EVERCORE ISI

Technology | Semiconductors and Semiconductor Equipment

September 4, 2017

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Upcoming Potential Catalysts:

Covered Company Events

MXIM - Tues, Sep 5, 5pm - Business Update Call

Competitor's Conference - Semiconductor Attendees

Wednesday: MCHP, MU, SWKS, ADI, QRVO, ASML, MXIM, KLAC, NVDA, TXN, AVGO, INTC. Thursday: MTSI, LRCX, XLNX, TER. Friday: QCOM

Our Top Picks:

Our top picks in Semis are NVDA (best growth in Semis on AI/Deep Learning, Autonomous Driving, and Gaming cycles), XLNX (Data Center leverage to Inference + ADAS + Industrial), MU (Still too low street estimates, still improving pricing and supply/demand environment in DRAM, tech positioning in NAND, absurd P/E), WDC (under-appreciated earnings power in worst NAND ASP conditions; likely accretive transaction with Toshiba, leader in Storage) and ADI (on track for deleveraging, synergies - both topline and bottom line, and path to $5-6 in FCF in next 24 months). Our top picks in SPE are AMAT (drive to $4-5 in normalized EPS suggests shares cheap today led by Silicon leadership and leverage to OLED), LRCX (excellent leverage to 3-D NAND arm's race as etch/deposition grows as % cap intensity), and ASML (leadership in EUV/ Immersion, with vision to €9.00 plus in EPS in 2020 timeframe).

The Times They are A-Changin: Post Summer Pause, Look for 4Q Rally for Semiconductor Stocks

There are growing concerns that this is as good as it gets with Y/Y semi revenues peaking in 2Q, margins near or above historical peaks, and a 8.5 year run with the SOX outperforming the S&P 500 by 87% since 2009. Oppositely, valuations still remain cheaper for Semis vs. the broader market and most other cyclicals. We have also seen meaningful consolidation through M&A, which has led to more rational behavior including better pricing that suggests this time is a bit different for Semis – which definitely scares investors and emboldens the shorts. Since June 8th – these fears have resonated – despite earnings moving higher, multiples have compressed – with the SOX basically flat despite June Q EPS coming in 4+% better and September Q guided 3+% better.

From a Macro perspective, the LEI (leading indicator index) is just barely above its prior peak – whereas it typically takes about 4 years for the LEI to get back to its prior peak, this time took a decade. After it has made a new peak, it has been an average of 6yrs until the next recession, with 4 years the shortest time – suggesting the next downturn will not come until at least 2021. We have thought we have been in the 6th inning of the cycle since 2014. Perhaps, now we are in the 7th inning – but if in fact the next recession comes in 2021, we think it's a bit early to abandon cyclicals, in particular Semiconductors.

From a content perspective, we believe Semiconductors are entering a third wave of rising silicon intensity, with the first two waves led by the advent of the PC and then Smartphones. Today, it is fairly obvious with the rising content in Automotive. But we believe we are seeing other areas exhibit similar content growth, particularly across the industrial complex and consumer space. We view one of the most significant trends driving rising silicon intensity is the increase in data creation driven by new areas of compute. We expect this to be a significant tailwind to the semiconductor industry as this data needs to be analyzed, stored and processed. Semiconductors have historically averaged ~44bps of GDP with a prior peak of ~60bps around the internet bubble (2000) and an expectation of ~51bps in 2017. Assuming WW nominal GDP grows per IMF targets (3.6% in CY17 followed by 5% in CY18-20) and silicon intensity approaching 55-60bps, this would suggest WW Semiconductor revenues of ~$450B-525B by 2020 (vs. ~$400B in CY17). Thus, overall Semi revenues are likely 10-30% below likely peak – so estimates have more room to run higher.

Looking to current consensus, 2H17 estimates are below normal seasonality. Assuming a backdrop of rising silicon intensity, we continue to see upside to consensus estimates through 2H17 and into 2018. So earnings should prove to be positive catalysts to look forward to in October. That being said, we believe that the street remains cautious/negative on the space and highlight that in-line prints and guides were generally met with hostility during 2Q17. Which begs the question – are Semis poised to move higher post-Summer or are we at a peak with a pullback coming. We readily acknowledge the current market is terribly difficult. Everything fundamental says stay Long, while everything from the charts suggests Short (up until last week). This has led to investor sentiment, on the margin, worsening. The good news – we think this sets the stage for a 4Q rally.

Add it all up and we continue to believe we are in a LT secular bull market for Semiconductors with a recession being years out so any pull back should be bought. So our call – buy on dips into a likely 4Q rally supported by an improving economy, a successful iPhone launch, potential for a pick-up in M&A, and the simple vision as investors return from the Beach in August that the stocks are cheap on a relative basis and estimates are moving higher over the next 2 quarters.

Our top themes and ideas: 1) Still Early Stage of AI Training and Inference – buy NVDA and XLNX; 2) DRAM Trading as if Peak, but Valuation More Indicative of Trough - Buy MU; 3) WDC Mispriced – Even Worst Case Scenario Suggests EPS > $10 through 2020 – Buy WDC; 4) Arms Race in NAND to Continue, Buy the Arms Dealers LRCX and AMAT; 5) Lithography Dominance Bolstered by EUV – Buy ASML; and 6) High-Quality ADI lowering leverage and on track to $6 in FCF by 2019 – Buy ADI.

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From a Macro perspective, the LEI (leading indicator index) is just barely above its prior peak – whereas it typically takes about 4 years for the LEI to get back to its prior peak, this time took a decade. After it has made a new peak, it has been an average of 6 years until the next recession, with 4 years the shortest time – suggesting the next downturn will not come until at least 2021. We have thought we have been in the 6th inning of the cycle since 2014. Perhaps, now we are in the 7th inning – a clear time to look for an exit – but if in fact the next recession comes in 2021, we think it's a bit early to abandon cyclicals, in particular Semiconductors.

From a content perspective, we believe Semiconductors are entering a third wave of rising silicon intensity, with the first two waves led by the advent of the PC and then Smartphones. Today, it is fairly obvious with the rising content in Automotive. But we believe we are seeing other areas exhibit similar content growth, particularly across the industrial complex and consumer space. We view one of the most significant trends driving rising silicon intensity as the increase in data creation driven by new areas of compute. We expect this to be a significant tailwind to the semiconductor industry as this data needs to be analyzed, stored and processed. Semiconductors have historically averaged ~44bps of GDP with a prior peak of ~60bps around the internet bubble (2000) and an expectation of ~51bps in 2017. Assuming WW nominal GDP grows per IMF targets (3.6% in CY17 followed by 5% in CY18-20) and silicon intensity approaching 55-60bps, this would suggest WW Semiconductor revenues of ~$450B-525B by 2020 (vs. ~$400B in CY17). Thus, overall Semi revenues are likely 10-30% below likely peak – so estimates have more room to run higher.

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Add it all up and we continue to believe we are in a long-term secular bull market for Semiconductors with a recession being years out so any pull back should be bought. Our call – buy on dips into a likely 4Q rally supported by an improving economy, a successful iPhone launch, potential for a pick-up in M&A, and the simple vision as investors return from the Beach in August that the stocks are cheap on a relative basis and estimates are moving higher over the next 2 quarters.

Our top themes and ideas (outlined in the note below) are as follows: 1) Still Early Stage of AI Training and Inference – buy NVDA and XLNX; 2) DRAM Trading as if Peak, but Valuation More Indicative of Trough - Buy MU; 3) WDC Mispriced – Even Worst Case Scenario Suggests EPS > $10 through 2020 – Buy WDC; 4) Arms Race in NAND to Continue, Buy the Arms Dealers LRCX and AMAT; 5) Lithography Dominance Bolstered by EUV – Buy ASML; and 6) High-Quality ADI lowering leverage and on track to $6 in FCF by 2019 – Buy ADI.

Our Top Themes Heading into 4Q and Beyond

(Please note that we remain restricted on AVGO, NXPI, and QCOM)

1. **Still Early Stages of AI Training and Inference – Buy NVDA and XLNX.** With NVDA shares bouncing back post-earnings, investors are clearly looking through any temporary Data Center pause into strong 2H growth driven by Volta ramp, further supported by a favorable Gaming seasonality, a strong AAA-rated gaming launch title schedule and continued GPU inventory tightness. Here, we continue to think NVDA's CUDA software and platform approach remains underappreciated and should sustain continued excellent growth ahead as Data Center revenues approach $2.5B into CY18. We model Gaming Segment growth of 17% for CY18/19 to account for Volta ramp, and model Data Center revenues reaching $3.5B vs. $2.8B earlier in CY19. Net-net, we model overall revenues growing to $12.5B in CY19, with higher Data Center revenue contributions uplifting Gross Margins from 60.4% to 61%. With LT growth drivers in Data Center, Gaming and Automotive intact and a line-of-sight to ~$6.00+ in EPS by 2019, we maintain our Outperform rating and $180 Price Target (30x $6 CY19 EPS). Look for update from us post NDR which includes CEO Jensen Huang following the week of September 10th.

   For Xilinx, we continue to see Fair Value of $80 and upside to consensus estimates for FY18, with a conservative management team setting low expectations. The recent quarter proved the increasing diversification of their business model (and a broadening customer base), with strength in ADAS in Autos, a broad-based Industrial recovery, Test and Measurement product cycles and a Defense program ramp offsetting weakness in Communications (both Wired and Wireless). Layer in continued upside to Data Center growth, particularly with FPGA as a service at AWS, where the second phase of deployment with much broader market expanding potential is underway (using Xilinx's SDAccel to enable software developers), and we continue to view the initial DC guide of $200-300M in revenues by CY20 as conservative (especially since it did not incorporate the revenue potential for AWS FPGA as a Service). Management commentary around AWS has become increasingly constructive, highlighting the opportunity for FPGA acceleration to "go viral" with the second phase of F1 deployments. Leading edge should also be a continued area of growth, given the company's excellent competitive positioning at the sub-28nm nodes. With management holding off on raising total revenue / margin guide for FY18 while holding OpEx at the $1B run-rate level highlighted at the Analyst Day, we continue to see estimate revisions moving higher through the year. With growing optimism on the Inference / Hyperscale and ADAS opportunities for Xilinx FPGAs (not to mention emerging 5G growth drivers in FY19), we wouldn't be surprised if the company's average FCF multiple didn't grow from the current 17x-18x range to closer to 20x over time. To this end, we maintain our Outperform rating and $80 Price Target (20x expected FCF of $4.00 by CY19).

