Investment Grade Semiconductor 2019 Credit Outlook

Sector credit profiles are well-positioned to weather a near-term growth slowdown

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Executive Summary

Credit quality for semiconductor firms remains robust. Credit ratings in the semiconductor sector remain buoyed by entrenched competitive advantages that drive strong returns on invested capital and free cash flow. Though we expect growth to slow over the next year or two, we believe conditions remain conducive to further margin expansion. With the less burdensome tax rules governing cash repatriation, companies now have additional flexibility to utilize cash on hand to fund capital needs, reducing the need for external funding. As a result, new debt issuance among semiconductor firms has all but disappeared for 2018.

Key Takeaways

- Morningstar Credit Ratings maintains stable ratings on six out of seven rated semiconductor issuers. We raised our outlook on KLA-Tencor (BBB+, positive) to positive from stable in February 2018 in recognition of strengthening operating performance and efforts to reduce leverage. We believe pillar trends remain supportive of stable credit.
- Demand for semiconductor products continues to expand into new end-uses, including secular-growth channels in automation, artificial intelligence, and cloud computing. We believe this contributes to solid long-term support for growth and improving diversification away from the industry's traditionally cyclical consumer and enterprise PC customers.
- Use of debt remains conservative relative to the broader corporate market, though semiconductor leverage has steadily risen over the past decade as companies have taken advantage of low interest rates. Companies have also gradually reduced available cash balances over time as the industry has matured, though we expect internal cash flow generation to remain robust.
- Key risks to the sector over the next year include potential impact from the trade conflict between the U.S. and China. While the near-term effects appear modest for U.S.-based semiconductor firms, we are concerned about trade restrictions pressuring global economic growth which may lead to lower spending on technology. We also view mergers and acquisitions as an additional risk to credit, though less of one than a year ago. Deal activity has quieted following regulatory blockage of two large transactions earlier this year, though we believe that companies are continuing to actively search for acquisition opportunities.
- Highlighted Issuers: We believe Xilinx Corp. (A, stable) and Analog Devices (A, stable) are positioned to report strong revenue growth in the near-term, supporting already solid margins. Also, despite near-term growth headwinds for Texas Instruments (AA-, stable) and KLA-Tencor, we expect their respective margin trajectories to remain stable.

Industry Outlook

Credit Pillar Trends

Morningstar Credit Ratings maintains stable ratings on six out of seven rated issuers. We raised our outlook on KLA-Tencor to positive from stable in February 2018 in recognition of strengthening operating performance and efforts to reduce leverage. We believe updated pillar trends remain supportive of stable credit.

Business Risk Scores for all seven rated issuers were unchanged (Exhibit 1) over the past year. Morningstar Equity Research Group continues to assign wide and narrow economic moats to each of the rated semiconductors, which contribute to healthy Business Risk pillars. Business Risk is also supported by low capital market dependence moderate for most issuers. We continue to view operating uncertainty as moderate, though we ascribe additional uncertainty to some issuers to account for potential event risk, such as acquisitions or mergers. Across the sector, we continue to view product concentration and cyclicality as moderately high, which we believe modestly constrains further improvement in Business Risk.

Exhibit 1 Credit Pillar Trends (Versus a Year Ago)

	Credit Rating	Rating Outlook	Business Risk	Cash Flow Cushion	Solvency	Distance to Default
Texas Instruments	AA-	stable	no change	no change	no change	no change
Intel	AA-	stable	stronger	no change	stronger	no change
Applied Materials	A+	stable	no change	stronger	no change	weaker
Analog Devices	A	stable	no change	weaker	weaker	weaker
Maxim	A	stable	no change	no change	no change	no change
Xilinx	A	stable	no change	stronger	no change	weaker
KLA-Tencor	BBB+	positive	no change	stronger	stronger	no change

Source: Morningstar Credit Ratings, LLC

The Solvency pillar also remained stable for most over the past year, supported by solid returns on invested capital and moderate financial leverage. We note improving trends for Intel and KLA-Tencor from lower debt. Only one issuer, Analog Devices, indicates a weaker Solvency Score relative to a year ago, attributable to its cash acquisition of Linear Technology in 2017 that increased financial leverage and diluted returns on invested capital from higher goodwill.

Exhibit 2 MCR Investment-Grade Semiconductor Credit Coverage Pillar Comparison

	TXN	INTC	AMAT	MXIM	ADI	XLNX	KLAC
Morningstar Rating	**AA-**	**AA-**	**A+**	**A**	**A**	**A**	**BBB+**
Rating Outlook	Stable	Stable	Stable	Stable	Stable	Stable	Positive
PILLARS (1=Strong; 10=Weak)							
Business Risk	3	3	4	5	4	5	5
Moat	Wide	Wide	Wide	Wide	Wide	Narrow	Wide
Uncertainty	Medium	Medium	High	High	Medium	Medium	High
Size	9	10	9	5	7	5	6
Concentration	2	3	2	2	2	2	1
Management	3	3	3	3	3	3	2
Dependence	5	4	5	5	3	5	5
Cyclicality	2	1	2	2	2	2	2
Cash Flow Cushion	3	4	2	3	5	3	3
Solvency Score	1	2	2	2	4	2	2
Distance to Default	2	3	3	2	4	2	3

Source: Morningstar Credit Ratings, LLC

Meanwhile, Cash Flow Cushion trends appear stronger for more than half of the group, driven by revenue growth and expanding cash flow. As with Solvency, the exception was Analog Devices, which saw its Cash Flow Cushion weaken because of higher debt maturities.

Of the four pillars, we note Distance to Default weakened for three of the seven rated issuers, driven by a trend toward higher return volatility for the common stocks over the past year (refer to Exhibit 17 on Page 23), In the three cases, the higher equity return volatility eclipsed a stable enterprise value to market capitalization ratio over the period. According to indexed total return data from Morningstar Inc., the average total return volatility for the seven rated semiconductor issuers was 28% over the past 300 days, compared with 17% a year ago. Meanwhile, the second variable in our Distance to Default Score calculation, the ratio of enterprise value/market capitalization remained flat across the sector relative to a year ago.

Embedded in our current ratings and outlooks is our expectation that revenue growth is likely to slow in 2019 with a modest recovery in 2020 (Exhibit 3). Despite slower growth, we expect EBITDA margins to follow a modest expansion trend in the years ahead as manufacturers continue to reduce operating costs and increase production efficiency. We believe much of the growth next year will be contributed by specialty manufacturers Analog Devices and Xilinx. Though we currently expect a net decline in Texas Instruments growth in 2019, we believe analog product growth will remain in the mid- to high-single digits.

Exhibit 3 Key Operating Forecast Assumptions

	Revenue Growth (%)				EBITDA Margin (%)			
	2017A	2018E	2019E	2020E	2017A	2018E	2019E	2020E
Texas Instruments	11.9%	5.7%	-3.8%	8.3%	46.4%	48.4%	48.0%	50.4%
Intel	5.7%	13.8%	2.6%	3.8%	42.1%	45.4%	43.9%	43.5%
Analog Devices	20.9%	2.4%	5.0%	6.2%	33.1%	42.7%	43.8%	45.8%
Maxim Integrated	4.6%	8.0%	0.3%	7.3%	42.7%	44.5%	41.2%	41.7%
Xilinx	8.1%	17.4%	5.8%	5.5%	34.5%	33.3%	34.0%	34.3%
Applied Materials	34.3%	18.7%	-2.0%	0.1%	29.4%	29.7%	29.7%	28.7%
KLA-Tencor	5.1%	4.8%	3.2%	0.1%	40.3%	40.0%	40.0%	39.0%
Group Average	**12.9%**	**10.1%**	**1.6%**	**4.5%**	**38.3%**	**40.6%**	**40.1%**	**40.5%**

Source: Morningstar Equity Research, MCR estimates.

Growth Outlook by Product Segment

The World Semiconductor Trade Statistics (WSTS) recently revised its 2018 growth forecast to 15.7% from 12.4% previously. We note that WSTS has historically set a conservative forecast early on and typically revises it higher throughout the year, a pattern that remains consistent in 2018. The key exception in the past five years was 2016, a year characterized by a decline in semiconductor sales in the first half with some offsetting growth in the back half. WSTS's current forecast (Exhibit 4) is supported by 26.5% growth in memory and 9.5% growth from analog chips. The spring update increased nearly 300 basis points from the prior forecast and 540 basis points above the preliminary forecast released in November 2017.

