-12% CAGR). Overall, we continue to focus on content gainers in consumer / wireless such as OW-rated AVGO and QRV0 and N-rated SWKS.

We believe consumer electronics-exposed companies should see slight upside in 2Q and 3Q on continued WFH demand trends (e.g. solid tablet, home electronics demand). We believe non-smartphone consumer demand in 2Q and 3Q should be sustained at these high levels as the economy continues to recover and especially in areas such as smartwatches and wireless headsets.

Automotive and Industrial

The auto industry continues to show strong momentum in 2Q21 and into 2H21. Given continued supply constraints and known fab shutdowns (i.e. Texas weather related and Renesas fire), auto production is expected to decline sequentially in 2Q21 but grow sequentially thereafter as we move through 2H21. On a Y/Y basis, IHS projects 2Q21 global vehicle production to be up 50% Y/Y (see [link](#)) and for 3Q21 to be flattish on sustained China strength and as the rest of the world continues to recover. CY21 global auto production is expected to increase by ~11% Y/Y (vs prior expectations of 13% Y/Y) given the supply chain constraints which has led to continued auto global production cuts. In industrial, the global PMI in June was 55.5, the twelfth consecutive month of above 50 PMI (>50 signals expansion) since emerging out of the COVID-19 lockdown in 2Q20 and at levels comparable to 2010 (emerging out



of the financial crisis). In addition, we see sustained strength within healthcare and aerospace & defense, which is often lumped in Industrial for most of our coverage universe. Looking ahead, our Economics & Policy research team is forecasting global GDP growth of 6.4% in 2021 and 4.6% in 2022. Companies with solid auto / industrial content exposure include OW-rated TXN, N-rated ON, and N-rated NXPI. Not Rated MXIM and ADI also have significant exposure to automotive / industrial semiconductor markets.

JPM C2Q21 and C3Q21 Estimates vs. Consensus

For companies reporting June quarter results over the next several weeks, we provide our revenue and adjusted EPS estimates vs. consensus estimates below.

Table 1: JPM 2Q21E/3Q21E Revenue Estimates vs Consensus

\$ in millions

	2Q21E		3Q21E	
	JPM	Consensus	JPM	Consensus
AMD	\$3,600.00	\$3,609.13	\$3,780.00	\$3,790.80
INTC	\$17,800.00	\$17,797.53	\$18,034.00	\$18,175.80
MCHP	\$1,548.00	\$1,549.50	\$1,586.70	\$1,588.22
MTSI	\$151.98	\$152.08	\$153.26	\$154.77
MXIM	\$684.98	\$680.69	\$684.98	\$687.67
NXPI	\$2,570.02	\$2,572.86	\$2,714.50	\$2,693.59
ON	\$1,620.00	\$1,624.26	\$1,620.00	\$1,612.35
QRVO	\$1,080.00	\$1,079.74	\$1,230.00	\$1,204.42
SWKS	\$1,100.00	\$1,103.91	\$1,225.00	\$1,225.46
TXN	\$4,350.00	\$4,348.88	\$4,567.50	\$4,591.13
WDC	\$4,499.58	\$4,529.00	\$4,900.20	\$4,884.88
XLNX	\$872.78	\$850.46	\$894.62	\$874.62

Source: J.P. Morgan estimates and Bloomberg Finance L.P.

Table 2: JPM 2Q21E/3Q21E (Non-GAAP) EPS Estimates vs Consensus

	2Q21E		3Q21E	
	JPM	Consensus	JPM	Consensus
AMD	\$0.54	\$0.54	\$0.55	\$0.55
INTC	\$1.05	\$1.07	\$1.07	\$1.08
MCHP	\$1.90	\$1.91	\$1.97	\$1.98
MTSI	\$0.54	\$0.53	\$0.54	\$0.53
MXIM	\$0.84	\$0.85	\$0.82	\$0.83
NXPI	\$2.31	\$2.32	\$2.53	\$2.48
ON	\$0.49	\$0.49	\$0.53	\$0.51
QRVO	\$2.45	\$2.46	\$3.11	\$3.02
SWKS	\$2.13	\$2.14	\$2.48	\$2.47
TXN	\$1.81	\$1.85	\$1.96	\$2.02
WDC	\$1.45	\$1.48	\$2.06	\$2.01
XLNX	\$0.86	\$0.84	\$0.91	\$0.88

Source: J.P. Morgan estimates and Bloomberg Finance L.P.