2. **DRAM Trading as if Peak, but Valuation Indicative of Trough - Buy MU**. Despite ongoing DRAM supply shortages and robust demand, Micron continues to trade as if we are at peak. However, with Micron's book value expected to reach $25 by November 2018, shares at only 1.2x projected book value are trading much closer to trough levels of 1.0x and well below historical average of 1.5x (and never mind peak of 2.75x). We continue to model rational behavior across all three suppliers with a focus on maximizing profitability as opposed to market share. Here we continue to model supply of only low 20's percentages in both CY17 and CY18, with demand tracking closer to mid to high 20's in the same timeframe. Now some fear a more aggressive ramp of new capacity, but we just don't see it. We think 3-5% annual wafer growth is required simply to offset lost wafers out on reduced productivity in the move to 1xnm. And even if DRAM manufacturers wanted to add, equipment lead times now stretch into 2Q18 meaning supply ordered today would not add to bit output until 2HCY18 at the earliest….which gives us comfort that DRAM supply will continue to be tight through CY18 and that book value will approach $25 in the 2HCY18 timeframe. With earnings power on an annualized basis approaching $8.50 for the August Q (look for upside to August Q – perhaps positive pre-announcement early September post Labor-Day from mgmt) and higher thereafter (think $9-10 annualized into Nov Q), shares at a current P/E of 3-4x is simply too cheap to ignore. Layer in debt pay-down, improving NAND competitive positioning with the move to 3-D, leverage to emerging XPoint technology, mid-cycle earnings of at least $4-5, and overall bullish long-term growth expected for both DRAM

and NAND, and we reiterate our Outperform rating and $40 price target. MU probably offers the best upside in all of Semis through year-end, in our view.

3. **WDC Mispriced – Even Worst Case Scenario Suggests EPS > $10 in 2020:** With WDC trading at $90, we continue to believe that investors are underestimating the earnings power of the company's NAND business (as well as system level approach), while at the same time assuming significant declines in the HDD business. We think SSDs will continue to cannibalize HDDs, increasingly penetrating the enterprise nearline business, particularly as NAND cost per GB will dip to the $0.10/GB level in late 2018/early 2019 on the ramp of 64L QLC. As demand for NAND continues to accelerate on enterprise adoption and the cost structure of 3D NAND improves, we maintain that WDC's earnings will prove resilient to fluctuations in pricing. To that end, we looked at several scenarios that assume HDD revenues declining 5% per year, and HDD OMs declining 1% per year, with NAND bits growing 40% per year – at the midpoint of the industry's assumed 35-45% annual growth. Even if we model ASPs down 30% per year for 2018-2020, and cost down 25%, we expect 2020 EPS of at least $10. Assuming ASPs down 25% per year in that same period (and cost down just 20%), we come up with EPS of $12.50 (an optimistic scenario, with ASPs and costs both down 20%, suggests a rather rosy $19). We thus reiterate our Outperform rating and $130 price target, which equates to ~9.7x our $13.40 EPS estimate for 2018 and 10-13x our longer-term earnings outlook – hardly aggressive in our view. Additionally, we note that a resolution of WDC's ongoing legal dispute with Toshiba over the fate of Toshiba's half of their JV would be positive for the company.

Figure 1. WDC Scenario Analysis

Case 1: NAND ASPs -30%, Cost -25%	2017	2018	2019	2020
		NAND		
Bits	35%	40%	40%	40%
ASPs	2%	-30%	-30%	-30%
Cost Down	-14%	-25%	-25%	-25%
GM	50%	50%	47%	43%
OM	33%	36%	32%	28%
Revenues	$9,953	$11,201	$11,017	$10,760
		HDD		
GM	32.3%	31.0%	30.0%	30.0%
OM	13.2%	12.2%	11.2%	10.2%
Revenues	$10,026	$9,517	$9,008	$8,578
Total Revs	**$19,979**	**$20,718**	**$20,024**	**$19,338**
EPS	**$12.50**	**$13.88**	**$12.11**	**$10.17**

Case 2: NAND ASPs -25%, Cost -20%	2017	2018	2019	2020
		NAND		
Bits	35%	40%	40%	40%
ASPs	2%	-25%	-25%	-25%
Cost Down	-14%	-20%	-20%	-20%
GM	50%	51%	48%	44%
OM	33%	36%	34%	30%
Revenues	$9,953	$11,738	$12,316	$12,842
		HDD		
GM	32.3%	31.0%	30.0%	30.0%
OM	13.2%	12.2%	11.2%	10.2%
Revenues	$10,026	$9,517	$9,008	$8,578
Total Revs	**$19,979**	**$21,255**	**$21,323**	**$21,420**
EPS	**$12.50**	**$14.77**	**$13.90**	**$12.67**

Case 3: NAND ASPs -20%, Cost -20%	2017	2018	2019	2020
		NAND		
Bits	35%	40%	40%	40%
ASPs	2%	-20%	-20%	-20%
Cost Down	-14%	-20%	-20%	-20%
GM	50%	52%	52%	52%
OM	33%	38%	39%	40%
Revenues	$9,953	$12,168	$13,601	$15,126
		HDD		
GM	32.3%	31.0%	30.0%	30.0%
OM	13.2%	12.2%	11.2%	10.2%
Revenues	$10,026	$9,517	$9,008	$8,578
Total Revs	**$19,979**	**$21,684**	**$22,609**	**$23,703**
EPS	**$12.50**	**$15.96**	**$17.50**	**$18.96**

HDD Assumptions - Revenues -5% per annum, with OMs declining 1% per annum
SSD Assumptions - Bit growth remains constant at 40%

Source: Company data, Evercore ISI Research

4. **Arms Race in NAND to Continue, Buy the Arms Dealers LRCX and AMAT** – Led by the transition to 3D NAND and near-insatiable demand for storage, we forecast sustained greenfield capacity adds. More specially, we expect industry capacity to grow from 1.6M/wspm today to 2.0M/wspm in just a few years. NAND bit demand is expected to grow 40% in 2017 and 2018, with supply unlikely to meet demand until next year on a difficult transition to 3D. Layer in pricing that is steadily shrinking to $0.10/GB (vs. $0.03/GB for HDD), and we see an acceleration of the cannibalization of HDDs by SSDs, as the pricing premium is more than offset by NAND's better performance and durability. With demand having proven to be surprisingly inelastic at a time of growing prices, we see the reverse happening should the industry be able to ramp supply (in particular as QLC starts to ramp next year) – rather than a dramatic dropoff in ASPs, we envision accelerated adoption of NAND in the data center, driving continued spending. NAND is nearing ~50% of total WFE spending of $43B in 2017 and we believe this level of investment is sustainable over the next 3-5 years, particularly when you include likely entrance of China into the mix in the 2019-2020 timeframe. On sustained 3D NAND capacity investments, we would look to own the arms dealers – with LRCX and AMAT the best positioned to benefit from this trend. Look for a positive Analyst Day from AMAT in

late September as likely positive catalyst for shares over the next 4 weeks (with Lam hosting Analyst Day in November).

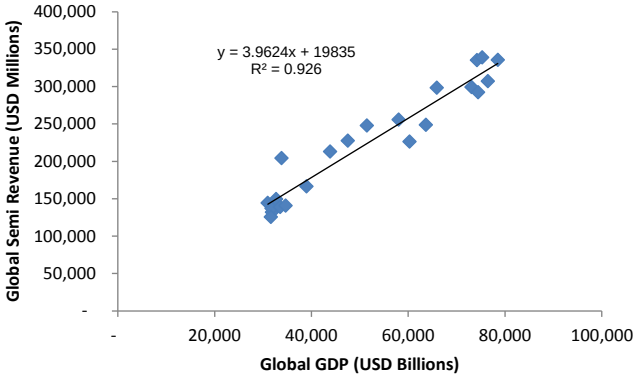
5. **Lithography Dominance Bolstered by EUV – Buy ASML.** With ASML on track to earn €9 or more into the 2020 timeframe and greater earnings thereafter, we see a clear path for ASML shares to €180 (20x target model) into the 2018-2019 timeframe suggesting 40% incremental upside. We estimate that ASML will have 90+% market share in overall lithography revenues in CY17, with EUV over time driving market share even higher. As for catalysts, EUV will become mainstream in 2018 led by TSMC 7nm+ node (assuming 2-4 layers at 45k/wspm, TSMC will need 4 EUV tools), and intel and Samsung's true 7nm node, as well as 1y DRAM adoption at 1-2 layers (assuming full adoption at Samsung's 475k/wspm DRAM facilities, equates to 9-18 EUV tools). Over the next 12 months, the manufacturing industry will move from pilot line and development to high volume manufacturing. In turn, we suspect the top 3 manufacturers (TSMC, Samsung, Intel) will become increasingly vocal on plans for EUV – we don't think it's terribly unreasonable to have a more clear adoption outlook by the end of 2017, with a high degree of clarity by mid-2018. Now, it's all about execution at ASML – driving a) improved uptime/performance for HVM, b) EUV GMs higher, c) further penetration of Hermes, and 4) overall share gains with Holistic Lithography. Finally, there is a service element to EUV that we believe is not fully appreciated by investors – this could be a €1B business by the 2025 timeframe and add incremental €1 over-time to EPS. We reiterate Outperform rating and 12-month price target of €145, with medium-term upside to €180 well intact.

6. **Highest Quality ADI Tracking to Low Leverage and $6 in FCF by CY19.** We continue to believe the combined ADI/LLTC is still arguably the highest quality Semiconductor company with best of breed margins (70%/40% GM/OMs), excellent B2B leverage (>80% revs I/A/I), and sticky, long-lasting revenue stream that will generate industry leading 40% FCF margins over time. Add in Apple moving to a 5% customer and we see room for multiple expansion as we see B2B driven outperformance through FY18 and beyond led by GDP acceleration globally including China, sustained strength in A&D aided by HITT, and rising Instrumentation (both ATE and in-house) sustaining elevated Industrial spending. With ADI on track to generate $6.00 in FCF by the CY19 timeframe as well as reach 2.0x net leverage by December 2018, focus will soon shift to shareholder returns as ADI starts returning 80-100% FCF to shareholders and we continue to see upside to at least $100 for ADI shares into the CY18 timeframe (if not $120 if we assume multiple expansion to 20x). Considering our vision for 20+% upside, we remain buyers.

"This Time is Different" – Might it be True?