Exhibit 4 WSTS August 2018 Revenue Forecast by End Market

	Global Revenue in $000			*Growth (%, YoY)*		
	2017A	**2018E**	**2019E**	**2017A**	**2018E**	**2019E**
Discrete Semi	21,651	24,143	25,398	11.5%	11.5%	5.2%
OptoElectronics	34,813	38,097	40,960	8.8%	9.4%	7.5%
Sensors	12,571	13,609	14,536	16.2%	8.3%	6.8%
Integrated Circuits	**343,186**	**401,252**	**421,146**	**24.0%**	**16.9%**	**5.0%**
Analog	53,070	59,419	62,624	10.9%	12.0%	5.4%
Microcontrollers	63,934	69,053	72,380	5.5%	8.0%	4.8%
Logic	102,209	111,016	116,987	11.7%	8.6%	5.4%
Memory	123,974	161,763	169,156	61.5%	30.5%	4.6%
Total	**412,221**	**477,101**	**502,040**	**21.6%**	**15.7%**	**5.2%**

Source: World Semiconductor Trade Statistics

WSTS also increased its growth estimate for 2019 to 5.2% from the prior revision in April at 4.4%. While growth is currently expected to remain positive for all categories, the WSTS projects optical, sensors and analog categories to lead growth while microcontrollers and memory are expected to lag the sector.

Logic

The WSTS is forecasting logic to grow 5.4% in 2019, following projected growth of 8.6% in 2018. Over the past five years, the dominant source of demand for processor innovation has been mobile technology, supplanting personal computers, which had previously been the highest users of the most advanced processor technology. In the years ahead, companies like Intel (AA-, stable), Advanced Micro Devices (B-, stable), and NVIDIA (not rated) are increasingly gearing their product development efforts around large-scale server-based data processing to meet the rapidly evolving use of cloud-based computing capacity to manage high-volume data flows. Unlike mobile chip design, for which engineers are highly constrained by the small form factor and extremely limited power resources, server chip design for higher and higher performance offers a wider array of possibilities. As performance needs grows constantly to meet the accelerating daily volume of data, system designers are always on the lookout for the newest and most-powerful processing technology, fueling research and development into designs that are increasingly complex and difficult to manufacture.

The expansion of large-scale data processing applications has also increased opportunities for graphics processors and programmable logic devices to more efficiently tackle challenging workloads. For example, last year's surge in cryptocurrency pricing drove up demand for graphics processors to produce new currency units. The basis of cryptocurrency is a highly computationally-intensive encryption algorithms which require a high-performance computing system that can operate efficiently over long periods of time.

As data workloads have rapidly grown over the past decade, high-volume users discovered that graphics processing circuitry (GPU's) has many of the characteristics needed to reliably run intensive computational work. Therefore, GPU's have become popular as a key component in parallel-processing systems which save the core CPU for critical computational tasks while farming out high-intensity but repetitive tasks to the GPU components to increase efficiency. This not only leads to higher sophistication in gaming but also works well for advanced computational work like crypto-currency mining as well as artificial intelligence and deep-learning applications. The high demand for GPU products from crypto miners in 2017 outstripped the supply available in the primary market, which drove up the price and largely shut out gamers and other traditional users. With crypto pricing much lower now compared with the peak in late 2017, demand from miners for GPU's has largely dissipated and pricing is coming down quickly to more normalized levels. With pricing high early this year, the market for lightly-used GPU's has flourished as crypto miners have taken GPU's out of service, which we believe has largely satisfied pent-up demand. We believe that 10 to 15 million GPU's that had been tasked for mining have now come offline this year. For 2019, we believe that supply and demand will continue to migrate toward more normal conditions and pricing will stabilize at a lower, sustainable level.

The rapid increase in the number of connected devices and the back-end infrastructure required to handle that vast amounts of data generated by those devices has also increased the popularity of programmable logic chips (FPGA's). FPGA's offer flexible and customizable logic programming which is highly useful for data center customers and has been rapidly gaining share from traditional single-function non-programmable circuitry (ASIC), around which electronic equipment was traditionally designed. FPGA's are becoming particularly useful to artificial intelligence and deep learning applications due to the capability to adapt programming as the system "learns." For 2019, we expect growth in FPGA's to remain robust and contribute positively to the operating performance of Xilinx and Intel (which acquired FPGA-maker Altera in 2015). We undertake a more thorough analysis of the emerging opportunities in AI/deep learning applications further on in this report.

Analog

The WSTS forecasts growth in revenue from analog components to be 5.4% in 2019, following 12% growth targeted for 2018. Analog circuitry is widely used in sensor arrays, power management systems, and signal processing and has been consistently one of the fastest-growing product segments in recent years. We believe that analog circuitry will remain at the forefront of the semiconductor end-use expansion wave. Analog systems are integral to automotive driver assist and safety systems, wearable "smart" technology, and mobile devices. Unlike digital circuitry which exclusively handles all data in electrical form (1's and 0's), analog circuits take external stimuli like sound, light, vibration, or heat and convert these into an electronic signal. We have included a deeper analysis of the use of analog chips in automated driving applications later in this report.

While digital circuitry continues to achieve improved efficiency at smaller geometries, engineers have found it more difficult to design analog systems at reduced scale. At reduced size, components of analog systems are vulnerable to electrical noise and signal leakage as components are physically positioned closer together on the chip. Analog designs also contain a higher proportion of custom design components which would have to be completely re-designed to move to a new process node, which would increase costs.

In consideration of these constraints, the analog industry remains well behind graphics and processors in scaling down to smaller process nodes. In fact, many analog semiconductor products still rely on 20 or 28 nanometer process nodes (which refers to the width of a single transistor) instead of the current generation 14 and 10 nanometer chipsets that are currently in production. However, components have worked well at the larger scale and are robust, well-tested, inexpensive and easy to integrate into system designs resulting in lower production cost to manufacturers. A side effect of using older-generation technology has been higher margins for analog companies relative to other types of semiconductors, with Texas Instruments among the highest among the group. Despite some softening in some of TI's end markets, we expect some cost offset from disciplined inventory management and the planned roll-out of 300-millimeter wafer manufacturing capacity that promises to improve efficiency even further, contributing to lower production costs.

Memory

WSTS expects growth in memory products to decline to 4.6% in 2019 from expected growth of 30.5% in 2018. The primary driver behind the drop is the sharp pricing correction occurring in the memory market. Forecasters are predicting sharp declines in NAND memory in 2019. In response, key manufacturers, like Samsung and Hynix have shelved plans to expand production capacity. In recent years, memory prices have been pushed steadily higher on strong demand and rapid technological innovation that has made memory more powerful and flexible. A key reason for the significant run-up in NAND memory prices was related to the shift from planar (two-dimensional) to 3-dimensional memory chips, which allowed dramatic increases in capacity without increasing the footprint of the chip. With future advances likely to be more muted, we believe the pressure to upgrade to new chips has lessened. NAND demand was also driven by the global surge in mobile devices, which added to pressure on existing NAND capacity over the past year.

Meanwhile, demand for DRAM memory has been supported by secular growth in data center capacity, which requires massive amounts of storage capacity. This resulted in a shortage of DRAM and sharply higher pricing over the past year. However, manufacturers have been steadily adding capacity during the year, which has taken the wind out of future pricing expectations. Relative to NAND, we believe that the DRAM market competition remains rational despite the high concentration of manufacturers. Despite the current pricing correction, we also believe the longer-term drivers for sustainable memory demand remain intact.

Wafer Fabrication Equipment

Morningstar's Equity Research Group is currently projecting global wafer equipment spending to be up 7.5% in 2018, followed by a 6% decline in 2019. Given the short-term headwinds from memory, we believe equipment orders from logic and foundry customers will gain share in 2019. Key demand drivers in the coming year include Intel’s ramp of its 10-nanometer processor technology and Taiwan Semiconductor’s (not rated) roll-out of its second-generation 7-nanometer technology. Also, we believe that to the extent that overall wafer equipment spending is lower year-on-year, this decline can be mitigated by equipment refurbishment services on older-generation tools. The use of older tools has increased as the length of time between node evolutions has expanded and from increasing diversity among end-users in the use of older-generation technology.