We Anticipate the Market to Continue Discounting an Improving Economic Outlook and Positive Earnings Revisions in 2021 and Into 2022

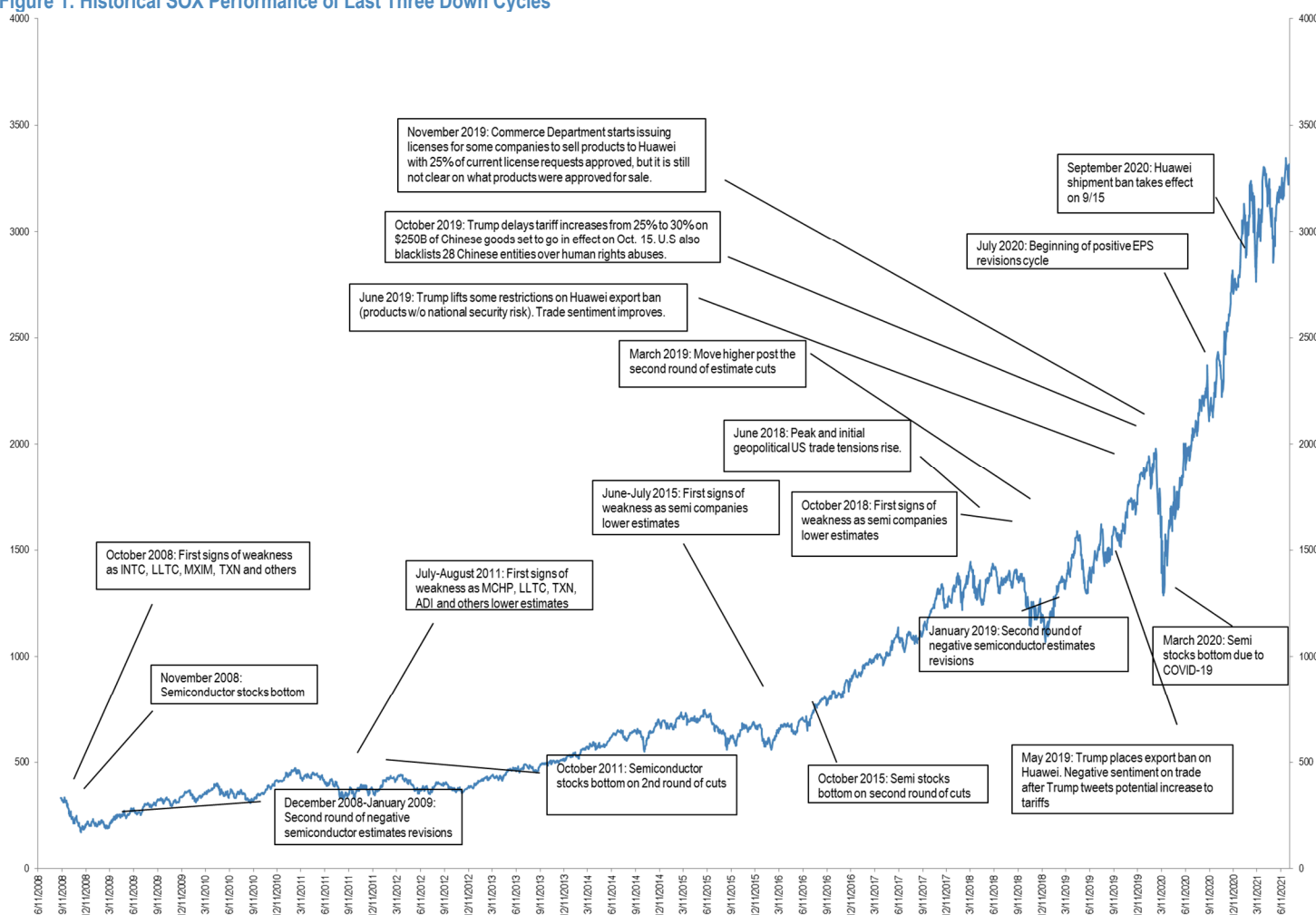
Following equity outperformance in 2020, we expect further upside in semiconductor stocks in 2021 as investors continue to positively discount improving industry trends and positive EPS revisions, which began in 2Q20 and which we expect to continue as move through 2021 as global semiconductor demand continues to improve. Semi stocks were up ~20% in the 1H of the year and we expect continued YTD performance in Semis stocks at least through the end of this year on continue Y/Y revenue growth and positive EPS revisions into 2H21. We continue to remain positive on semiconductor stocks as we are still in the early innings of a multi-quarter upcycle and in addition to strong demand