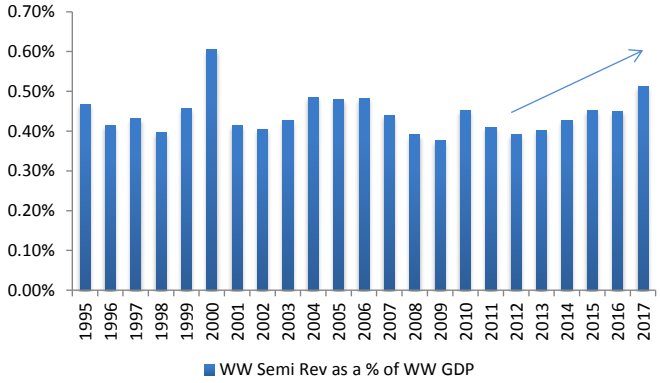
Semiconductor revenues have proven to be highly correlated to global GDP over the last 20 years, generating an R squared coefficient of 0.93. Logically, this makes sense – more goods produced, more electronics produced. As a result, we have seen the long-term growth trends of GDP vs Semis track roughly in-line (+4.3% vs +4.2% respectively since 1995). While we believe that Semis will continue to depend on overall GDP growth to sustain its own core growth trajectory, we view increasing silicon intensity as a potential source of upside. Semiconductors have historically averaged ~44bps of global GDP. Semis contribution to GDP has been gradually increasing since 2012 and we expect it to reach a new high of 51bps in 2017 (excluding 2000 internet bubble peak of 60bps). Unlike 2000, we do not view this increase as an outlier but rather as a new norm based on increasing silicon intensity across end-markets and the pervasiveness of electronics across a broad spectrum of applications (discussed in greater detail below). As a result, we believe that semiconductors can enjoy a sustained period of GDP+ growth with muted cyclicality as many of the new drivers remain in the early innings. To this end, we would not be surprised to see Semi intensity approaching 2000's peak level of 60bps over time.

Figure 2. Global GDP vs Semi Revenue has Shown Strong Correlation from 1995-2016



Source: Company data, Evercore ISI Research

Figure 3. Semis Contribution to GDP has Gradually Increased Over the Last 5 Years



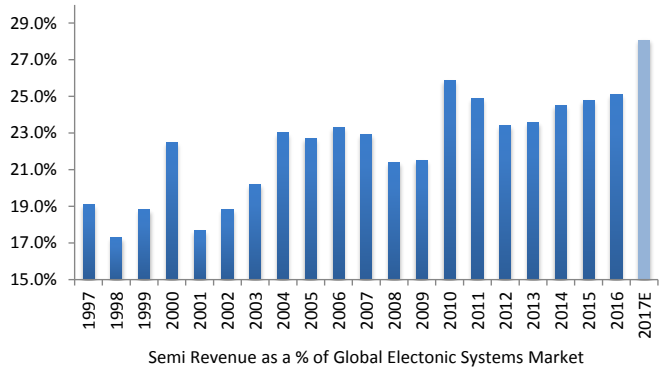
Source: Company data, Evercore ISI Research

To cut straight to the chase – we believe we are now in a higher growth environment with muted cyclicality. The "this time is different" argument is always a difficult one but there are a few items that we point out to support this thesis. It is important to note that the crux of this argument is that today's environment is seeing a faster rate of change than ever before – this is leading to a theoretical supply demand imbalance for the foreseeable future amongst a rational group of players.

Silicon Intensity Increasing – Progressing from Consumer to I/A/I

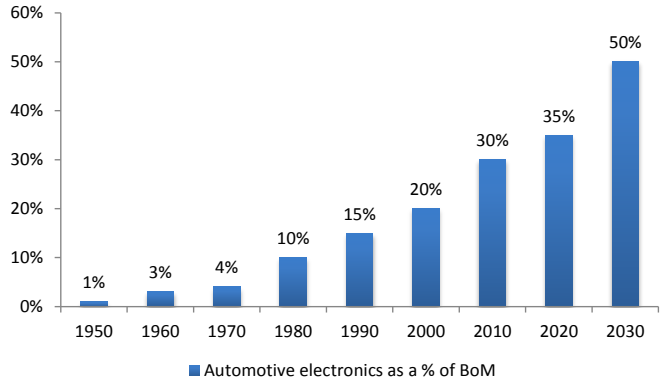
From a content perspective, we believe semiconductors are entering a new wave of rising silicon content as electronics become ever more pervasive. PCs broke ground in introducing the consumer to owning compute power, smartphones introduced the consumer to carrying compute power, and the next wave (and perhaps the largest in terms of total content) is introducing ubiquitous computing through industrial, automotive and infrastructure applications. This progression from consumer to I/A/I has fostered a main stream acceptance of technology/innovation which we believe will accelerate the transition. One of the most obvious examples can be found in the automotive industry. Electronics within vehicles are becoming increasingly important across various verticals including ADAS (safety), Infotainment, and Powertrain. This focus on electronics can be found particularly in higher-end vehicles which will inevitably make their way to the main stream market over the next handful of years. Additionally, we believe (as does consensus at this point) that semiconductor content will be forced into vehicles through ADAS as safety agencies make 5-star ratings increasingly stringent. Other examples include items such as factory automation where the manufacturing processes continue to get smarter and the medical field where new applications are regularly being introduced.

Figure 4. Semi Revenue as a % of Total Electronic Systems Market Increasing Over Time



Source: IC Insights, Evercore ISI Research

Figure 5. Electronics as a % of Automotive BoM Increasing Significantly Over Time

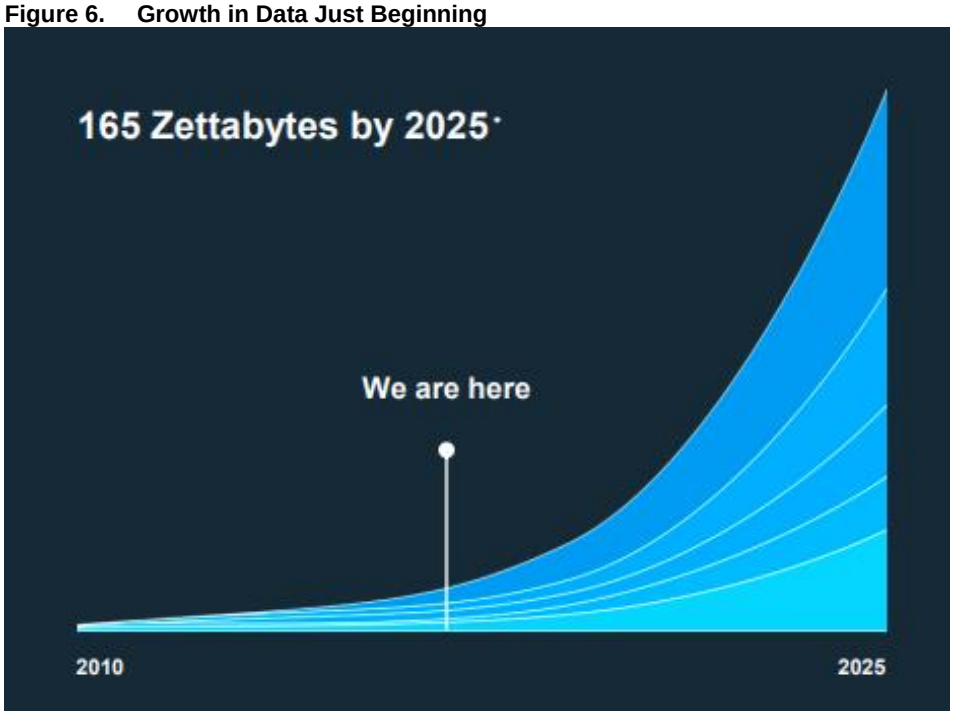


Source: PWS, Evercore ISI Research

Proliferation of Data – Data Creation, Data Analytics, Data Storage

As silicon intensity increases and electronics become more ubiquitous, it would only make sense that we now have an increasing amount of data available to us. This data is being created at an exponential rate which we believe will continue into the foreseeable future as we remain in the early innings of this new wave of silicon content (think AI, Deep Learning, Autonomous Driving, etc.). This has massive implications for the semiconductor industry as all of this data is analyzed, stored, and then processed. The primary beneficiaries of this trend will be datacenter and memory where technology innovation at the silicon level will only take clients so far before they are forced to move up the stack or increase the number of units purchased. We note that this phenomena will not only occur on the back end, but edge computing will also benefit as big data driven results need to be implemented.

Figure 6. Growth in Data Just Beginning

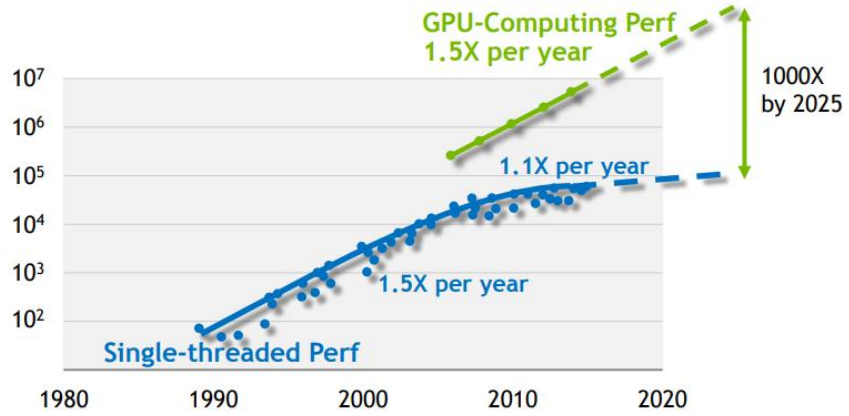


Source: IBM, Evercore ISI Research

Moore's Law Slowing – Benefits Accruing More to Chipmakers Today?

With Moore's Law slowing and the consequential gains in transistor costs diminishing, we believe the Semiconductor market could be transitioning from a deflationary to inflationary environment. We get there are clear advances coming (i.e. EUV, new architectures, advances to software and materials, new advanced packaging technologies, etc), but this also comes at a price. Capital intensity in the move from 16nm to 7nm is projected to increase by 65% ($265M per 1k/wspm vs. $160M per 1k/wspm). Considering this backdrop, do not look for leading edge foundries to build capacity on spec. On the other hand, as Moore's law slows, we may see supplemental parts added which can serve to boost processing power to keep performances increases up. A prime example of this is the inclusion of GPU in the data center. As CPU performance improvements slow and an increasing number of workloads incorporate parallel processing, we are seeing GPUs accelerate the space and offer a significant TCO advantage to customers. All-in-all, our sense is that the free-ride from doubling of transistor count every year afforded to the end consumer is slowing, and chipmakers are in a prime positon to benefit from this – including higher ASPs, funding to support capacity investments, and/or demand for new technologies to sustain performance.