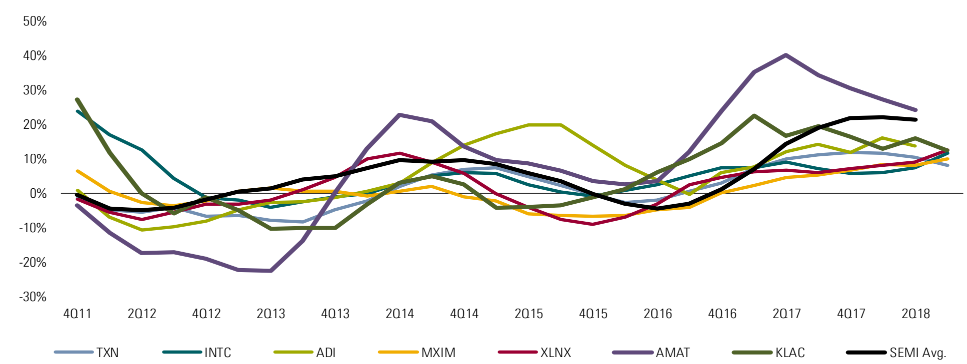
On a macro level, we believe China will remain a key source of wafer equipment demand as the government pursues its long-term strategic plan of reducing China’s dependence on semiconductor imports. We believe China’s focus will remain on older-generation, lower-complexity chip technology from which are more forgiving to manufacture relative to cutting-edge technology.

In the near-term, we believe KLA-Tencor’s lower exposure to memory manufacturers will help support its operating performance relative to Applied Materials, though both firms should benefit from an increase in service demand on older equipment.

Year-to-Date Operating Performance

For the first half of 2018, World Semiconductor Trade Statistics reported global semiconductor sales 21% higher from a year ago, with growth reported across all product categories, though led by memory. Operating performance in the third quarter as reported so far supports the recent trend toward slowing revenue growth, particularly for wafer equipment manufacturers (Exhibit 5).

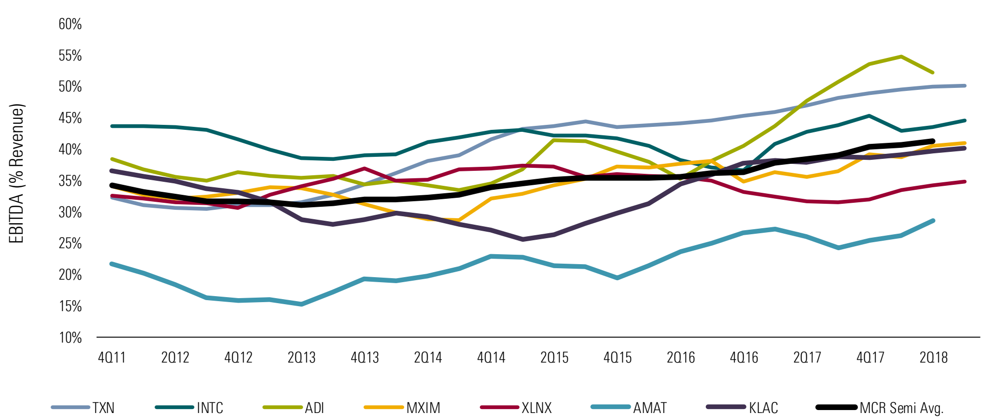
Exhibit 5 Trailing Four-Quarter Revenue Growth



Source: World Semiconductor Trade Statistics, company reports, MCR estimates

Notwithstanding some dispersion in sales growth, we note that EBITDA margins remain consistently strong across the semiconductor group and continue to trend wider (Exhibit 6). Solid cost controls have helped firms benefit maximally from the inherent operating leverage in the business. Analog Devices margin has been skewing higher relative to group as it integrates Linear Technology, which has historically generated higher margins.

Exhibit 6 Trailing Four-Quarter Margin Trends



Source: Company reports, MCR estimates

Secular Growth Drivers

Historically, the primary user of semiconductors was to power personal computers, which remains a highly cyclical industry. In the past decade, use of semiconductor products has expanded to mobile phones, which we believe now make up 10% of global semiconductor production. With the emergence of cloud computing and integration of logic and sensor technology into a growing array of traditionally non-connected devices, such as automobiles, appliances and even clothing, the market for semiconductor products is targeted to expand over the next decade.

A subtle consequence of the increasing diversity in end-users of semiconductors has been a modest slowdown in the cadence of new chip architecture. The pace of innovation has historically aligned with Moore's Law, which predicts a doubling of the number of transistors per chip every 2 years. This historically has been a target for research and development, spurring new design and production techniques. Although Moore's Law remains popular benchmark for semiconductor innovation, many new chip use cases are increasingly able to utilize older-generation chip designs, extending the production cycle for each generation of technology and reducing costs. This applies mainly for lower-intensity applications or form factors where size or power consumption efficiency are less of a concern, engineers are able to rely on older and less-expensive technology around which to develop their products.

From a manufacturer standpoint, it has also become more efficient to lengthen production runs in existing nodes to take advantage of high production efficiencies. In 2017, Intel decided to lengthen the production run on its 14-nanometer line for a third year instead of scaling down to 10-nanometer as it had originally intended to last year. As a result, it was able to produce third-year 14 nanometer products more cheaply since it had already progressed up the production learning curve, driving an improvement in yield.

Recently, one of the fastest expanding segments has been analog circuitry. Analog circuitry is widely used in sensor arrays, power management systems, and signal processing. The subsegment remains at the forefront of the semiconductor end-use expansion wave. Analog systems are integral to automotive driver assist and safety systems, wearable "smart" technology, and mobile devices. Unlike digital circuitry which exclusively handles all data in electrical form (1's and 0's), analog circuits take external stimuli like sound, light, vibration, or heat and convert these into an electronic signal.

While digital circuitry continues to achieve improved efficiency at smaller node geometries, engineers have found it more difficult to design analog systems at reduced scale. At reduced size, components of analog systems are vulnerable to electrical noise and signal leakage as components are physically positioned closer together on the chip. Analog designs also contain a higher proportion of custom design components which would have to be completely re-designed to move to a new process node, which would increase costs.

In consideration of these constraints, the analog industry remains well behind graphics and processors in scaling down to smaller process nodes. many analog semiconductor products still rely on 20 or 28 nanometer process nodes (which refers to the width of a single transistor) instead of the current generation 14 and 10 nanometer chipsets that are currently in production. However, components have worked well at the larger scale and are robust, well-tested, inexpensive and easy to integrate into system designs resulting in lower production cost to manufacturers.

With slowing cryptocurrency demand, graphics companies are indicating early signs that GPU product shortages have been easing. However, we believe there is considerable demand for GPU's from other sources to support pricing.

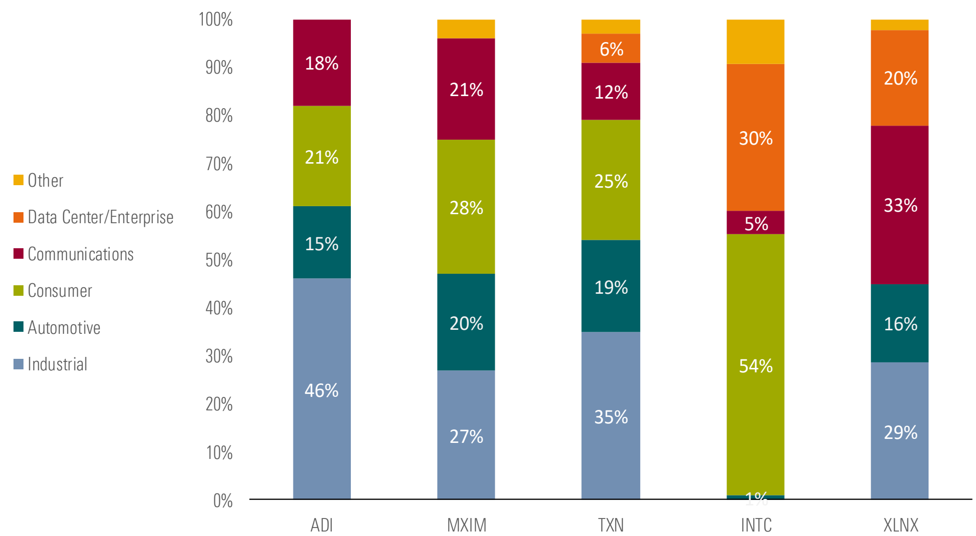
Xilinx reported healthy demand for its FPGA's from data center and telecommunications, which more than offset decline in cryptocurrency demand. Longer term, we expect a sustained demand for FPGA's from deep learning applications, taking advantage of their power and design flexibility. Intel reported a strong quarter led by growth in data center and cloud providers. PC sales also increased year-over-year, led by a refresh among enterprise customers. Intel's investment in data center beginning to bear fruit, highlighting its ability to offer flexible chipsets, combining traditional CPU's with FPGA's (Altera) and memory components.