trends, we believe our companies will exert strong pricing power amidst a tight supply environment. Global semiconductor demand continues to expand FASTER than the rate of supply growth resulting in pricing power, solid order/backlog visibility and Q/Q declines in customer/channel inventories. We anticipate the positive earnings revisions to be broad-based as demand across almost all end-markets remains strong (auto, industrial, compute, mobile, gaming, networking) and with previously weak end-markets (cloud/hyperscale and enterprise) picking up strength into the 2H. For capital allocation, the dividend yield of companies should provide valuation support in case the SOX further sells off and with share buybacks beginning to restart after a pause in 2020. In terms of valuation, the SOX is trading at ~20x consensus 2022 earnings estimates (vs. S&P 500 at ~20x) but in our view remains reasonable as we anticipate another 15-20%+ potential upside in out-year EPS estimates. Our positive 2021 and 2022 semi industry outlook is underpinned by multiple drivers: continued global GDP growth in CY21 (6.4% growth in 2021) and in CY22 (4.6% growth in CY22) from 2H20, cloud/hyperscale datacenter capex growth (top 4 US CSPs up 18% Y/Y), strong 5G base station deployments (global deployment up 35% Y/Y), global auto production growth (up 11% Y/Y in CY21 and up 9% Y/Y in CY22), and 5G smartphone shipments likely to more than double Y/Y.



Figure 1: Historical SOX Performance of Last Three Down Cycles



Source: Bloomberg Finance L.P.

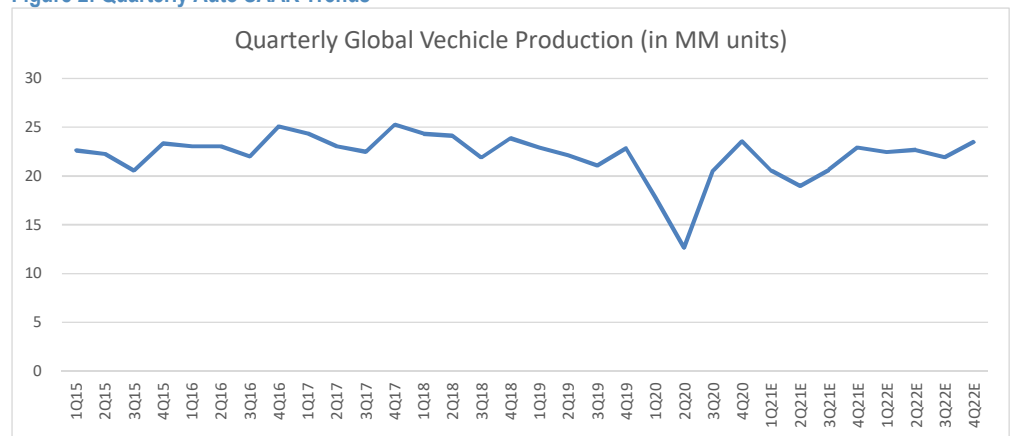
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WSTS semiconductor industry revenue data was published for the month of May 2021 and showed continued strong Y/Y growth reflective of the continued tight supply chain dynamics (units up modestly M/M but saw strong pricing power). After 32.0% Y/Y growth (up 33.0% Y/Y ex. memory) in industry sales in the month of April, May industry sales trend was up 30.0% Y/Y (up 32.0% Y/Y ex. memory). On a M/M basis, May sales were better than seasonal trends led by strong Memory sales. May Memory sales (both DRAM and NAND) were up double-digit% M/M on both strong unit shipments and strong pricing power. This is in-line with our positive outlook on the memory markets and in-line with Micron's recent commentary where the team expects supply to remain tight in both DRAM and NAND through CY21 and into CY22 (see note [here](#)). Excluding Memory, Analog, Microprocessor, and Microcontroller were all sub-seasonal though strongly above seasonal in April. On a Q/Q basis, following three consecutive quarters of above-seasonal demand trends, 2Q21 QTD is tracking to a 10% sequential growth (700bps above seasonality). Strong QTD (April/May vs Jan/Feb) segments include total



Analog (up 8.6%), general purpose analog (up 13.3%), general purpose MCU (up 9.8%), power transistors (up 11.6% Q/Q), DRAM (up 27%), and NAND (up 15.4%) Overall the data is in line with our global TMC conference takeaways (see note [here](#)), where all of our companies under coverage discussed near-term demand strength across all end markets, expanding supply/demand gap, and with tight/supply dynamics persisting well into 2022. We expect stronger revenues in the second half of the year and into 2022 as demand trends continue to remain strong and as companies continue to add incremental/disciplined capacity going forward. On a Y/Y basis, the three-month rolling average industry revenue and ex-memory industry growth were up 26.2% Y/Y and 27.7% Y/Y, respectively. Overall, we see semi industry revenues up 17-19% range Y/Y in 2021 and see another 8-10% Y/Y growth in CY22. We continue to remain positive on semiconductor and semiconductor equipment stocks given that we are still in the early innings of a multi-quarter upcycle and in addition to strong demand trends we believe our companies will exert strong pricing power amidst a tight supply environment.