Figure 7. Slowdown in CPU Perf Gains can be Offset Through GPU Acceleration

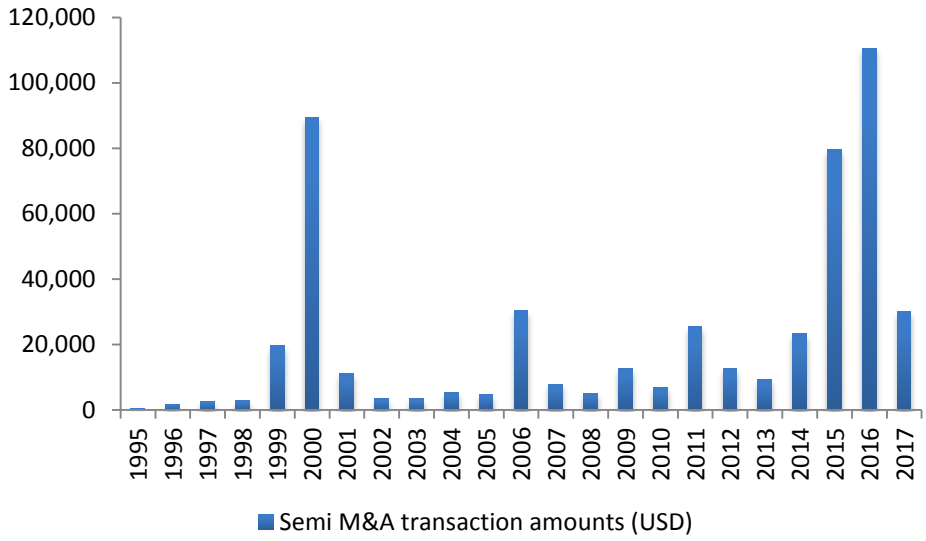


Source: NVDA Investor Day 2017, Evercore ISI Research

More Rational, Consolidated industry – Deepening Moats & Barriers to Entry

Over the past few years we have seen a significant amount of M&A activity within the semiconductor industry. The result: a more consolidated industry where participants are incentivized to act in a more rational behavior. We believe that this trend has yielded an industry where supply chain management is key and generally, margins are valued over share. This new world order is a primary contributor to muted cyclicality as broad-based channel stuffing and inventory corrections are lessened in magnitude and price wars are not as severe. Both TXN and ADI recently moved to exclusive distribution deals which leverage their consolidated position to extract more value from distribution through exclusive arrangements with distributors and providing dedicated field applications technical and sales support to a broader set of customers. In another example, a high-market share communications infrastructure provider raised pricing recently on its products.

Figure 8. Significant Consolidation in the Semi Industry - M&A Transactions (dollars) Increasing



Source: Company data, FactSet, Evercore ISI Research

A Closer Look at Key End Market Drivers

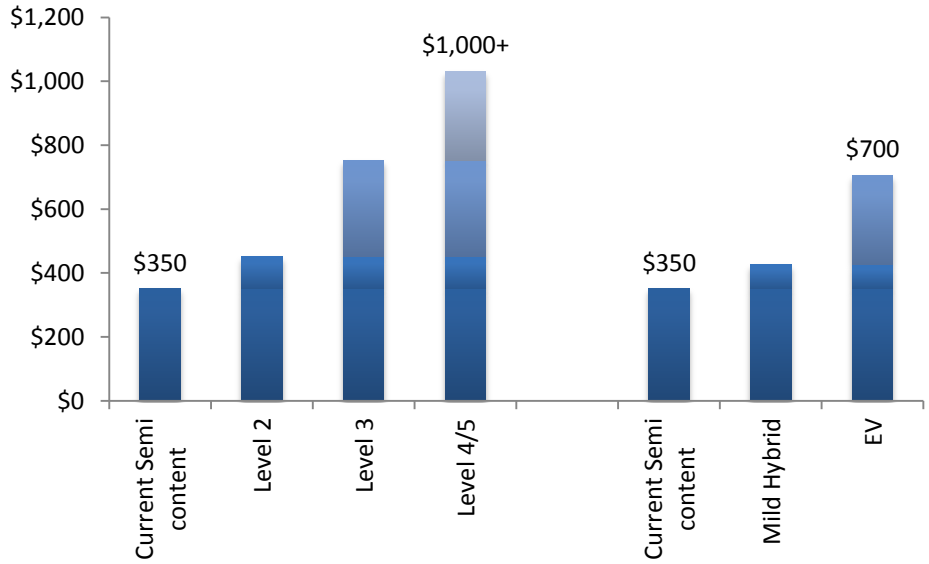
The big picture items listed above provide an overview of why we believe that the space will continue to grow GDP+. That being said, from a bottom's up approach, we believe that there are many nascent applications where will look for significant growth in the coming years.

Automotive – The Revolution is Just Beginning

While this may be the most feared of the semiconductor end markets, we believe it may be one of the most underappreciated. Global LV production is slowing, particularly in the US – this is bad for semis. That being said, we continue to believe that the content story here is more than enough to offset a shortfall in overall shipments. Electrification in automobiles is growing at a rapid pace and as a result, more and more semiconductor content is being added to the car. We view the strong growth in autos being driven by high-end vehicles were content is a key differentiator among OEMs. Moving forward we believe that these high-end inclusions will trickle down to the main stream vehicles and ADAS safety features will be pushed into all new cars to not only meet stringent NCAAP regulations, but also to provide a competitive solution as new features are marketed to consumers. LMC's current global estimates peg light vehicle (LV) production at a CAGR of ~2% through 2024. We believe that the content growth story will add an incremental 5-10% to the unit growth rate depending on exposure (we prefer higher ADAS exposed companies) and believe that electrification remains in the early innings on a global basis.

To provide further color, we estimate that vehicles today contain ~$350 of semiconductor content. Core semi content will continue to increase as incremental features are added, but we see significant jumps based on level of autonomy and degree of electrification. As we transition from level 2 autonomy to level 3 autonomy, we see semi content roughly doubling, and then increasing another 25% as we move to level 4/5 to $1,000 in content. Further, as cars transition from traditional internal combustion engines (ICE) to mild hybrids, semi content increases ~20% and when transitioning to an EV, increases 100%. Electric vehicles still remain a small portion of today's production (~3%), but as these vehicles grow as countries enforce emission regulations, semiconductors will be a prime beneficiary. It is important to remember that while US weakness is a negative for the space, the US only accounts for ~17% of global production and SUVs continue to remain resilient which helps to offset a portion of the downside (better mix).

Figure 9. Auto Semi Content's Strong Opportunities in Autonomous and Electrification

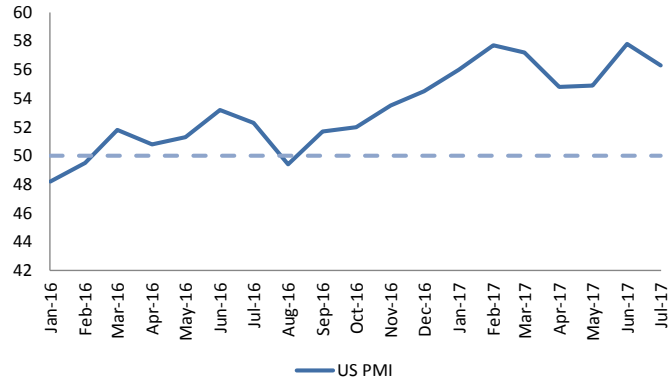


Source: Infineon, Evercore ISI Research

Industrial – Certainly Not Flashy, but Growth is Growth

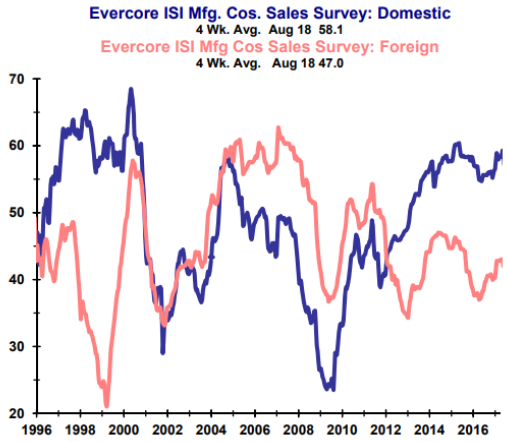
The industrial end-market continues to outperform expectations as increasing content growth and new applications drive the market higher. While content increases will continue to bolster this end-market, we believe that macro factors will remain the key determining factor of core growth and note that we see no signs of deterioration at this time. US PMI remains in expansionary territory and is increasing ~7-8% Y/Y, Evercore ISI industrial surveys continue to tick up (on both the domestic and foreign front) and there is plenty of runway left in terms of applications and content to drive GDP+ growth. That being said, industrial growth over the last twelve months has been at an abnormally high level. As we enter into 2018, we expect this growth to decelerate from +21% Y/Y over the LTM (MXIM, ON, XLNX, IFX, ADI industrial segments) to a more normalized run rate of +5-10%, but we believe the market will offer a soft landing as inventories remain in check, lead times begin to stabilize, and ordering patterns normalize.

Figure 10. US PMI Remains in Healthy Expansionary Territory



Source: Company data, Evercore ISI Research

Figure 11. Evercore ISI Industrial Surveys Continue to Tick- Up



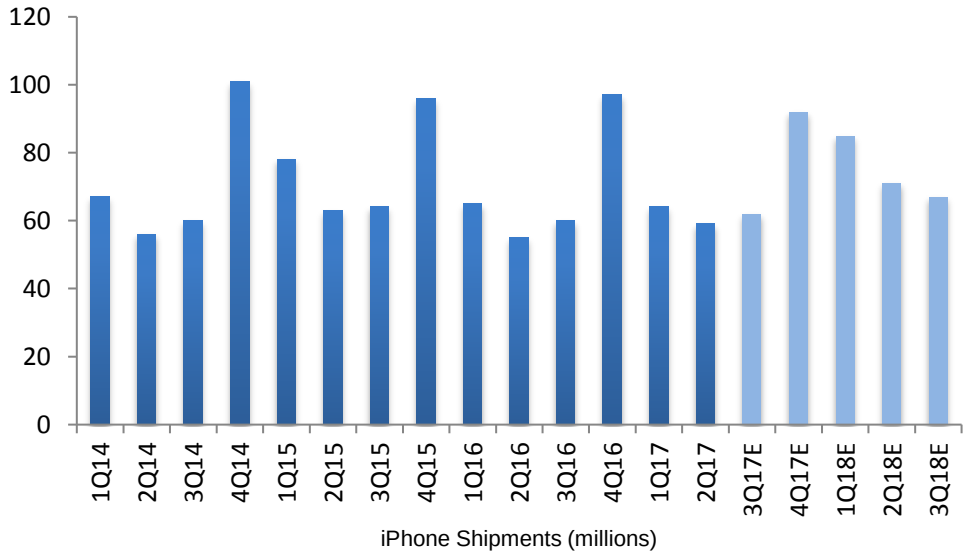
Source: Company data, Evercore ISI Research

Consumer – Focus Shifting to Apple iPhone 8 Launch

The consumer market has been the hardest hit recently as PC continues its secular decline, smartphone growth has slowed, and tablets have been made redundant by large screen smartphones. We believe that expectations for this space are sufficiently negative and view positive data points as icing on the auto/industrial/datacenter stories. Starting with PCs, we expect that market to decline at a low- to mid-single digit CAGR through 2020 after declining 8% in 2015 and 5% in 2016. We believe the segment will stabilize as we are now closer to a core PC market which will continue to refresh (and be bolstered by with growth from Chromebooks and Ultralights). Short-term, ODM notebook shipments grew 6% in the June Q, but declined 31% in July, which may suggest that inventories in the channel are now largely normalized. We expect PCs to remain "strong" into the back half of the year, declining low-single digits Y/Y in CY17 after declining 3.4% Y/Y in 1H17.