On the horizon, we believe new memory capacity is beginning to alleviate tight supply conditions, driving pricing lower after prolonged period of upward pressure. Memory prices appear to be tracking weaker into year-end with forecasts pointing to low single-digit growth in 2019. Demand for memory has benefited from persistent shortages last year and into the first quarter, though early second quarter results indicate prices have begun to fade. However, the backlog of pending memory production capacity has begun to grow, slowing the momentum of pricing and demand.

We believe that expanding demand for semiconductors is likely to contribute to a long-term strengthening in industry fundamentals as engineers develop products to address more sophisticated use cases. Analog and sensor products appear to remain at the forefront of this growth, though plenty of demand exists for graphics processors, reprogrammable logic chips and memory. With a rapidly growing profusion of new data and a trend toward distributed processing, we also believe data transmission technology will also be critical over the next decade, spurring development of better wireless and fiber-optic transport networks, all of which will likely be controlled by semiconductors.

As it stands today, the semiconductor firms that Morningstar Credit Ratings rates are already fairly well diversified by end-market (Exhibit 7). However, for the three analog semiconductor companies that in the group (Analog Devices, Texas Instruments and Maxim), automotive and industrial end-markets represent the two largest revenue contributors.

Exhibit 7 End-Market Diversity Among Semiconductor Manufacturers



Note: Consumer segment for Xilinx includes Automotive.
Source: IC Insights.

Morningstar Credit Ratings expects these segments to continue to lead the analog sector over the next year or two. The consumer segments for these companies is primarily associated with mobile devices, though will likely evolve to include more wearable technology and augmented reality devices. The communications segment represents telecommunications network systems. For Intel, consumer PC's remain its largest exposure, although we expect data center (shown under enterprise computing) to grow at a faster rate over the next few years. Intel also now has a modest but rapidly-growing exposure to the automated driving market through its 2017 acquisition of Mobileye. In the sections to follow, we highlight two emerging areas of semiconductor technology: Vehicle Automation and Deep Learning.

Vehicle Automation

Technology is being integrated across all major aspects of an automobile's core functions: Power Train, Chassis, Safety and Control, Comfort and Control, Infotainment, Electronic Systems, and, Networking/Connectivity. Automated driving technology makes use of a wide variety of semiconductor products, including analog chips, sensor arrays, FPGA's and logic circuitry.

The Society of Automotive Engineers classifies driving technology systems into five levels of autonomy:

1. **Driver Assistance**: Human control of most vehicle functions, though some, such as steering or speed/braking control can be automated in specific situations. Most cars already have one or more Level 1-type systems on board, such as cruise control, parking assist, or anti-lock brakes.
2. **Partial Automation**: Automated control of both steering and acceleration or deceleration based on external environmental data. Examples include cruise control or automatic braking. Human monitoring required.
3. **Conditional Automation**: These systems offer limited automation of safety-critical systems. Example: use of automatic pilot in low-speed traffic congestion situations. However, the driver must remain prepared to resume control as conditions change.
4. **High Automation**: Automated systems are designed to handle all safety and driving functions for the duration of a trip without human intervention under normal driving conditions.
5. **Full Automation**: All systems fully automated with performance equivalent to a human in every driving scenario.

Exhibit 8 summarizes Morningstar Equity Research Group's outlook for growth in automated driving over the next five years. While it expects growth to be similar between Level 2/Level 3 applications with Level 4/Level, it believes penetration of L2/L3 will increase faster given the greater near-term opportunity in that segment.

Exhibit 8 Autonomous Driving Growth Forecast

	2017	2018	2019	2020	2021	2022	CAGR
L2/L3 AD Penetration (%)	2.0%	5.0%	9.0%	15.0%	16.0%	17.5%	
Number of L2/L3 Cars (millions)	1.5	3.8	6.99	11.75	12.96	13.83	
Estimated L2/L3 Revenues ($ millions)	112	304	594	1,057	1,231	1,397	66%
L4/L5 AD Penetration (%)	0.3%	0.4%	1.0%	1.5%	2.0%	2.8%	
Number of L4/L5 Cars (millions)	0.19	0.3	0.78	1.17	1.62	2.17	
Estimated L4/L5 Revenues ($ millions)	145	243	641	998	1,418	1,956	68%
Total Addressable Market ($ millions)	258	547	1,235	2,055	2,649	3,353	67%

Source: Morningstar Equity Research Group., Ward's Automotive, and company documents.

Deep Learning/Artificial Intelligence

Over the next few decades, we expect deep learning applications to be a key driver of innovation in semiconductor technology, forcing systems to handle growing volumes of data at rapidly increasing levels of efficiency. We expect that an enormous amount of computing power will be required to support the adoption of deep learning, presenting new opportunities for a variety of semiconductor manufacturers. We expect the proliferation of smartphones and wearables and the adoption of IoT across virtually every end market to generate massive amounts of raw data which will need to be processed on the back-end. For example, Intel has estimated the average data volume for each internet user will increase from 650 megabits per day in 2016 to 1.5 gigabits per day by 2020, a compound average growth rate of 23%. This does not include the increase in commercial data generation through e-commerce, financial services, healthcare or connected-device networks. It also does not account for the massive data demands from automated driving technology which will add to the data pile over time.

The rise of deep learning increases our ability to process large-scale data flows and efficiently transform them into understandable and actionable information for companies and individuals. For example, Amazon's Alexa home assistant product features a voice-activated AI interface and access to the Cloud to perform searches, conduct and manage e-commerce transactions, and execute on-demand video and music playback. Both Alphabet and Microsoft offer competing home assistant products.

In a March 2018 release, IDC forecasted that worldwide spending on cognitive and artificial intelligence systems will total $19.1 billion in 2018, up 54% from 2017. IDC further expects spending to grow at a compound average rate of 46% per year, reaching total spend of $52 billion by 2021. Key industry contributors to the growth are expected to be retail and healthcare, in addition to financial services.

There are two phases in developing a deep learning accelerator: training and inference. Training involves educating a neural network to complete a task, while the inference phase applies the trained neural network to real-world problem solving. A successfully trained neural network requires interactive training with enough data to ensure the accelerator can generate reasonable results subject to realistic conditions. Due to the compute-intensive nature of the training process, speed and accuracy are critical to success. In contrast to the training phase. the inference phase is less compute intensive and the accelerator can be run through distributed computing networks or on edge devices, such as smartphones, tablets or PCs. For the end-user, the critical consideration in choosing an accelerator becomes balancing among accuracy, cost, speed and power consumption to achieve the proper cost/benefit mix. Morningstar Equity Research Group estimates that the total addressable market for training and inference accelerators will grow to $8 billion and $12 billion respectively by 2021.

We expect the growing workloads for deep learning applications to result in additional demand for general-purpose CPU's. However, CPU's alone are often not able to meet the increasingly dynamic requirements of these workloads. As a result, hardware accelerators, including GPU's, co-processors, FPGA's, and application-specific integrated circuits (ASIC), are being incorporated into chipsets to satisfy the more intense AI processing demands (Exhibit 9). We believe GPU's will feature prominently in the training process of deep learning, as their parallel processing capacities can materially reduce time spent on training neural networks by increasing the efficiency of system processor cores.

However, we also believe non-GPU components may also contribute unique advantages to assist in AI applications. For example, FPGA's offer engineers the flexibility to reconfigure the circuitry to adapt to constantly evolving workloads. FPGA's are also capable of transmitting large volumes of data at low latency, which is a benefit for communications and data connectivity. Meanwhile, ASICs serve as inexpensive energy efficient and high performing alternatives to CPU's and FPGA's for applications requiring less flexibility of processing demands, such as smart appliances.