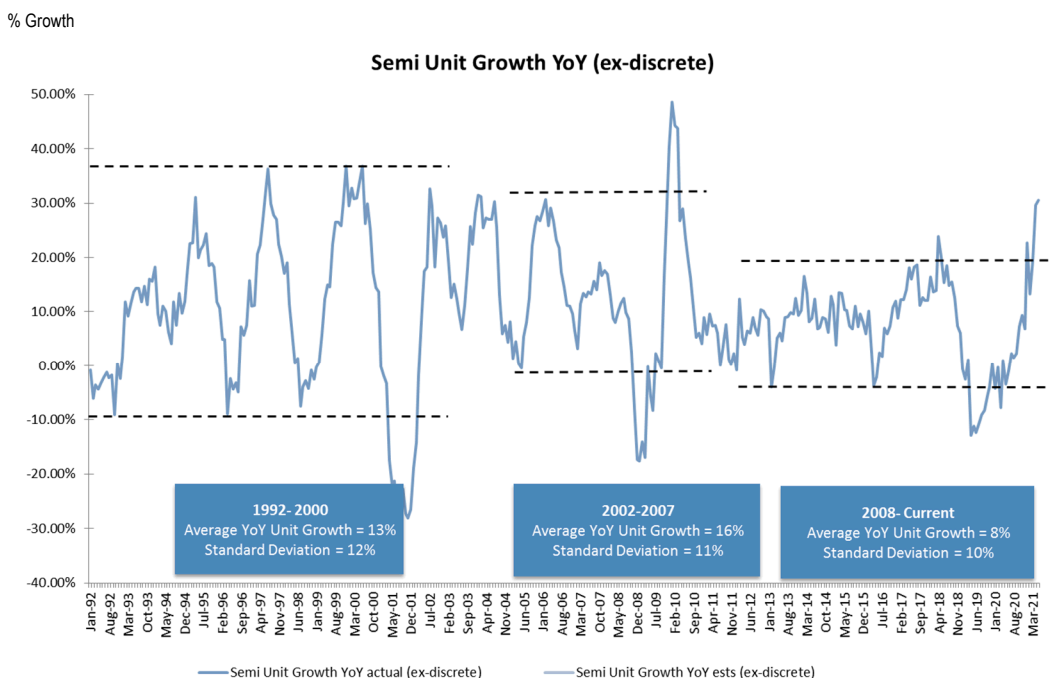
Figure 2: Quarterly Auto SAAR Trends



Source: IHS.



Figure 3: Semiconductor Industry Thesis - Entering more stable growth phase in semis (unit growth Y/Y); focus on scale (market leadership), margin/FCF expansion and capital allocation



Source: WSTS.

Table 3: Distribution inventory days below levels during prior industry inventory correction

	Distribution inventory days		Lead time	
	Current	Normal	Current	Normal
ADI	Below range	7-8 weeks		
MCHP	22 days	27-47 days	Extended	4-8 weeks
NXPI	1.6 months	2-3 months	Extended	16 weeks
ON	8.4 weeks	11-13 weeks	30-32 weeks	8-12 weeks
TXN		4.5 weeks	Stable	

Source: Company reports from most recently reported quarter.

Since 3Q20, the industry exhibited better than typical seasonal growth (Table 4), driven by broad-based demand growth. Supply-side indicators remain tight and are constrained across all end markets. Distribution levels are at/near the low end of companies' targeted range and with lead times (from 3-6 months to 5-9 months) continuing to get stretch out as demand strengthens. In fact, we believe companies are still shipping 15-50% below current end-market demand. We estimate that the industry is only 30-40% through the current up-cycle and will take another 4-6 quarters for supply to catch up with demand and inventories across the value chain to get back to normalized levels.



Table 4: Industry Q/Q growth above historical trends starting in 3Q20 (first time since 2Q18)