Moving to smartphones, we expect the market to grow at a low- to mid-single digit CAGR through 2020 after growing 28% in 2014, 11% in 2015, and 5% in 2016. The slowdown comes largely as the developed world becomes saturated and technological innovation slows which causes a push-out in the replacement rate. Offsetting these items is the potential growth in emerging markets. As infrastructure is built out, smartphones are made available to an increasing number of people which will continue to drive its TAM higher. Ericsson estimates that smartphones accounted for ~50% of the total global subs in 2016 – this number is expected to increase to ~75% by 2020 (+2.9B smartphone subs) as 4G/5G ramp globally. Near-term we look for AAPL to drive the market as Consensus appears to be meaningfully discounting the new iPhone launch - currently estimating iPhone units +7.3% in 2H17 off of easy comps, and +9.8% in CY18 (well below the iPhone 7's launch year of +20.8%). We believe that there has been a pause in demand ahead of the much anticipated iPhone "8" launch which will be filled regardless of delivery timing. Look for a successful launch by Apple to be a very important catalyst for Semi shares.

Figure 12. iPhone Estimates Appear Conservative for New Model Launch



Source: Company data, FactSet, Evercore ISI Research

Datacenter – Evolution Across the Compute Landscape

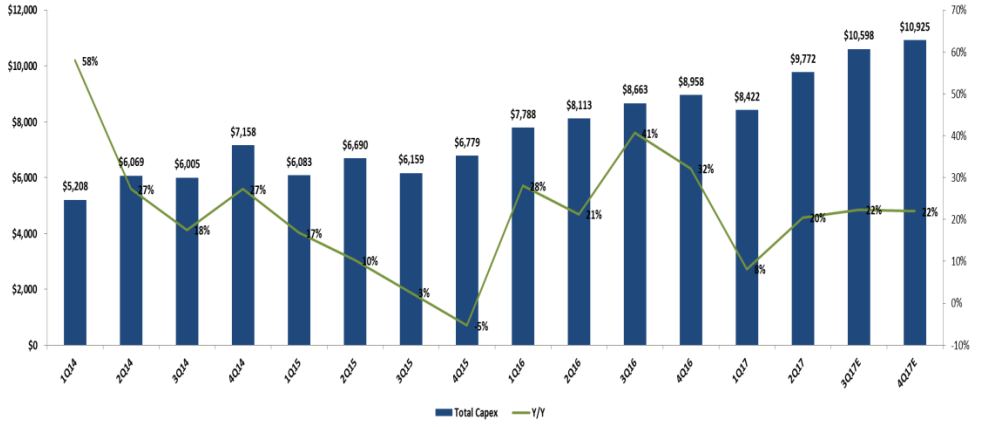
Currently, processing is dominated by INTC's CPUs but as compute shifts from linear to parallel, options such as GPUs and FPGAs become more attractive due to performance advantages. We view both FPGAs and GPUs as winners in a slowing Moore's Law world, as can be seen in increasing deployments of both FPGAs and GPUs in hyperscale. As Moore's law slows, accelerator architectures like GPUs and FPGAs should continue to grow as a percentage of total compute resources. Further, AI is still a rapidly evolving field in both Training and Inference, but we do believe that we are on the cusp of massive growth in AI Architectures with GPU, FPGA and CPU vendors as the main beneficiaries. We like NVIDIA's position in AI Training given its competitive advantage supported by CUDA and its complete ecosystem. For inference, we view FPGAs as being well positioned, though the TAM for Inference will consist of a range of solutions from FPGAs to CPUs to GPUs.

For NVDA, investors are clearly looking through any temporary DC pause into strong 2H growth driven by the Volta ramp. We continue to think NVDA's CUDA software and platform approach remains underappreciated and should sustain continued excellent growth ahead as Data Center revenues approach $2.5B into CY18 and $3.5B into CY19. For Xilinx, we continue to like the role FPGAs play for AI Inference and Compute in Data Center, particularly with FPGA as a service at AWS, where the second phase of deployment with much broader market expanding potential is underway (using Xilinx's SDAccel to enable software developers), and we continue to view the initial DC guide of $200-300M in revenues by CY20 as conservative (especially since it did not incorporate the revenue potential for AWS FPGA as a Service).

Intel's AI portfolio consists of CPUs, Nervana ASIC-based AI Training and Altera FPGA-based AI Inferencing solutions, along with the surrounding ecosystems (libraries, SDKs) that are key to Intel's push into AI. The Nervana acquisition gave Intel access to a common architecture for AI implementation; the technology will be integrated across the entire product portfolio, including Purley. Intel is positioning FPGAs (gained through the Altera deal) as the architecture of choice to accelerate inference applications in deep learning. Near term we look for INTC's Purley launch in the 2H to spark demand, with ~43% estimated DCG OMs for 2HCY17 (Guide 40% for CY17) driven by ASPs (Skylake) and better seasonal uplift against fixed costs. Purley is the biggest update in a decade, with 1.65x average performance improvement and a 60% lower TCO. Intel is focused on a platform approach (CPUs, 3D Xpoint, Omni-Path) driving strong generational performance improvements, with a focus on workloads rather than synthetic benchmark improvements.

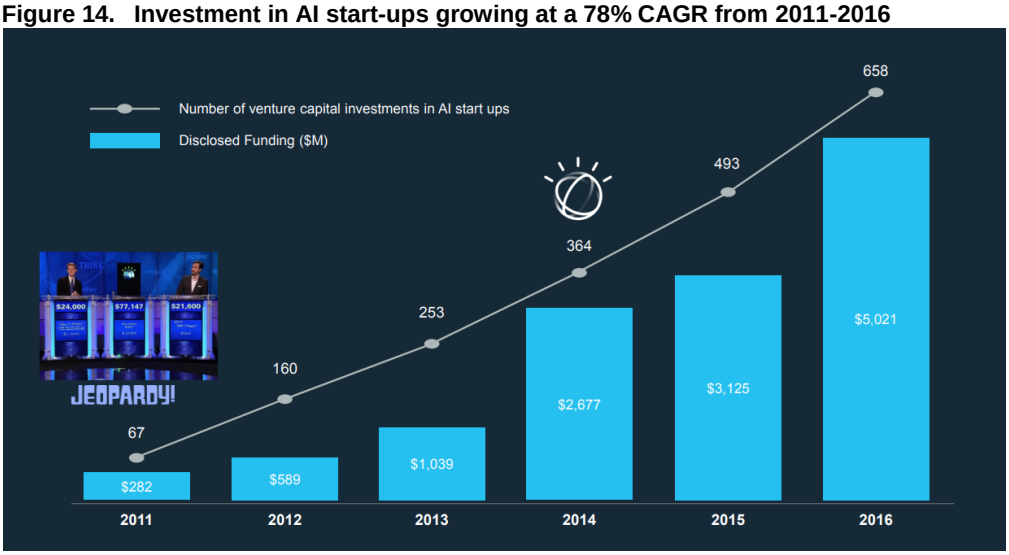
Cloud Capex continues to show strong Y/Y gains, and capex guides from MSFT and FB suggest another robust year for hyperscale spending (FB guided 2017 Capex up 60% Y/Y to $7-7.5B, while MSFT forecast continued Capex growth into 2017). Further, Alibaba's Capex is up sharply in 2017.

Figure 13. Hyperscale Cloud Capex Continues to Grow Y/Y



Source: Company Data, Evercore ISI Research

Figure 14. Investment in AI start-ups growing at a 78% CAGR from 2011-2016



Source: IBM, Evercore ISI Research

Communications Infrastructure – Focus shifts to 5G rollout, Metro build-outs

With rising front-end radio content driven by wireless trends like 4.5G (Carrier Aggregation, MIMO, etc.), we remain positive on XLNX and ADI which have exposure to the radio front-end. As we head towards the end of the year, we believe investor attention shifts in 2018 to global 5G infrastructure buildouts which promise to offer a long-duration infrastructure investment. Further, we continue to see Wired Metro strength outside China, while China Metro should also finally resume growth after the provincial build-out delays in 1H2017.

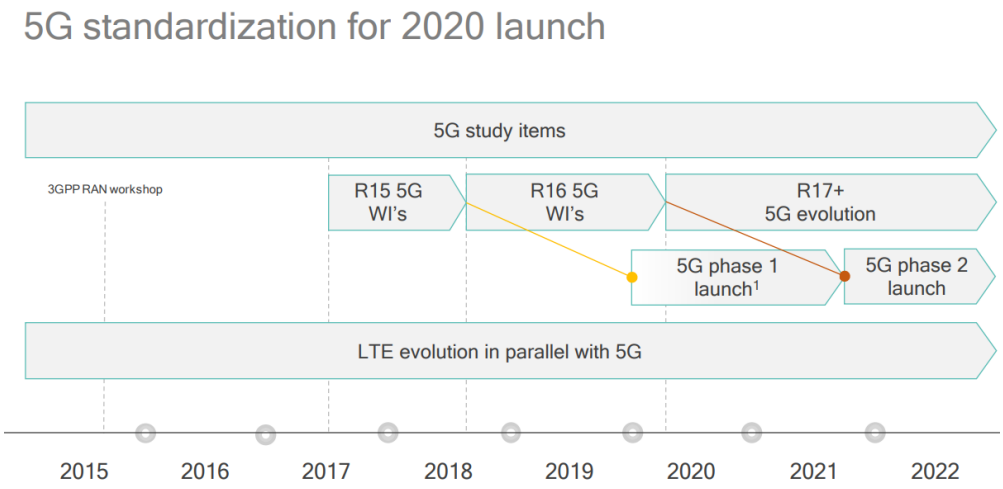
China has been front and center of the communications infrastructure debate, with a slowdown in 4G Capex and pushout of wired Metro deployments. Nearer term, the investment by Alibaba and Tencent in China Unicom should help kick-start a near-term Capex cycle as the telecom providers look to install 2M base stations over the next 3 years to expand rural wireless coverage. While sentiment is bearish, we would point to a study by MIIT in China which estimates that 5G Capex is expected to start from RMB220B ($33B) in 2020 before peaking at RMB313B ($47B) in 2023, with a cumulative capex of RMB2.85T ($424B) by 2030. Here we point to comments by China Mobile indicating 5G buildouts in 2019, potentially accelerating the timeline in achieving the above numbers. Secondly, we should see resumption of growth in Metro buildouts in China for the provincial networks as the delays and inventory overhang finally resolve itself this year. Here, we note the recent China Mobile tender which is for the first part of “Phase 13”. China Mobile is targeting 80k-100k 100G ports in 2018, up from 50k in 2017 and 60k in 2016. Further, we expect competitive capex announcements by China Unicom and China Telecom to remain competitive with China Mobile 100G Capex.