Exhibit 9 Applicability of Common Semiconductor Types to Deep Learning

Chip Type	Pros	Cons	Training Rank	Inference Rank	Leading Vendors
CPU	General-purpose, already in servers and PCs, sufficient for inferencing	Serial-processing is less efficient than parallel-processing	N/A	N/A	Intel
GPU	Highly parallel, high performance, uses popular AI framework (CUDA)	Less efficient than FPGAs, scalability, inefficient unless fully utilized	1	3	Nvidia
FPGA	Reconfigurable functionality, good for constantly evolving workloads, efficient	Difficult to program, lower performance versus GPUs, no major AI framework	2	2	Intel, Xiilnx
Co-Processor	Similar to CPUs but more parallel processing	Less efficiency, parallelism, and cores compared to GPUs	3	4	Intel
ASIC	Best Performance, Most Energy Efficient, Fully Customizable	Expensive, requires high volume to be practical, quickly outdated, not flexible	4	1	Intel, Google

Source: Morningstar Equity Research Group.

Amazon, Alphabet, and Microsoft are all large-scale players in cloud computing. These firms were early adopters of deep learning technology to organize and mine the large volumes of data flowing through their systems each day. Intel maintains a dominant share in data center processing technology while NVIDIA is the market leader in GPU products. Meanwhile, Intel and Xilinx both have strong market share in FPGA's. Finally, International Business Machine has invested heavily in deep learning software to develop its Watson analytical engine which we believe will be a revenue growth contributor for IBM in the years ahead.

Leverage and Capital Allocation Trends

As semiconductor firms have matured over the past 20 years, we note that the average variability of operating results has been moderating. However, we still expect performance to remain more cyclical than the average corporate issuer over time. As operating performance has become more stable, semiconductor companies have become more comfortable taking on long-term debt. Though use of debt in the sector remains conservative relative to other areas of technology, leverage has steadily risen for the sector as companies have taken advantage of low-rate debt. Since 2007, total debt has outpaced the growth in EBITDA, with total debt ending 2017 at 1.9 times EBITDA compared with less than 0.5 times in 2007 (Exhibit 10). Worth noting is that of the seven companies in our coverage cohort, five reported no material debt in 2007.

Companies have also been slowly reducing the balances of cash and investments they keep on hand, with cash net of total debt declining from 1.3 times EBITDA to zero in 2017. Historically, semiconductor firms have generated a lot of their operating cash outside of the U.S., with excess cash piling up over time due to onerous tax liabilities for repatriating the cash onshore.

Exhibit 10 Average Rated Semiconductor Evolving Toward a Net-Debt Position

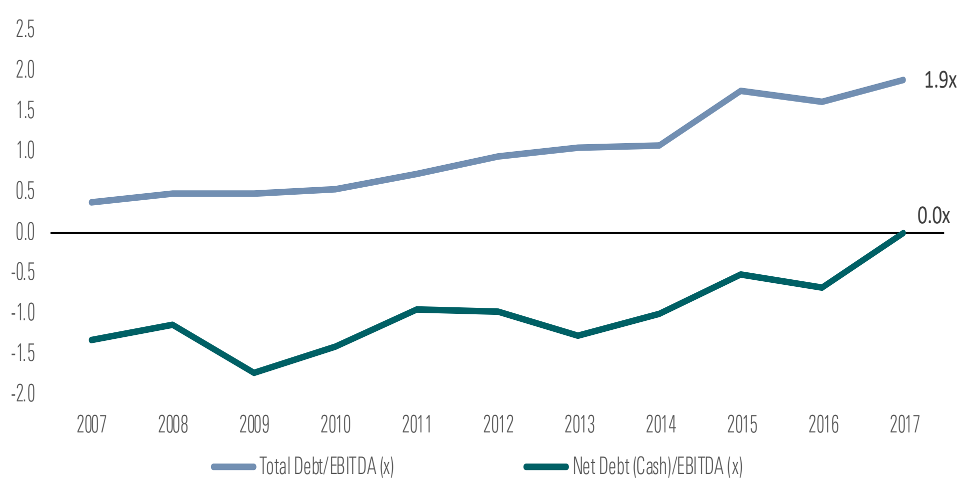
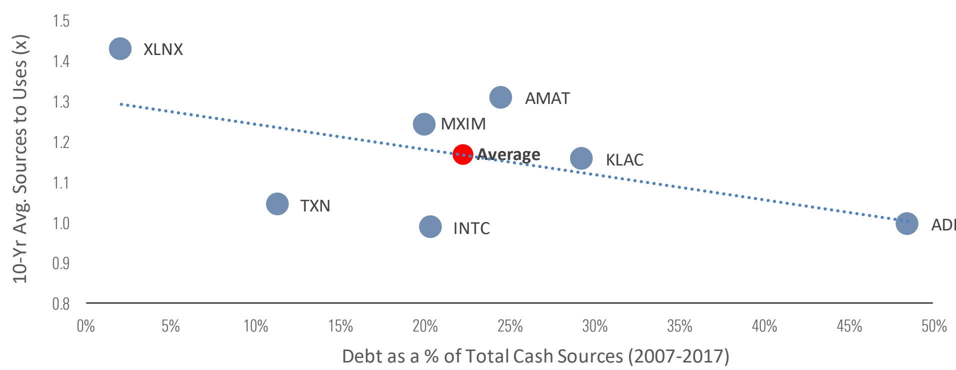


Chart measures the average gross and net leverage metrics for the investment grade semiconductors rated by Morningstar Credit Ratings,
Source: Company reports, MCR estimates.

Exhibit 11 below examines each issuer's capital generation and debt issuance profile. The vertical axis measures each company's total cash sources as a multiple of its total uses over the 2007 through 2017 period. Total sources include net new debt issuance during the period as well as cumulative free cash flow generation. The horizontal axis presents total debt as a percentage of each company's cash sources. A company that produces more cash than it spends with a low percentage of cash sources coming from external debt, will map to the upper left portion of the chart. Meanwhile, companies that spend most or more than they take in with a high percentage of cash sources coming from external debt will map to the lower right corner of the chart. We believe the two measures taken together present a clearer picture of each issuer's ability to generate cash flow internally and its willingness to spend that cash.

Exhibit 11 Payout of Cash is High For Most Firms, Supported by Debt Issuance



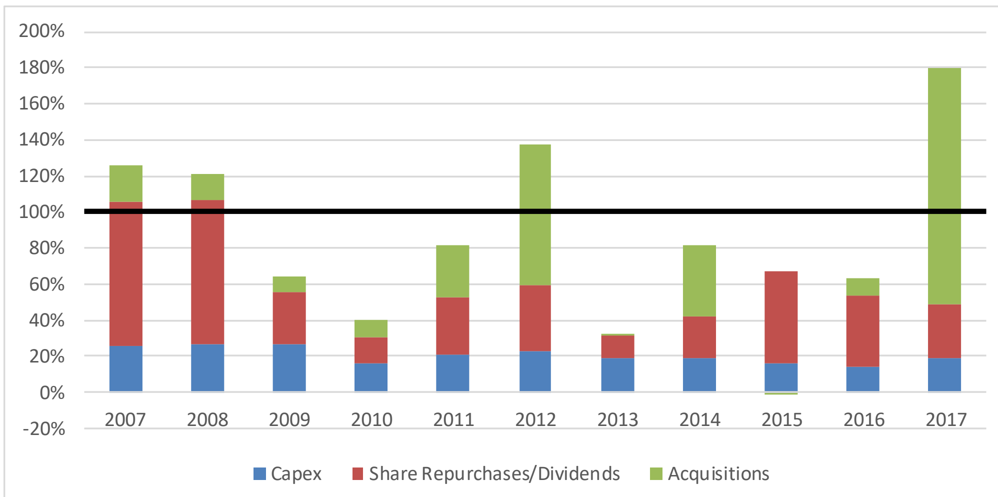
Source: Company reports, MCR estimates.

In our view, the more debt a company issues relative to internal sources suggests to us a more aggressive capital policy, particularly if the cash sources to uses ratio is close or below 1.0. Basic on this framework, the most conservative issuer is Xilinx, which banked 40% of its total cash sources during the period and net debt issued totaled just 2% of total cash sources. During the 10-year period from 2007 through 2017, Xilinx's EBITDA increased by 77% cumulatively, while cash and investments increased by 192%. Conversely, we note that the most aggressive company was Analog Devices, which paid out all of its cash sources to either acquisitions or share repurchases with net debt representing nearly half of total cash sources.