%

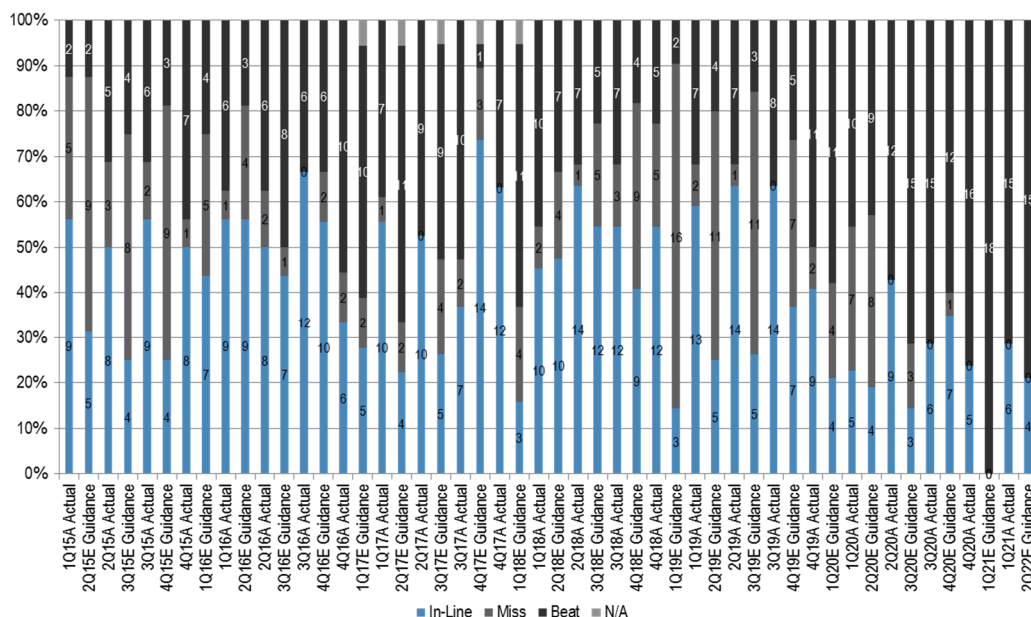
Quarter	10-year Avg. Q/Q Growth	Actual
3Q14	8%	7%
4Q14	0%	0%
1Q15	-1%	-5%
2Q15	3%	1%
3Q15	7%	1%
4Q15	0%	-2%
1Q16	-2%	-5%
2Q16	3%	1%
3Q16	6%	12%
4Q16	-1%	5%
1Q17	-2%	0%
2Q17	2%	5%
3Q17	7%	11%
4Q17	-1%	6%
1Q18	-2%	-2%
2Q18	3%	6%
3Q18	7%	6%
4Q18	0%	-8%
1Q19	-6%	-10%
2Q19	-2%	1%
3Q19	13%	9%
4Q19	-1%	1%
1Q20	-3%	-3%
2Q20	3%	-1%
3Q20	6%	10%
4Q20	-1%	5%
1Q21	-4%	4%

Source: WSTS.

Following four consecutive quarters of positive EPS revisions that began in 2Q20 (i.e., 1Q21 - CY21 EPS estimates were revised higher by 7-9%, 4Q20 CY21 EPS estimates revised higher by ~9%, 3Q20 - CY21 EPS estimates revised higher by 2-10% and 2Q20 CY21 EPS estimates revised higher by 12-25%), we expect continued positive EPS revisions as we move through 2Q21 and in 2H21. The number of companies in 1Q that delivered in-line/better out-quarter guidance was at ~95% (100% last quarter) - reflective of strong demand trends and tight supply dynamics across almost every end-markets in semis. We continue to see broad-based strength across in automotive, smartphone, PC, and gaming and with previously weak end-markets (cloud/hyperscale and enterprise) picking up strength into the 2H.



Figure 4: Semiconductor Coverage Universe Revenue Results and Guidance vs. Consensus – 1Q15A to 2Q21 Guidance



Source: Company reports, J.P. Morgan estimates and Bloomberg Finance L.P.

Many Companies Have Attractive Dividend Yields and Buybacks Likely to Restart

While semiconductor companies have focused on increasing shareholder returns, due to COVID-19 many companies under coverage have suspended share buybacks to either conserve cash or as a result of the “optics” of share buybacks amid declining economic activity and increasing unemployment. We believe that as fundamentals continue to improve, many companies under coverage will restart their share buybacks. We believe companies will maintain/increase their dividend programs as fundamentals continue to improve in 2021 and into 2022. Table 5 illustrates dividend yields for select large-cap semi companies.

Table 5: Dividend Table

Company	Yield
AVGO	3.0%
INTC	2.4%
TXN	2.1%
ADI	1.7%
MCHP	1.1%
SWKS	1.1%
MRVL	0.4%
NVDA	0.1%
Average	1.5%
S&P Average	1.3%

Source: Bloomberg Finance L.P. as of market close 07/13/2021.