Outside of China, we see continued capex strength in India as Reliance Jio continues its infrastructure build-outs and other telecom vendors match Reliance after a period of telecom consolidation and tower divestments. Further, we should see Metro build-out strength outside China, particularly in North America (Verizon).

We like XLNX for its exposure to rising radio content and 5G in wireless. We also like Intel’s role in 4G/5G build-outs with a strong communication service-provider (CSP) portfolio offering centralized compute processing, helping telecom providers save on Capex.

With China LH/Metro seeing signs of coming back given China Mobile’s tender offer for 2018 (doubling 100G ports Y/Y in CY18) and Data Center growth still ahead, we continue to like MTSI as it benefits from both secular uplift in Data Center and a cyclical upswing in Metro/LH in CY18. Further, we expect next-generation PON network deployments to occur in CY18 as well which should benefit MTSI.

Figure 15. 5G build-out timeline being pulled into 2019



Source: Company Presentations, Evercore ISI Research

Investor Positioning – Positive Set-Up for 2H17

Looking to current consensus, 2H17 estimates are below normal seasonality – setting up for what we believe will be another positive earnings results into the October timeframe.

Figure 16. Consensus Modelling Roughly Normal Seasonality in 2H17

	Consensus Q/Q		Normal Seasonality		Above/(below)	
	3Q17	4Q17	3Q17	4Q17	3Q17	4Q17
INTC	6.3%	2.4%	7.3%	2.2%	-0.9%	0.2%
NVDA	5.7%	3.1%	17.6%	3.7%	-11.9%	-0.6%
XLNX	0.8%	0.8%	-1.6%	-0.3%	2.3%	1.1%
MTSI	-12.3%	2.3%	-1.5%	1.3%	-10.8%	1.0%
TXN	5.8%	-6.4%	6.3%	-7.6%	-0.4%	1.2%
ADI	4.6%	-3.5%	8.6%	-9.3%	-4.0%	5.7%
MXIM	-4.2%	1.1%	-3.0%	-2.0%	-1.3%	3.1%
AMD	23.1%	-11.4%	10.9%	-7.7%	12.2%	-3.7%
QCOM	8.0%	1.5%	0.7%	6.9%	7.3%	-5.4%
AVGO	7.6%	-1.9%	11.4%	-2.3%	-3.8%	0.5%
MCHP	3.0%	-2.0%	5.8%	-0.2%	-2.8%	-1.7%
IFX	6.3%	-2.9%	1.4%	-7.0%	4.9%	4.1%
SWKS	8.9%	7.5%	12.0%	8.1%	-3.1%	-0.6%
MRVL	1.0%	-3.2%	1.5%	-6.0%	-0.5%	2.7%
ON	2.0%	-2.9%	4.5%	4.7%	-2.4%	-7.5%
CY	1.5%	-1.6%	2.5%	-5.2%	-1.1%	3.6%
CAVM	3.3%	3.0%	16.4%	9.1%	-13.1%	-6.0%
MPWR	12.4%	-2.5%	9.9%	-5.6%	2.6%	3.1%
CRUS	27.9%	28.5%	46.0%	30.5%	-18.1%	-2.0%
IDTI	2.2%	5.6%	3.6%	-0.6%	-1.4%	6.2%
CREE	0.4%	3.1%	-3.7%	4.7%	4.1%	-1.6%
SIMO	-8.3%	7.6%	10.7%	-6.0%	-19.0%	13.6%
Total	**6.4%**	**0.1%**	**7.2%**	**0.5%**	**-0.7%**	**-0.4%**

Source: Company data, FactSet, Evercore ISI Research. Normal seasonality: 5-year average Q/Q change.

Company commentary on the cycle has been largely positive through 2Q17. Inventories across the chain remain at healthy levels. Lead times are generally extended but remain stable. No abnormal ordering patterns on cancellation or expedites. And still no signs of double ordering. We believe this should add confidence around an overall healthy supply chain entering the back half which should mitigate any risk of inventory correction.

Figure 17. Company Commentary Post 2Q17

Company	Inventory Commentary (post CQ2)	Other Cycle Commentary (post CQ2)
ADI	Inventory at distributors remained at 7 weeks which has been very stable over many quarters	Lead times have remained very stable at 4 to 6 weeks
ARW	Customers currently want more inventory - they have to build inventory to support new wins	Cancellation rates are normal - not seeing an increase - extended lead times persist in discrete, embedded, and passives
AVT	Comfortable with inventory levels	Lead times are expanding - they haven't seen any double ordering yet - nothing abnormal with cancellation or expedite rates
MCHP	Inventory levels at MCHP and distis are towards the low-end of the normal range - inventory is still very low across the board	Lead times are longer than target but they have stabilized - avoiding double ordering
MXIM	Channel inventories slightly above target range	Lead times unchanged
ON	ON inventory down and disti inventory flat Q/Q in 2Q17 - didn't see any evidence of invenory build in the channel or abnormal ordering in 2Q	Lead times up moderately Q/Q in 2Q17 - supply is keeping up with demand so there is not a tremendous imbalance here
TXN	Inventories within target range	Lead times are steady - cancellations remain low - expedites remain normal

Source: Company data, Evercore ISI Research

We believe that there are also various positive catalysts which are setting up into the back half of the year across industries:

- **Server –** Purley release sparking server demand and thus a tailwind for ancillary parts (GPU, memory, etc). We also expect a re-acceleration of growth in NVDA's DC business.
- **Smartphone –** iPhone 8 release on September 12th into conservative consensus expectations.
- **PCs –** New INTC and AMD parts offering a jump in performance may spark demand for PC's. Also, we see a strong slate of AAA titles driving sustained gaming demand.
- **Memory –** supply/demand balance to remain healthy and participants to remain rational resulting in pricing tailwinds continuing through year-end. We continue to look for MU to positive pre for the August Q – and if not there, then should see excellent numbers when the company reports on September 26th.
- **Analog –** MXIM will be updating its business model on September 6th – we expect uplift to GM/OM targets.
- **Semi Equipment –** Applied Materials will host its annual Analyst Day on September 27th followed by Lam Research hosting its in November. Look for AMAT's stock to move higher into this event.

Given this set-up, we believe that a particular item of note is the short interest in the space. Over the last 3 months we have seen a significant step-up in short interest across the computing, mixed signal, PLD, and storage spaces as the street grows more negative on semis. The largest increase was in the memory vertical (+49% vs 3mos ago) led by increased shorts in STX (probably rightfully so) and MU. Across the other segments we saw strong increases in MRVL, MTSI, XLNX, AMD, and MXIM with strong reductions of short interest in NVDA, TXN, and CAVM. We believe that the increase in short action sets up well for in-line or better results/guides in the 2H.

Figure 18. Short Interest vs 1 month ago vs 3 months ago

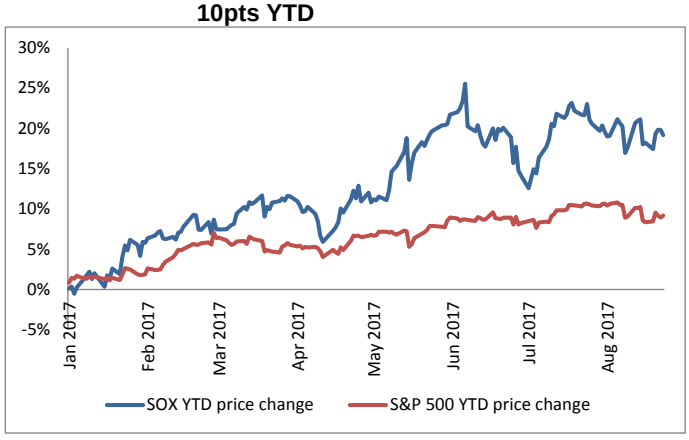
Company	Ticker	Short Interest (M)	Short Interest 1 Month Ago (M)	MoM Change in Short Int	Short Interest 3 Month Ago (M)	3M Change in Short Int
Computing		$318.2	$319.4	0%	$283.1	12.4%
Intel	INTC	$100.8	$102.3	-1%	$90.9	10.9%
Qualcomm	QCOM	$19.2	$25.1	-24%	$20.9	-8.3%
NVIDIA	NVDA	$15.7	$16.4	-4%	$28.7	-45.1%
Xilinx	XLNX	$25.6	$24.4	5%	$16.0	59.7%
Marvell	MRVL	$9.2	$6.1	51%	$5.7	61.1%
AMD	AMD	$147.7	$145.1	2%	$120.9	22.2%
Mixed Signal		$18.2	$18.9	-4%	$17.2	6.2%
Broadcom	AVGO	$2.9	$3.1	-5%	$3.4	-14.5%
NXPI	NXPI	$3.5	$5.1	-32%	$3.4	4.7%
Cavium	CAVM	$3.9	$3.3	18%	$5.4	-27.3%
MACOM	MTSI	$7.9	$7.4	6%	$5.0	57.3%
Analog		$49.1	$52.4	-6%	$49.9	-1.6%
Texas Instruments	TXN	$9.7	$13.2	-27%	$13.9	-30.7%
Analog Devices	ADI	$8.5	$8.6	-1%	$8.0	7.0%
Infineon	IFX	NA	NA	NA	NA	
Maxim	MXIM	$4.3	$5.0	-13%	$3.6	19.5%
Microchip	MCHP	$26.6	$25.7	4%	$24.4	9.1%
Storage		$105.1	$87.4	20%	$70.3	49.4%
Micron	MU	$54.7	$47.4	15%	$41.6	31.5%
Western Digital	WDC	$5.7	$5.7	-1%	$5.1	10.4%
Seagate	STX	$44.7	$34.3	30%	$23.6	89.6%
SPE		$39.4	$35.5	11%	$43.2	-8.8%
ASML Holding NV	ASML-ams	NA	NA	NA	NA	
Applied Materials	AMAT	$13.4	$12.9	4%	$13.4	0.0%
Lam Research	LRCX	$10.3	$9.1	14%	$13.6	-24.4%
KLA-Tencor	KLAC	$2.5	$2.3	8%	$2.6	-5.7%
Teradyne	TER	$8.2	$6.5	26%	$8.8	-6.8%
MKS Instruments	MKSI	$1.9	$1.9	1%	$2.3	-14.5%
Entegris	ENTG	$3.2	$2.9	10%	$2.6	23.7%

Source: Company data, Evercore ISI Research

Semis Still Cheap Amidst Pause in Relative Outperformance

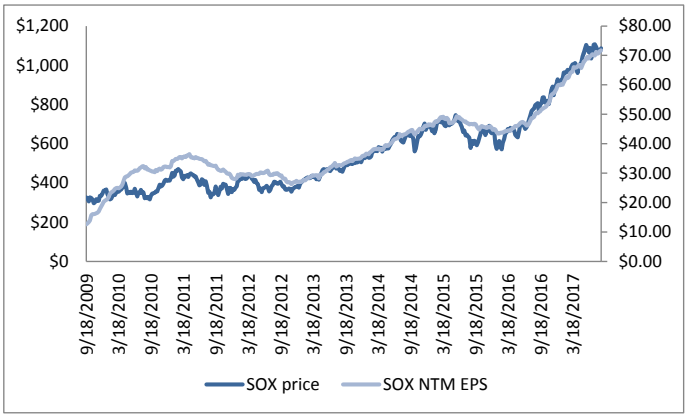
YTD the SOX has generated a 19% return vs the overall markets return of 9% (S&P 500). We believe that this outperformance, coupled with "peaking" consensus estimates, is leading the street to take a conservative stance on the space with a risk off approach. This can be seen many ways – i.e., stocks generally trading down on in-line earnings in 2Q17, short interest skyrocketing over the last 3 months, and a semi market multiple refusing to expand despite overall market valuations rising. When taking a step back and viewing the market where it stands today, we firmly believe that the opportunity in the space remains attractive. Fundamental drivers remain strong, balance sheets are supportive, the industry is acting rationally, and valuations are below the overall market, other tech names, and other cyclical names.