We attribute most of Analog's debt issuance to its 2017 merger with Linear Technology, resulting in $6.0 billion of net new debt issuance. However. through 2016, we note that its sources-to-uses ratio was 1.26 times over the prior 10 years with debt growth representing just 18% of total sources over that period which would have positioned it much more conservatively than it is now. Texas Instruments and Intel are both indicated as moderately aggressive in the chart, primarily due to a low ratio of sources to uses. Both companies have historically maintained high payouts of free cash flow, which contribute to the low sources/uses ratio. However, use of debt has been on the lighter side of the group and both companies have been highly disciplined in their management of internal capital. Meanwhile, Maxim, Applied Materials and KLA-Tencor all have above average sources/uses but a higher proportion of each has come from external debt financing.

Exhibit 12 below illustrates the average allocation of cash flow uses among semiconductor firms over the past 10 years. Each bar reflects the average percentage of operating cash flow for each of the seven firms in our rated universe. The key takeaway from the chart is that semiconductor firms have generally adhered to a conservative and consistent allocation of cash flow, with payouts kept below the level of full payout for most of the period. While acquisitions have been an infrequent use of cash flow, they have been meaningful when they have occurred and account for the bulk of excess cash payout observed during each period.

Exhibit 12 Acquisitions Have Historically Been the Primary Driver of Debt Issuance

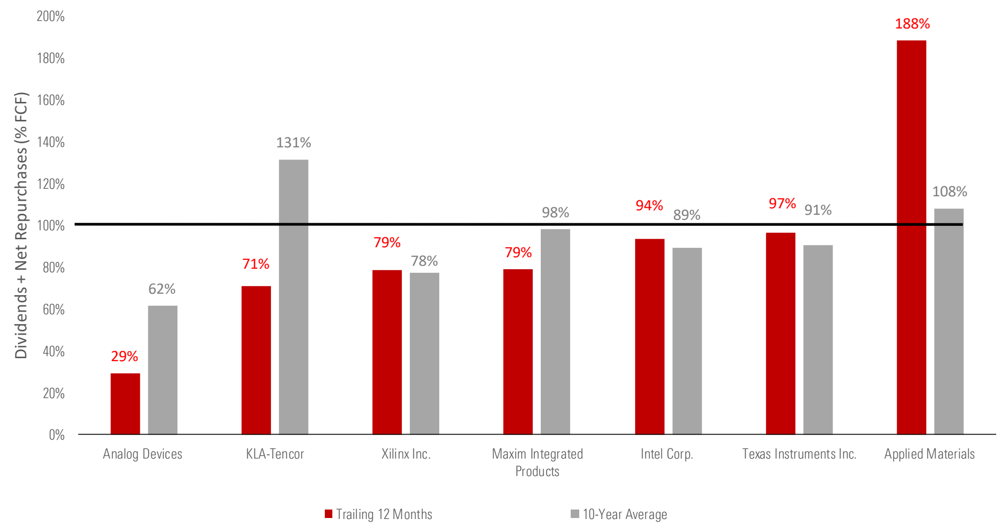


Source: Company reports, MCR estimates.

Exhibit 13 provides another way to look at payout trends among the semiconductor group. Over the most recent decade, Analog Devices and Xilinx were the low end for payout of net share repurchases and dividends while Applied Materials and KLA-Tencor were firmly at the high end of the peer range.

We note that payout ratios remain in line with or below the 10-year average for most companies over the most recently-reported 12-month period, though Applied Materials' 12-month payout is up sharply to 188% compared with its 10-year average of 108%. Texas Instruments has also modestly increased its payout to 97% over the trailing 12-month period, but it remains in line with management's stated policy to payout 100% of free cash flow, adjusted for debt maturities. Although Analog Devices' payout is the lowest over the most recent period, we believe it is likely to rise in future quarters as the company resumes its share repurchase program. However, KLA-Tencor and Maxim are currently paying out far less than they have historically.

Exhibit 13 Dividend and Share Repurchase Average Payout Ratios



Source: Company reports, MCR estimates

KLA's payout ratio increased in the most recent quarter ended Sept. 30 as the company increased repurchases under a new $1 billion authorization. Management also intends to repurchase $1 billion of additional shares to offset its planned acquisition of Orbotech, which is scheduled to close in the next 12 months. As a result, we may see payout exceed 100% for a short period of time.

As we noted earlier, tax reform has had a disproportionate impact on many technology firms, which produce much of their earnings and cash flow outside the U.S. We expect a good portion of the benefits of the higher cash flow to continue to accrue to shareholders through share repurchases and dividends. None of the featured semiconductor firms have announced any material changes to their existing capital allocation policies as a direct result of tax reform. As a result, companies have pulled back on debt issuance they otherwise might have pursued, drawing against foreign cash instead. Over time, we expect this could lead to a reduction in excess cash balances, incrementally reducing support for debt.

Sector Risks

Restrictive Trade Policies

The longer-term impact of incremental trade restrictions remains difficult to quantify, though we believe the contentious relationship between the U.S. and China represents a key source of risk to semiconductors in the near term. Tariffs have been in place since July and we have become less concerned about a disproportionate direct impact on semiconductor sales, though we believe the industry is exposed to the indirect impact of weaker global economic growth.

Semiconductors represent the U.S.'s fourth-largest export category, totaling $5.8 billion in 2016 according to data from U.S. International Trade Commission. For comparison, semiconductor imports from China totaled just $3.3 billion in 2016. In its July 20 public comment to the U.S. Trade Representative, the Semiconductor Industry Association (SIA) estimated that semiconductor trade with China represents a $2 billion annual surplus (with exports from U.S. exceeding imports from China).

The SIA also notes that China is the world's largest consumer of semiconductors but manufactures only 16% of its demand internally. The semiconductor segment is of high strategic importance to China, making it less likely that it will be singled out for retaliatory action in response to the U.S. Although the U.S. currently manufactures over half of global semiconductors domestically, certain portions of the supply chain including assembly, testing and packaging often occur inside China. If products sent to China are eventually exported back the U.S., then these could be subject to the new tariffs, making them less economically attractive to U.S. end-users.

Furthermore, while exports of semiconductor and related materials is relatively moderate, finished electronic goods make up a far larger portion of Chinese exports. For example, Apple Inc. (AA-, negative) assembles most of its products in China, including the three-largest: iPhone, iPod and Mac. We believe Apple products have been carved out of current tariff programs, though import of these products to U.S. consumers may be subject to future tariffs. To the extent that goods manufacturers are forced to pass through the tariffs as price increases, demand among consumers may decline and put backward pressure on the supply chain.

The first round of tariffs, which went into effect on July 6, include a wide range of semiconductor related products and tools. These include measurement and testing equipment for semiconductor wafers, appliances for dispersing liquids or powders used in the manufacture of printed circuit board s and assemblies, photosensitive transistors and semiconductor devices (analog), printed circuit board components designed for telecommunications and television displays and camera equipment.

Subsequent rounds have also levied tariffs on semiconductor products, wafer manufacturing equipment and assembled electronic products. The tariffs may disproportionately affect "fabless" chip-makers who rely on third-party foundries located throughout the world to manufacture their products, in whole or in part, though management teams have been largely silent on initial tariff impact, suggesting that it has not yet been material. Though some high-profile consumer products (including those from Apple) have been excluded from announced tariffs, large classes of consumer appliances like washing machines are still subject to the levies. As these increasingly tend to include electronic circuitry, including ASIC chips and printed circuit boards, suppliers of these components may be facing some margin pressure.

In Exhibit 14, we summarize the China exposure for the major semiconductor firms across two dimensions: Annual revenues sourced from Chinese-based customers and disclosure of manufacturing facilities located within China from which products may be exported. However, we note that production from these facilities often is intended to remain with China to serve local customers. This list may not include assembly, testing and packaging operations, which we noted earlier are often outsourced to China with the final products re-imported back to the U.S.