Consolidation in the Semi Industry Likely To Continue and Provides Valuation Support

2020 semiconductor and semiconductor capital equipment M&A deal activity reaccelerated in 2H20 and was above ~\$100B following two consecutive years of below \$100B. Bloomberg and company reports estimate total 2021TD semi and semicap deal volume at \$19.4B versus ~\$128B in 2020, \$47B in 2019, ~\$64B in 2018, ~\$140B in 2017 and ~\$141B in 2016. We believe overall M&A in semiconductors is characterized by “big getting bigger” and, going forward, we expect to start seeing a lot more M&A activity with the smaller/medium-sized companies, as there is pressure to drive scale to compete with much bigger competitors. In fact, after muted 1H20 deal activity, 2H20 deal activity reaccelerated sharply with three big deal announcements (above \$20B) from semiconductor companies such as NVIDIA (for ARM), Analog Devices (for Maxim), and AMD (for Xilinx). We believe deal activity will be a key component of capital allocation going forward and supportive of valuations in 2021 and beyond. Table 6 illustrates announced M&A since the middle of 2015.



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Table 6: We expect more M&A in the long term as industry consolidation should continue to support valuations

Announcement	Buyer	Target	Deal Value (\$M)	Status	Sector	Expected Completion
5/10/2021	MKS Instruments	Photon Control	387	Pending	Semicap	3Q21
4/21/2021	Skyworks	Silicon Labs' Infrastructure and Automotive Business	2750	Pending	Semi	3Q21
2/8/2021	Renesas	Dialog Semiconductor	5900	Pending	Semi	End of 2021
1/13/2021	Qualcomm	NUVIA	1,400	Pending	Semi	
10/28/2020	Marvell Technology Group Ltd	Inphi	8,200	Completed	Semi	
10/27/2020	Advanced Micro Devices	Xilinx	35,000	Pending	Semi	End of 2021
10/19/2020	SK-Hynix	Intel (NAND)	9,000	Pending	Semi	End of 2021
9/13/2020	NVIDIA Corp.	ARM Ltd.	40,000	Pending	Semi	1H2022
7/13/2020	Analog Devices	Maxim Integrated	21,300	Pending	Semi	Summer 2021
7/7/2020	Synaptics Inc.	Broadcom's Wireless IoT Connectivity Business	250	Completed	Semi	
4/6/2020	MaxLinear	Intel's Connected Home Business	150	Completed	Semi	
2/20/2020	Dialog Semiconductor	Adesto Technologies	358	Completed	Semi	
12/16/2019	Intel	Habana Labs	2,000	Completed	Semi	
8/8/2019	Broadcom	Symantec's Enterprise Security Business	10,700	Completed	Semi	
7/9/2019	Cisco Systems	Acacia Communications Inc.	2,600	Completed	Semi	
7/1/2019	Applied Materials	Kokusai Electric	2,200	Terminated	Semicap	
6/24/2019	Nanometrics Inc	Rudolph Technologies	N/A	Completed	Semicap	
6/10/2019	Intel	Barefoot Networks	N/A	Completed	Semi	
6/3/2019	Infineon Technologies	Cypress	10,000	Completed	Semi	
5/29/2019	NXP Semiconductors	Marvell's Connectivity Business	1,760	Completed	Semi	
5/20/2019	Marvell Technology Group Ltd	Avera Semiconductor LLC	650	Completed	Semi	