Figure 19. SOX has Outperformed the S&P 500 by Roughly 10pts YTD



Source: Company data, Evercore ISI Research

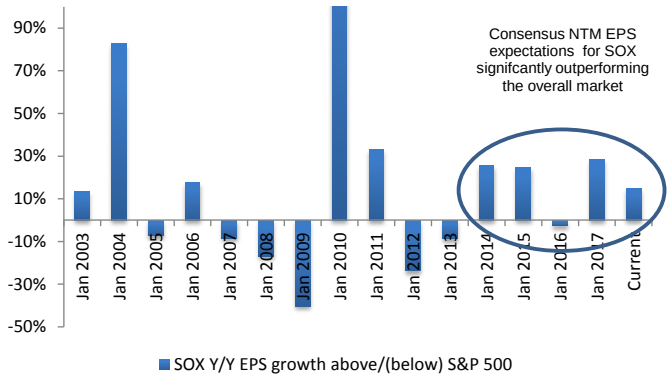
Figure 20. As the SOX Price Continues to Move Hand-in-Hand with NTM EPS Estimates



Source: Company data, Evercore ISI Research

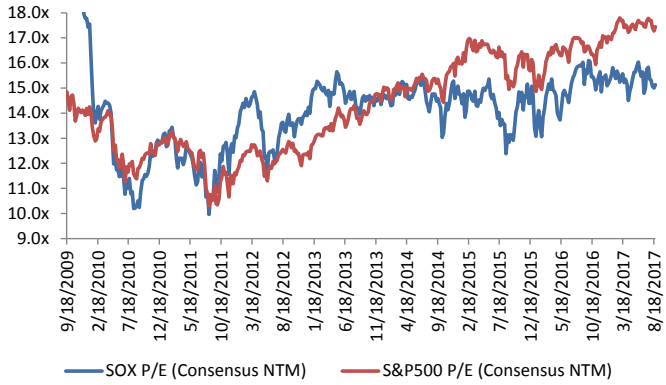
Over the past few years, consensus has modelled semiconductor growth well above that of the overall market. 2017 is more of the same as the SOX NTM is expected to grow +20% Y/Y vs the overall market (S&P 500) growth of +5%. As is the norm in the semiconductor space, once consensus becomes too positive, the peak is called. This has resulted in the SOX trading around a 15x P/E multiple since 2013 while the S&P 500 multiple has expanded to 18x. Further, when we compare Semiconductor multiples vs other tech sector multiples and other cyclical multiples, semis still appear very cheap across metrics. Given the growth prospects in the space, combined with muted cyclicality moving forward, we believe the discount is unwarranted.

Figure 21. SOX Exhibiting Strong Y/Y EPS Growth Expectations Relative to the Overall Market



Source: Company data, Evercore ISI Research

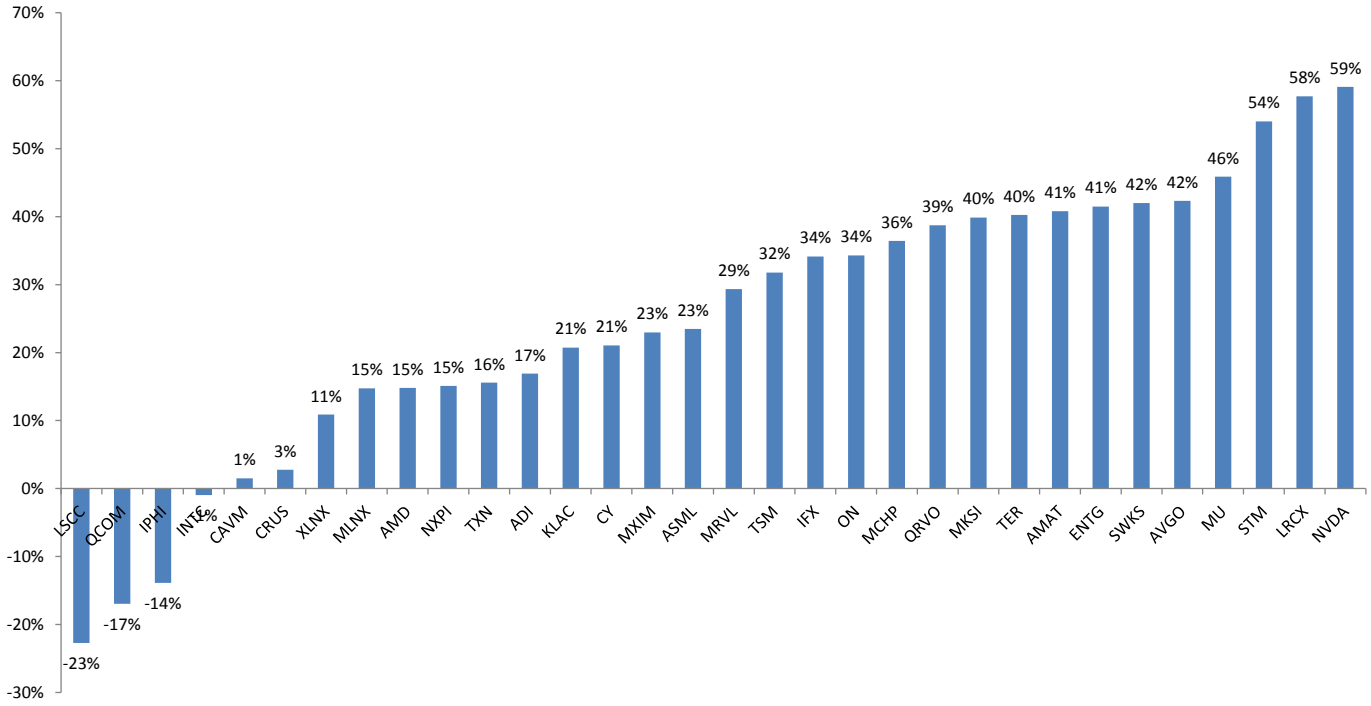
Figure 22. Which we Believe Warrants a Premium Multiple Yet the SOX Appears Constrained at 15x



Source: Company data, Evercore ISI Research

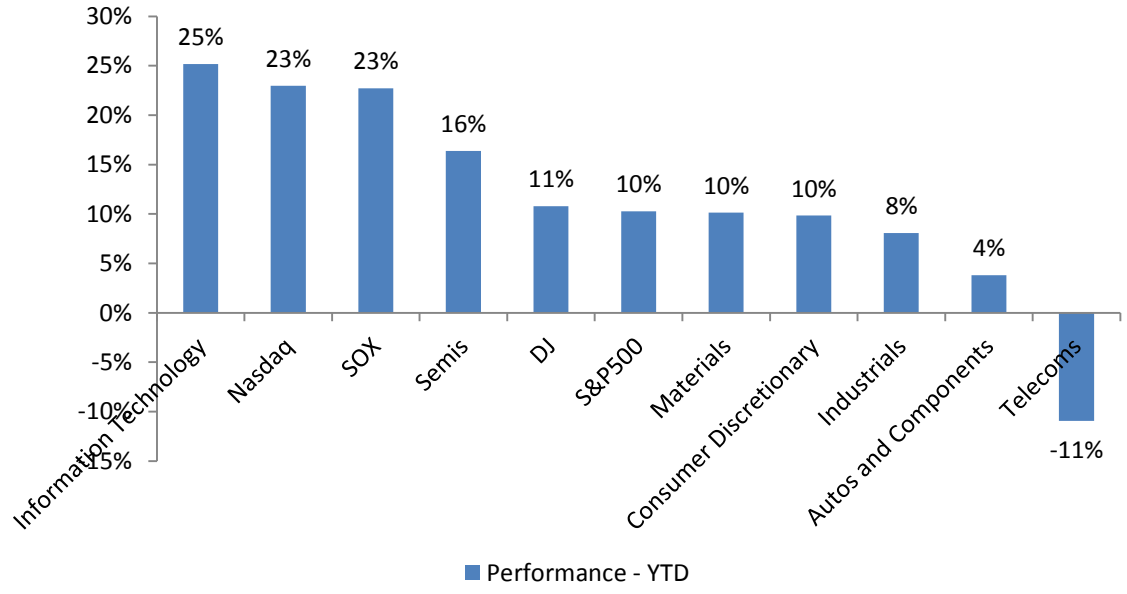
Performance: YTD for Select Semi Names

Figure 23. YTD Performance



Source: Company data, Evercore ISI Research

Figure 24. YTD Performance – Key S&P Indices

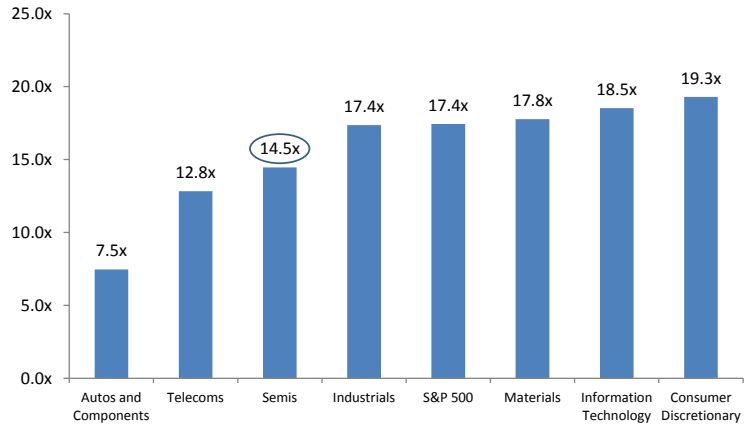


Source: Company data, Evercore ISI Research

Valuation/Relative Valuation – Semis and Others

Semis remain inexpensive relative to the S&) 500 and other cyclical industries on a P/E basis