Exhibit 14 The Industry's Largest Exposure to China Is Through Revenue, Which We Believe Will Be Less Affected by Tariffs

Company	Rating/Outlook	Information Disclosed on China
Intel	AA-/Stable	In its 2017 10-K, Intel reported that 23.5% of its revenue was contributed by customers based in China. Elsewhere in the filing, the company reported that 10%, or $4.3 billion, of its total property, plant, and equipment were allocated to its operations in China. Intel only maintains one principal chip manufacturing facility in China, a 300mm facility focused on producing 65 nm products. With the exception of two facilities located in Ireland and Israel, respectively, Intel's other production is primarily located in the United States. These proportions suggest that it appears to have more exposure to Chinese reprisals that will impact pricing for customers within China relative to the direct impact from U.S. tariffs on any products exported to the U.S. from its operations located within China.
Texas Instruments	AA-/Stable	The company reported in its 2017 10-K that 85% of its revenue is derived from customers located outside the United States. The company also maintains principal manufacturing facilities within China. Revenue directly contributed from China and Hong Kong was $6.6 billion (44%) in 2017. From management risk factors: "Additionally, certain countries where we operate have experienced, and other countries may experience, increasing protectionism that may impact global trade. This could result in an adverse effect on our operations and our financial results."
Analog Devices	A/Stable	Revenue from China accounted for 19% for the nine months ending July 2018. Based on its disclosure of principal manufacturing properties, we believe no significant part of its supply chain is located within China. However, it reported two principal properties located in China, both engineering and sales offices.
Xilinx	A/Stable	Xilinx reported $663.9 million (26%) of revenue sourced in China for its fiscal year ended March 2018. As a fab-less semiconductor company, Xilinx maintains no material production properties of its own. Instead, it sources its wafers and programmable circuit devices under long-term contract arrangements from third-party manufacturers. These include Taiwan Semiconductor, United Microelectronics Corp. and Samsung Electronics (see below).
Maxim Integrated Products	A/Stable	In fiscal 2018, China contributed 36% of total revenue. Maxim does not own or operate its own manufacturing facilities. In 2017, partner and merchant foundries represented 73% of Maxim's total wafer production, distributed across Japan, Taiwan and the United States. Maxim notes that while some assembly may occur in China, the bulk of its assembly, testing and shipping occur in the Philipines and Thailand.
Applied Materials	A+/Stable	For the fiscal year ended October 2017, Applied Materials disclosed that 19% of its revenue was contributed by customers in China. Two customers, Samsung Electronics and Taiwan Semiconductor Manufacturing Company (TSMC) accounted for 38% of revenue. Micron and Intel each contributed less than 10% in 2017. According to the company's disclosure, Applied Materials' supply chain is located in Germany, Israel, Italy, Singapore, Taiwan and the United States with some exposure throughout other unspecified countries in Asia.
KLA-Tencor	BBB+/Positive	KLA reports manufacturing operations in the United States, Singapore, Israel, Germany and China. Its China locations include one plant and one office. China accounted for 16% of fiscal 2018 revenues and 31% of revenues in its fiscal first quarter ended Sept. 30. However, management has seen no dislocation in its order flow from China and expects the region to continue to represent a significant proportion of its order flow in future quarters.
Micron	Not rated	For the fiscal year ended September 2018, Micron disclosed that half of its revenue was contributed by customers in China, though less than 2% of property and equipment was allocated to the region. These facilities are primarily focused on assembly and test. Management has indicated that the first round of tariffs was expected to reduce Micron's fiscal first quarter gross margin, but that mitigation efforts were likely to reduce the impact over 9-12 months.
Nvidia	Not rated	NVIDIA derived 25% of its year-to-date revenue from China during the first half of 2018. However, only 3% of the company's long-lived assets were allocated to the region. Since the tariffs went into effect in late July, NVIDIA management has not publicly indicated any specific impact on revenue or profit.
Tawain Semiconductor	Not rated	TSMC maintains production facilities in its home country Taiwan as well as locations in the U.S. and China, with the latter including TSMC China and TSMC Nanjing. TSMC's investment in Chinese wafer capacity is targeted primarily sales within China.
United Microelectronics	Not rated	In its 20-F annual filing with the SEC, United reported that 8% of its 2017 revenue was contributed by China. The company also disclosed that it owns or leases 11 wafer foundry facilities, including a 12-inch wafer facility located in China. However, 9 of its fabs are located in Taiwan and 1 in Singapore. The Chinese facility had a capacity of 218,000 wafer-equivalents in 2017, or just 3% of United's total capacity that year.
Samsung	Not rated	Samsung operates 2 of its 7 manufacturing plants in China, 4 in its home country of South Korea, and 1 in the United States. The company also reports that 16% of its global revenue was sourced from China in 2017.

Source: Company reports, MRC estimates.

Mergers and Acquisitions

We continue to view event risk as elevated for smaller firms as the trend toward industry consolidation has shown signs of persisting. Though we believe the near-term risk in this area is less than it was a year ago following the regulatory blocking of two high-profile merger attempts earlier this year, market speculation will likely continue to surface from time to time. In March, on the recommendation of the Committee on Foreign Investment in the United States, President Trump signed an executive order blocking Broadcom Limited's (not rated) hostile bid for Qualcomm on national security concerns. We view the move as an example of the harder stance being assumed by U.S. regulators regarding high-profile merger transactions. Subsequently, in July, Chinese regulators blocked the proposed merger of NXP and Qualcomm. The failure of these two transactions appears to have dampened merger speculation in the sector for now, with no new deals announced since March. However, over the long term we continue to view M&A risk as elevated given the importance of scale in the semiconductor industry. M

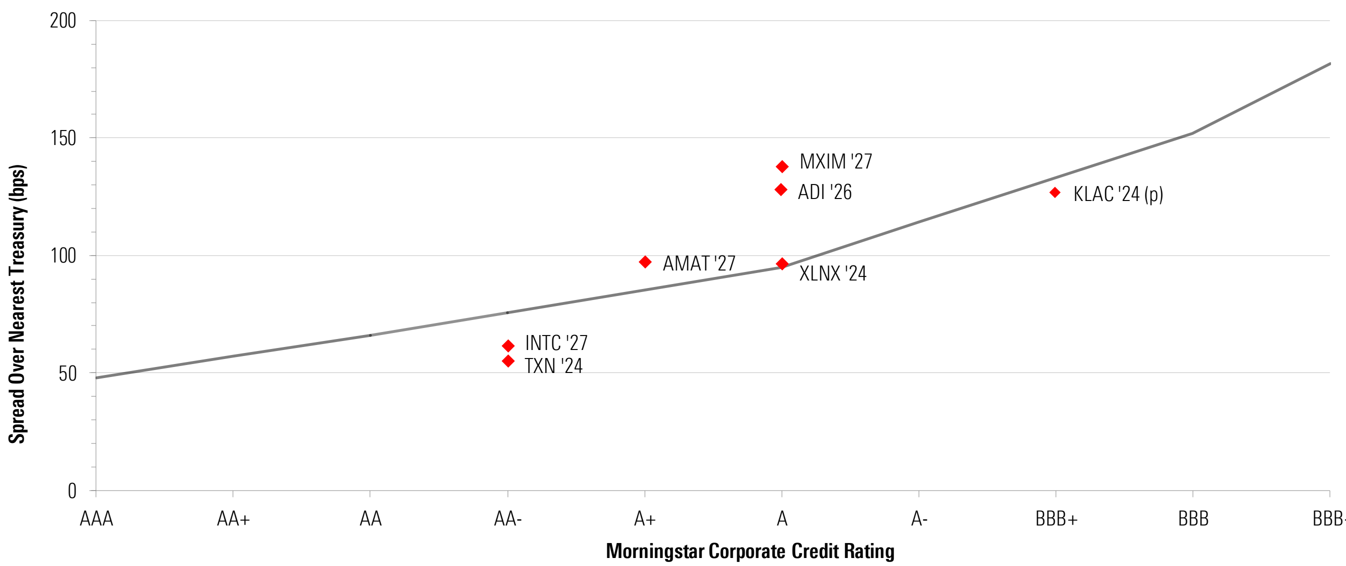
Exhibit 15 Summary of Announced Transactions in Semiconductors

Announced Date	Acquirer	Target	EV ($mm)	EBITDA Multiple	Status
03/01/15	NXP Semiconductor	Freescale	16,343	15.8x	Completed
05/28/15	Avago	Broadcom	31,388	27.0x	Completed
06/01/15	Intel	Altera	14,355	24.9x	Completed
10/21/15	Lam Research	KLA-Tencor	10,957	13.8x	Withdrawn
10/21/15	Western Digital	SanDisk	13,807	10.5x	Completed
12/14/15	Micron Technology	Inotera Memories	4,000	2.9x	Completed
01/19/16	Microchip Technology	Atmel	3,400	32.8x	Completed
07/26/16	Analog Devices	Linear Technology	14,218	18.7x	Completed
10/27/16	Qualcom	NXP Semiconductor	52,190	20.1x	Withdrawn
03/13/17	Intel	Mobileye	15,300	113.0x	Completed
09/20/17	Bain Capital	Toshiba Memory	18,000	NA	Completed
11/03/17	Broadcom	Qualcom	100,245	24.6x	Withdrawn
03/01/18	Microchip Technology	Microsemi	10,150	18.9x	Completed
03/19/18	*KLA-Tencor*	*Orbotech*	*3,200*	*17.2x*	*Pending*

Sources: Company filings, Bloomberg, MCR Estimates.