5/6/2019	Marvell Technology Group Ltd	Aquantia Corp	452	Completed	Semi	
4/10/2019	Qorvo Inc.	Active-Semi International	325	Completed	Semi	
3/27/2019	ON Semiconductor Corp.	Quantenna Communications Inc.	1,070	Completed	Semi	
3/15/2019	Ideal Industries	Cree Huizhou Solid State Lighting Co Ltd	310	Completed	Semi	
3/11/2019	NVIDIA Corp.	Mellanox Ltd.	6,900	Completed	Semi	
12/18/2018	Cisco Systems	Luxtera	660	Completed	Semi	
10/30/2018	MKS Instruments	Electro Scientific Industries	1,000	Completed	Semicap	
9/11/2018	Renesas	Integrated Device Technology	6,700	Completed	Semi	
7/11/2018	Broadcom Inc.	CA Technologies	18,900	Completed	Software	
5/8/2018	Cohu	Xcerra Corp	796	Completed	Semicap	
3/19/2018	KLA-Tencor Corp.	Orbotech Ltd.	3,200	Completed	Semicap	
3/6/2018	Cree	Infineon RF Power	428	Completed	Semi	
3/1/2018	Microchip Technology	Microsemi Corp	10,150	Completed	Semi	
11/20/2017	Marvell Technology Group Ltd	Cavium Inc	6,018	Completed		
10/5/2017	Dialog Semiconductor	Silego technology	276	Completed		
9/22/2017	Canyon Bridge Capital	Imagination Technologies	743	Completed		
6/12/2017	Synaptics Inc	Conexant Systems	341	Completed		
3/29/2017	MaxLinear Inc.	Exar Corp	446	Completed		
3/13/2017	Intel	Mobileye	15,300	Completed	Semi	
2/13/2017	IDT	Gigpeak	250	Completed	Semi	
2/2/2017	Veeco	Ultratech	815	Completed	Semicap	
12/21/2016	TDK	Invensense	1,300	Completed	Semi	
11/21/2016	MACOM	Applied Micro	770	Completed	Semi	
11/2/2016	Broadcom	Brocade	5,900	Completed	Semi	
10/31/2016	Inphi	ClariPhy	275	Completed	Semi	
9/23/2016	Shanghai Capital	Analogix Semiconductor	500	Completed	Semi	
9/13/2016	Renesas	Intersil	3,200	Completed	Semi	
8/25/2016	Littelfuse Inc.	ON Sem's Ignition IGBT business	100	Completed	Semi	
7/26/2016	Analog Devices	Linear Technology	14,800	Completed	Semi	
7/17/2016	Softbank	ARM Holdings	32,000	Completed	Semi	
6/15/2016	Cavium	QLogic	1,360	Completed	Semi	
6/14/2016	JAC Capital	NXP's Standard Products Business	2,750	Completed	Semi	
5/18/2016	ARM Holdings PLC	Apical Ltd	350	Completed	IP	
5/13/2016	NavInfo Co. Ltd	Autochips Heifei Inc.	598	Completed	Semi	
4/28/2016	Cypress	Broadcom's IoT	550	Completed	Semi	
3/3/2016	Cisco Systems	Leaba Semiconductor Ltd	320	Completed	Semi	
2/23/2016	MKS Instruments	Newport Corporation	980	Completed	Semicap	
2/4/2016	FormFactor Inc	Cascade Microtech	296	Completed	Testing	
1/13/2016	Microchip	Atmel	3,420	Completed	Semi	
12/14/2015	Micron Technology	Inotera Memories	3,200	Completed	Memory	
11/18/2015	ON Semiconductor	Fairchild Semiconductor	2,400	Completed	Semi	
10/26/2015	Integrated Device Technology	ZMDI	310	Completed	Semi	
10/21/2015	Western Digital	Sandisk	19,000	Completed	Memory	
10/20/2015	MicroSemi	PMC-Sierra	2,400	Completed	Semi	
9/30/2015	Mellanox	Ezchip	811	Completed	Semi	
9/7/2015	Mediatek	Richtek	879	Completed	Semi	
6/1/2015	Intel	Altera	16,700	Completed	Semi	