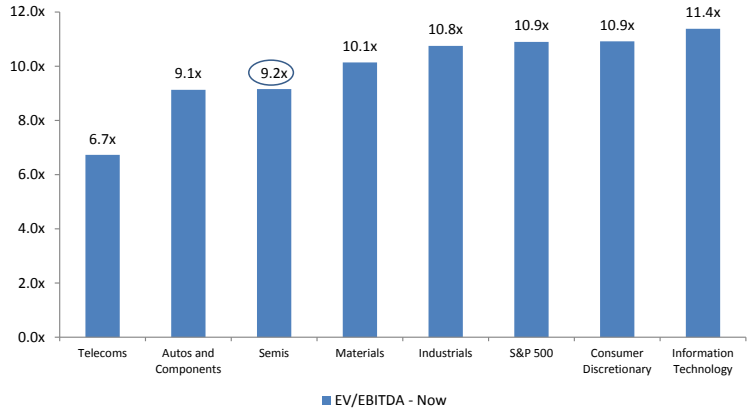
Figure 25. PE - NTM



Source: Company data, Evercore ISI Research

Likewise, Semi stocks remain inexpensive relative to the S&P 500 and cyclicals on an EV / EBITDA basis

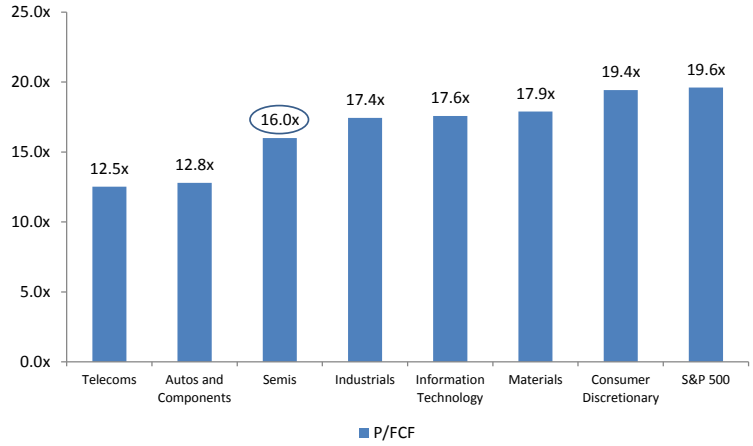
Figure 26. EV/NTM EBITDA



Source: Company data, Evercore ISI Research

On a P/FCF basis, Semis remain cheaper than the S&P 500 as well as Industrials

Figure 27. P/NTM FCF

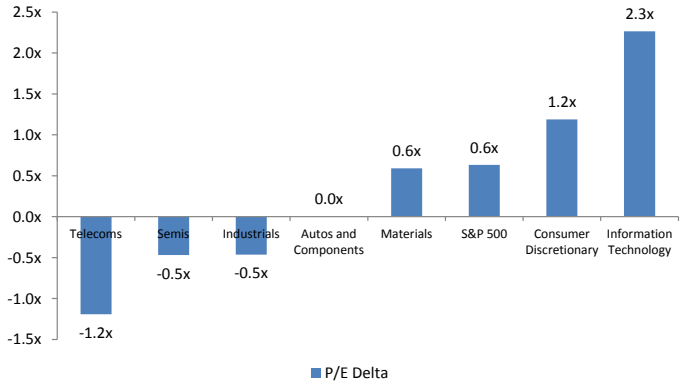


Source: Company data, Evercore ISI Research

Change in Valuation Multiples YTD

Semi multiples on a P/E basis have moved contracted significantly in CY17 YTD vs S&P 500 moving higher

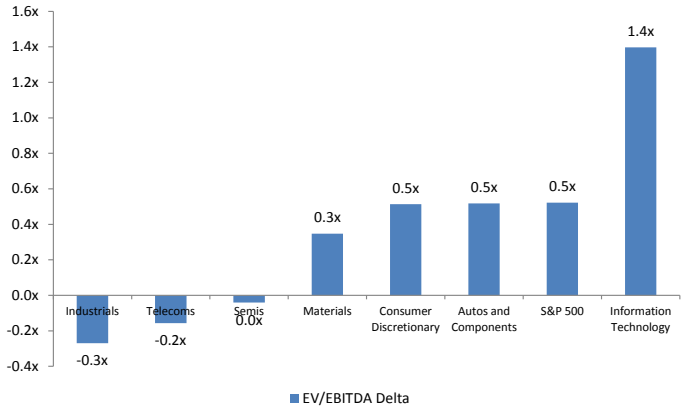
Figure 28. PE - NTM



Source: Company data, Evercore ISI Research

And Likewise for Semis on EV/NTM EBITDA basis….

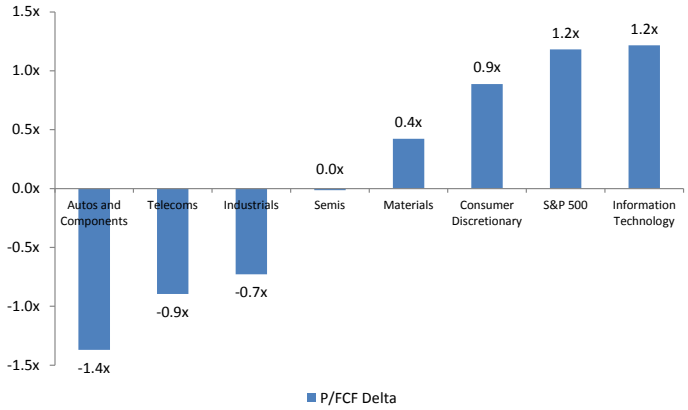
Figure 29. EV/NTM EBITDA



Source: Company data, Evercore ISI Research

And on a P/NTM FCF basis

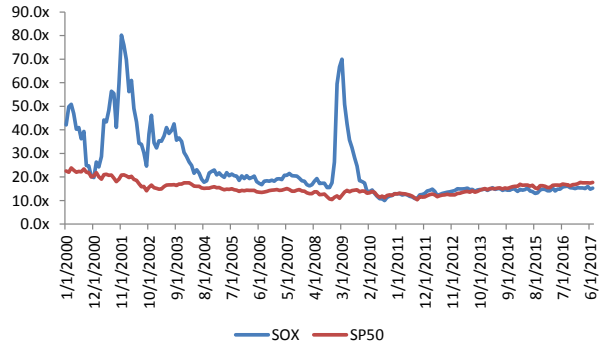
Figure 30. P/NTM FCF



Source: Company data, Evercore ISI Research

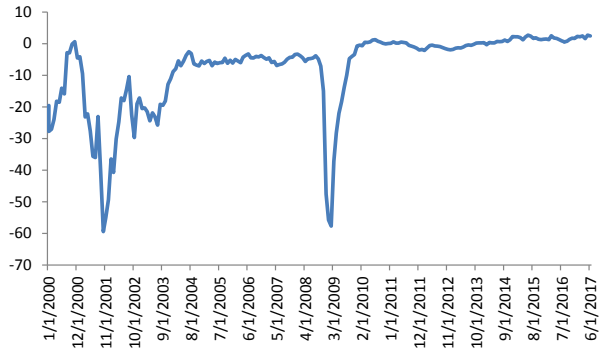
Historical Valuation – Sox vs. S&P 500

Figure 31. SOX vs. S&P500 – P/E



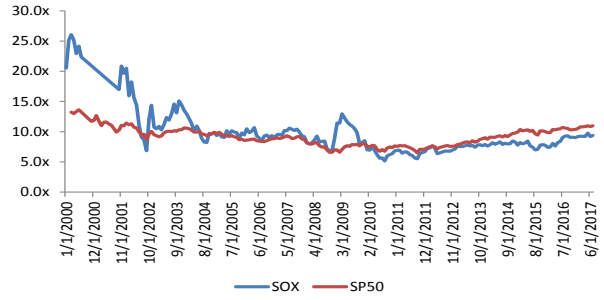
Source: FactSet, Evercore ISI Research

Figure 32. Historical P/E Delta (S&P500-SOX)



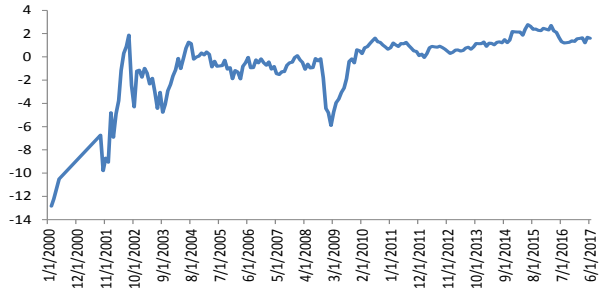
Source: FactSet, Evercore ISI Research

Figure 33. SOX vs. S&P500 – EV/EBITDA



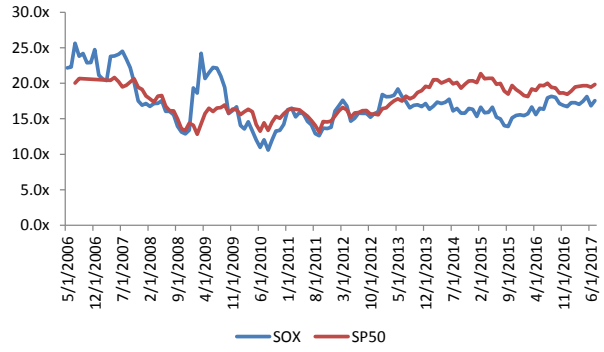
Source: FactSet, Evercore ISI Research

Figure 34. Historical EV/EBITDA Delta (S&P500-SOX)



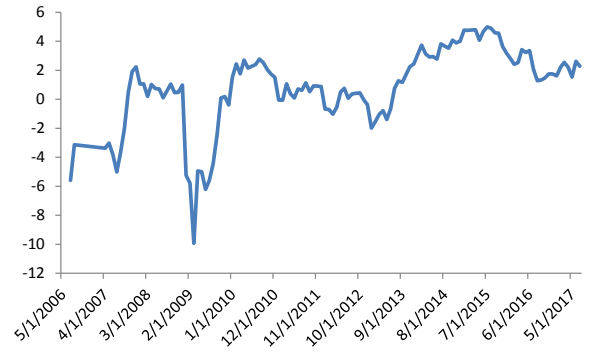
Source: FactSet, Evercore ISI Research

Figure 35. SOX vs. S&P500 – P/FCF



Source: FactSet, Evercore ISI Research

Figure 36. Historical P/FCF Delta (S&P500-SOX)



Source: FactSet, Evercore ISI Research

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Hold	236	36%	Hold	11	5%
Sell	57	9%	Sell	1	2%
Coverage Suspended	26	4%	Coverage Suspended	9	35%
Rating Suspended	9	1%	Rating Suspended	2	22%

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