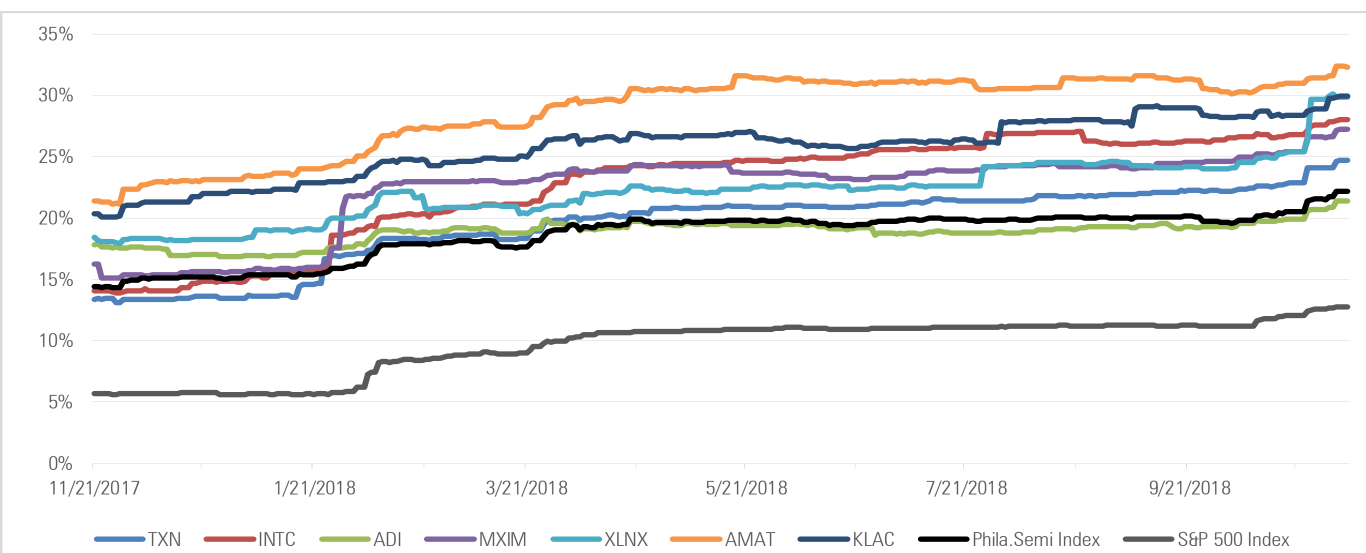
Market Data

Exhibit 16 Semiconductors Versus Morningstar Corporate Bond Index



Source: Morningstar Credit Ratings, LLC, Morningstar Inc., and Interactive Data. Data as of Nov. 7, 2018.
UR = rating under review/(p) = positive outlook/(n) = negative outlook.

Exhibit 17 Semiconductor Indexed Common Stock Total Return Volatility Trends



Source: Morningstar Inc. Data through Nov. 7, 2018.

Exhibit 18 Semiconductor Financial Comparables

	TXN	INTC	AMAT	MXIM	ADI	XLNX	KLAC
Morningstar Rating	**AA-**	**AA-**	**A+**	**A**	**A**	**A**	**BBB+**
Rating Outlook	Stable	Stable	Stable	Stable	Stable	Stable	Positive
COMPANY METRICS							
LTM as of Date	9/30/2018	9/30/2018	7/31/2018	9/30/2018	7/31/2018	9/30/2018	9/30/2018
Revenue	15,817	69,244	17,208	2,543	6,146	2,735	4,160
Growth	8.2%	11.5%	24.1%	10.1%	32.0%	12.5%	12.5%
EBITDA	7,924	31,215	5,320	1,007	2,836	950	1,667
EBITDA %	50.1%	45.1%	30.9%	39.6%	46.1%	34.7%	40.1%
Capital Spending	1,039	15,360	581	70	234	68	74
% of Sales	7%	22%	3%	3%	4%	2%	2%
CREDIT METRICS							
Total Debt	5,067	27,874	5,308	1,491	6,555	1,702	2,238
Cash & Investments	5,113	13,186	3,984	2,563	773	3,281	2,780
Net Debt (Net Cash)	(46)	14,688	1,324	(1,072)	5,783	(1,579)	(542)
Average Interest Rate	2.2%	1.9%	4.4%	2.2%	3.9%	2.9%	4.0%
Gross Debt/EBITDA	0.6x	0.9x	1.0x	1.5x	2.3x	1.8x	1.3x
Net Debt/EBITDA	0.0x	0.5x	0.2x	-1.1x	2.0x	-1.7x	-0.3x
EBITDA/GAAP Interest	72.0x	59.7x	23.0x	31.0x	11.1x	19.5x	18.8x
Free Cash Flow	5,934	14,372	2,828	737	2,135	848	1,163
FCF Margin (% Revenue)	38%	21%	16%	29%	35%	31%	28%
Dividends (LTM)	2,430	5,451	517	209	691	361	424
Dividends (% of FCF)	41%	38%	18%	28%	32%	43%	36%
Net Share Repurchases	3,300	8,015	4,811	374	(64)	306	402
Net Repurchases (% of FCF)	56%	56%	170%	51%	-3%	36%	35%
EQUITY METRICS							
Market Cap (Millions)	95,528	205,051	33,707	14,201	30,994	18,741	14,061
Enterprise Value (Millions)	95,482	220,259	35,221	13,129	36,776	17,162	13,518
Enterprise Value/EBITDA	12.0x	7.1x	6.6x	13.0x	13.0x	18.1x	8.1x

Source: MCR.

Exhibit 19 Morningstar Credit Ratings: Tech Media and Telecom Coverage

Issuer	Ticker	Corporate Rating	Rating Outlook	Moat*	Moat Trend*	Uncertainty*
Hardware						
Cisco Systems	CSCO	AA-	Negative	Narrow	Stable	Medium
Apple	AAPL	AA-	Negative	Narrow	Stable	High
International Business Machines	IBM	A+	Negative	Narrow	Negative	High
Xerox	XRX	BBB-	Negative	None	Negative	High
Software						
Microsoft	MSFT	AA+	Stable	Wide	Stable	Medium
Alphabet	GOOG	AA	Stable	Wide	Stable	High
Oracle	ORCL	AA-	Stable	Wide	Negative	Medium
Adobe	ADBE	AA-	Stable	Wide	Stable	Medium
Semiconductors						
Texas Instruments	TXN	AA-	Stable	Wide	Stable	Medium
Intel	INTC	AA-	Stable	Wide	Negative	Medium
Applied Materials	AMAT	A+	Stable	Wide	Stable	High
Analog Devices	ADI	A	Stable	Wide	Stable	Medium
Maxim Integrated Products	MXIM	A	Stable	Wide	Stable	High
Xilinx	XLNX	A	Stable	Narrow	Stable	Medium
KLA-Tencor	KLAC	BBB+	Positive	Wide	Stable	High
Advanced Micro Devices	AMD	B-	Stable	None	Stable	Very High
North American Telecom						
Verizon Communications	VZ	BBB	Stable	Narrow	Stable	Medium
AT&T	T	BBB-	Stable	Narrow	Stable	Medium
T-Mobile US	TMUS	BB	Stable	None	Positive	High
DISH Network	DISH	B+	Negative	None	Negative	Very High
Sprint	S	B	UR+	None	Stable	Very High
Media and Broadcasting						
Walt Disney Co.	DIS	A+	UR-	Wide	Stable	Medium
Comcast	CMCSA	BBB+	Negative	Wide	Stable	Medium
Omnicom	OMC	BBB+	Stable	Narrow	Stable	Medium
CBS Corp.	CBS	BBB	Stable	Narrow	Stable	High
Interpublic Group	IPG	BBB	Stable	Narrow	Stable	Medium
Viacom	VIAB	BBB	Stable	Narrow	Stable	High
Discovery Communications	DISCA	BBB-	Stable	Narrow	Stable	High
Netflix	NFLX	BB-	Stable	Narrow	Stable	Very High

Source: MCR.

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