Source: Bloomberg Finance L.P. and Company data.



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Table 7: Semiconductor Group and Comp Valuation

JPM Rating	Market Cap	7/13/21 Price	Non-GAAP EPS		P/E		Revenue		P/S		EV/Sales		Consensus Non-GAAP EPS		Consensus Sales		Consensus P/E		Consensus P/S		
			C21E	C22E	C21E	C22E	C21E	C22E	C21E	C22E	C21E	C22E	C21E	C22E	C21E	C22E	C21E	C22E	C21E	C22E	
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PC Semiconductors																					
INTC	OW	\$232,940	\$56.87	\$4.65	\$4.76	12.2	11.9	\$73,000	\$74,550	3.2	3.1	3.3	3.2	\$4.62	\$4.49	\$72,926	\$73,415	12.3	12.7	3.2	3.2
NVDA	OW	\$511,920	\$810.00	\$16.02	\$19.19	50.6	42.2	\$24,997	\$29,118	20.5	17.6	20.0	17.2	\$15.68	\$17.12	\$24,490	\$27,040	51.7	47.3	20.9	18.9
AMD	N	\$111,110	\$90.26	\$2.11	\$2.52	42.8	35.8	\$14,643	\$16,678	7.6	6.7	7.3	6.4	\$2.16	\$2.63	\$14,729	\$16,974	41.8	34.3	7.5	6.5
Memory																					
MU	OW	\$89,825	\$78.45	\$8.01	\$13.30	9.8	5.9	\$30,705	\$38,485	2.9	2.3	2.8	2.2	\$8.39	\$13.02	\$31,369	\$38,965	9.4	6.0	2.9	2.3
WDC	N	\$21,935	\$70.08	\$7.00	\$10.68	10.0	6.6	\$12,629	\$13,154	1.7	1.7	2.2	2.1	\$6.90	\$10.30	\$18,695	\$21,051	10.2	6.8	1.2	1.0
Enterprise/Networking/Datacenter Semiconductors																					
XLNX	N	\$33,360	\$133.96	\$3.52	N/A	38.1	N/A	\$3,525	N/A	9.5	N/A	8.9	N/A	\$3.46	\$4.11	\$3,470	\$3,784	38.7	32.6	9.6	8.8
MRVL	OW	\$39,363	\$56.77	\$1.40	\$1.93	40.6	29.4	\$4,248	\$5,109	9.3	7.7	12.0	10.0	\$1.34	\$1.81	\$4,079	\$4,986	42.3	31.3	9.7	7.9
AVGO	OW	\$207,640	\$484.01	\$27.83	\$31.76	17.4	15.2	\$27,533	\$30,045	7.5	6.9	8.5	7.8	\$28.04	\$30.43	\$27,543	\$29,236	17.3	15.9	7.5	7.1
Mobile Devices																					
SWKS	N	\$31,622	\$189.58	\$9.83	\$10.77	19.3	17.6	\$4,847	\$5,150	6.5	6.1	6.2	5.8	\$9.90	\$11.32	\$4,895	\$5,413	19.2	16.7	6.5	5.8
QRVO	OW	\$22,173	\$192.79	\$11.48	\$12.15	16.8	15.9	\$4,583	\$4,875	4.8	4.5	4.8	4.5	\$11.50	\$12.35	\$4,592	\$4,872	16.8	15.6	4.8	4.6
Analog/Microcontrollers																					
TXN	OW	\$178,772	\$191.20	\$7.60	\$8.08	25.2	23.7	\$17,774	\$18,604	10.1	9.6	9.9	9.5	\$7.57	\$7.99	\$17,583	\$18,276	25.3	23.9	10.2	9.8
ADI	NR	\$62,291	\$167.26	\$6.42	\$7.10	26.1	23.6	\$6,799	\$7,322	9.2	8.5	9.6	9.0	\$6.43	\$7.10	\$6,792	\$7,264	26.0	23.6	9.2	8.6
NXPI	N	\$57,786	\$204.00	\$9.78	\$10.75	20.9	19.0	\$10,611	\$11,304	5.4	5.1	5.9	5.5	\$9.69	\$10.66	\$10,579	\$11,206	21.1	19.1	5.5	5.2
MCHP	OW	\$40,516	\$143.93	\$7.72	\$8.47	18.6	17.0	\$6,204	\$6,686	6.5	6.1	7.8	7.2	\$7.74	\$8.39	\$6,204	\$6,627	18.6	17.2	6.5	6.1
MXIM	NR	\$27,305	\$100.61	\$3.34	\$3.79	30.1	26.5	\$2,734	\$2,963	10.0	9.2	9.5	8.8	\$3.35	\$3.66	\$2,722	\$2,893	30.0	27.5	10.0	9.4
Diversified/Consumer/Standard Components/Other																					
ON	N	\$16,890	\$37.92	\$1.94	\$2.46	19.5	15.4	\$6,342	\$6,755	2.7	2.5	2.9	2.8	\$1.92	\$2.32	\$6,309	\$6,612	19.7	16.3	2.7	2.6
MTSI	N	\$4,233	\$60.01	\$2.15	\$2.45	28.0	24.5	\$612	\$669	6.9	6.3	7.1	6.5	\$2.11	\$2.42	\$616	\$675	28.4	24.8	6.9	6.3
Semiconductor Capital Equipment																					
AMAT	OW	\$126,341	\$136.29	\$6.98	\$7.38	19.5	18.5	\$23,642	\$24,785	5.3	5.1	5.2	5.0	\$6.87	\$7.50	\$23,331	\$25,204	19.8	18.2	5.4	5.0
LRCX	OW	\$90,333	\$624.67	\$30.50	\$33.87	20.5	18.4	\$16,048	\$17,000	5.6	5.3	5.6	5.2	\$30.88	\$34.17	\$16,104	\$17,303	20.2	18.3	5.6	5.2
KLAC	OW	\$48,349	\$311.61	\$16.09	\$17.86	19.4	17.5	\$7,511	\$7,910	6.4	6.1	6.5	6.2	\$16.26	\$17.61	\$7,545	\$8,008	19.2	17.7	6.4	6.0
Large Cap Semi Average					28.5	23.8	8.8	8.0									23.2	21.0	8.9	8.3	
Small-Mid Cap Semi Average					21.4	18.6	4.8	4.5									21.6	18.9	4.8	4.5	
Semi Group Average (ex-outliers)					24.1	20.0	7.0	6.3									24.3	21.3	7.1	6.6	
SOX Index			3,301	147	168	22.4	19.6	6.4	5.9								22.4	19.6	6.4	5.9	
S&P500			4,370	191	213	22.9	20.5	2.9	2.8								22.9	20.5	2.9	2.8	

\$ in millions, except for EPS

Source: Company reports, Bloomberg Finance L.P and J.P. Morgan estimates. Pricing as of market close 7/13/2021.



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