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USA | Technology

Semiconductors

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Jefferies

EQUITY RESEARCH GLOBAL

Semiconductors
Moore Stress 2.0 – Follow the Money

Key Takeaway

Over the past 10 yrs, Moore's Law drove profitability to semis from customers and suppliers. Over the next 5 yrs, we believe the stalling transistor cost curve reverses that trend. We expect 1) more vertical integration by customers 2) pricing power by suppliers, and 3) emergence of a low GM business model in semis. We expect a downward bias on growth and margins for semis broadly, but view AMAT, LRCX, INTC, Samsung and AMD as beneficiaries of these trends.

Moore Stress 2.0: In our original Moore Stress note (Sep-'12), we argued that the inflecting transistor cost curve would structurally change the semiconductor industry. In this note we introduce Moore Stress 2.0, and argue that the inflection structurally changes the supply chain as well.

Follow the Money: The rapid pace of technology change in semis described by Moore's Law has caused both consolidation and a concentration of supply chain power within semis. Consequently, over the past 10 years, EBIT margins for semis have increased to 20%-30% (S&P500 top quintile), while those of its customers and suppliers declined. We think that a deceleration in the transistor cost curve will drive a mean reversion process on those 10-yr EBIT trends that manifests on three dimensions:

1) Customer Vertical Integration: We think a slower transistor cost curve levels the playing field between semiconductor companies and their customers. The internal design teams, and the companies they outsource design work to, have more time to optimize a design using older transistor technology for maximum economic benefit. Apple and Huawei are just two examples of traditional semiconductor customers that are increasingly designing their own chips - we expect to see more.

2) Supplier Pricing Power: We think two things give suppliers pricing power going forward: A) Consolidation: Semi-Cap and EDA companies have consolidated at a faster rate than their customers over the past several years; B) More Value: as it becomes more difficult to climb down the transistor cost curve at historical rates, improvements in supplier products will be considered higher value-add and command higher prices.

3) Lower Gross Margin Business Model: A decelerating transistor cost curve means longer time at a given transistor node, and more time for fast (or slow) followers to develop and amortize development for IP blocks. We think AMD's semi-custom business model offers a glimpse of what device makers may be up against: gross margins of 25%-30%, customer funded R&D in the form of NREs (non-recurring engineering), nominal inventory risk, and operating margins in the 15%-to-20% range.

Moore Stress 2.0 Beneficiaries: We think suppliers like AMAT and LRCX are poised to benefit from these trends and initiate coverage with a Buy on those stocks concurrent with this note. We continue to believe scale is critical for IDMs to stay on the historical Moore's Law Transistor cost curve, and view INTC and Samsung as long-term beneficiaries, as their competitors drop off. Finally, we think AMD's new business model and its unique position as a holder of intellectual property around x86, ARM, Graphics and server fabric technology, position it to benefit from these emerging dynamics.

Moore Stress 2.0 Challenged: We view high-margin, leading edge fabless companies as being potentially challenged by these dynamics, and are incrementally cautious on ALTR, XLNX and NVDA.

Links to Related Reports:

Moore Stress = Structural Industry Shift

Moore Stress - One Year Anniversary Compendium

Moore Stress 2.0: Equipment Supplier Leverage - Initiating Coverage

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Moore Stress 2.0: Follow the Money

Moore Stress is Real and Investable. In our original Moore Stress note (Sep-'12), we argued that the transistor cost curve inflection would structurally change the semiconductor industry. Since that note, MU is up 300%, a memory stock started paying a dividend (SNDK: August, 2013) and Altera shifted its sourcing of leading edge chips to Intel from TSMC. In Moore Stress 2.0, we argue that the inflection structurally changes the supply chain as well.

As Barbie may have said…"Semis are Tough!" Designing chips using the latest, leading edge transistors is not just extremely difficult to do, it is expensive too. IBS estimates that in 2004, it cost about $20 million to design an integrated circuit (IC) using 90nm transistors – that cost has skyrocketed to $170m to design an IC on 20nm transistors today. On the manufacturing side, it can cost upwards of $10 billion and three years to build a new leading edge semiconductor manufacturing facility.

Higher Costs Have Driven Semiconductor Consolidation. Importantly, the semiconductor industry has consolidated at a faster pace than its customers and suppliers, and therefore gained relative power in the supply chain. We think that this increased power shows up in their profitability (EBIT). Over the past 10 years, profitability of semiconductor companies has increased, and profitability of their customers and suppliers has decreased (Charts 3 and 4). Many semiconductor companies have EBIT margins in the 20%-to-30% range, putting them in the top quintile of the S&P500.

Follow the Money. The juicy semiconductor EBIT margins have always been a target for semiconductor customers and suppliers. We think that the inflecting transistor cost curve starts a mean reversion process on those 10-year EBIT trends that manifests on three dimensions:

1) Customer Vertical Integration: We think a slower transistor cost curve levels the playing field between leading edge companies and their customers. If the economic benefit of moving to the next smaller transistor is not as obvious, then why pay semiconductor companies a high margin to do it? The internal design teams at OEMs have more time to optimize an N-1 design for maximum economic benefit. Apple and Huawei are examples of traditional semiconductor customers that are now designing their own chips; we expect to see more (Charts 7 and 8).

2) Supplier Pricing Power: We think two things give suppliers pricing power going forward: A) Consolidation: Semi-Cap and EDA companies have consolidated at a faster rate than their customers over the past several years; B) More Value: as it becomes more difficult to climb down the transistor cost curve at historical rates, improvements in supplier products will be considered higher value-add and command higher prices. The mean reversion process has already started at EDA companies; we think Semiconductor Capital Equipment companies are next.

3) Lower Gross Margin Business Model: A decelerating transistor cost curve means longer time at a given transistor node, and more time for fast (or even slow) followers to develop and amortize IP blocks for different semiconductor manufacturing processes. We think AMD's semi-custom business model offers a glimpse of what device makers may be up against: gross margins of 25%-30%, customer funded R&D in the form of NREs (non-recurring engineering), nominal inventory risk, and operating margins in the 15%-to-20% range.

Moore Stress 2.0 Beneficiaries: We think suppliers like AMAT and LRCX are best poised to benefit from these trends, and in conjunction with this note, we launch coverage with Buy ratings on both. We continue to believe scale is critical for IDMs to

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stay on the historical Moore's Law Transistor cost curve, and view INTC and Samsung as long-term beneficiaries, as their competitors drop off. Finally, we think the power of AMD's new business model and its unique position as a holder of intellectual property around x86, ARM, Graphics and server fabric technology, position it to benefit from these emerging dynamics.

Moore Stress 2.0 Challenged: We view high-margin, leading edge fabless companies as being potentially challenged by these dynamics. We expect to see (and may already be seeing) slower growth associated with increased vertical integration by traditional semiconductor customers and increased price pressure as a new lower gross margin business model emerges to take advantage of the slower transistor cost curve. Below the top line, we expect higher R&D intensity as consolidation translates to increased pricing power by suppliers. We are incrementally cautious on ALTR, XLNX and NVDA.

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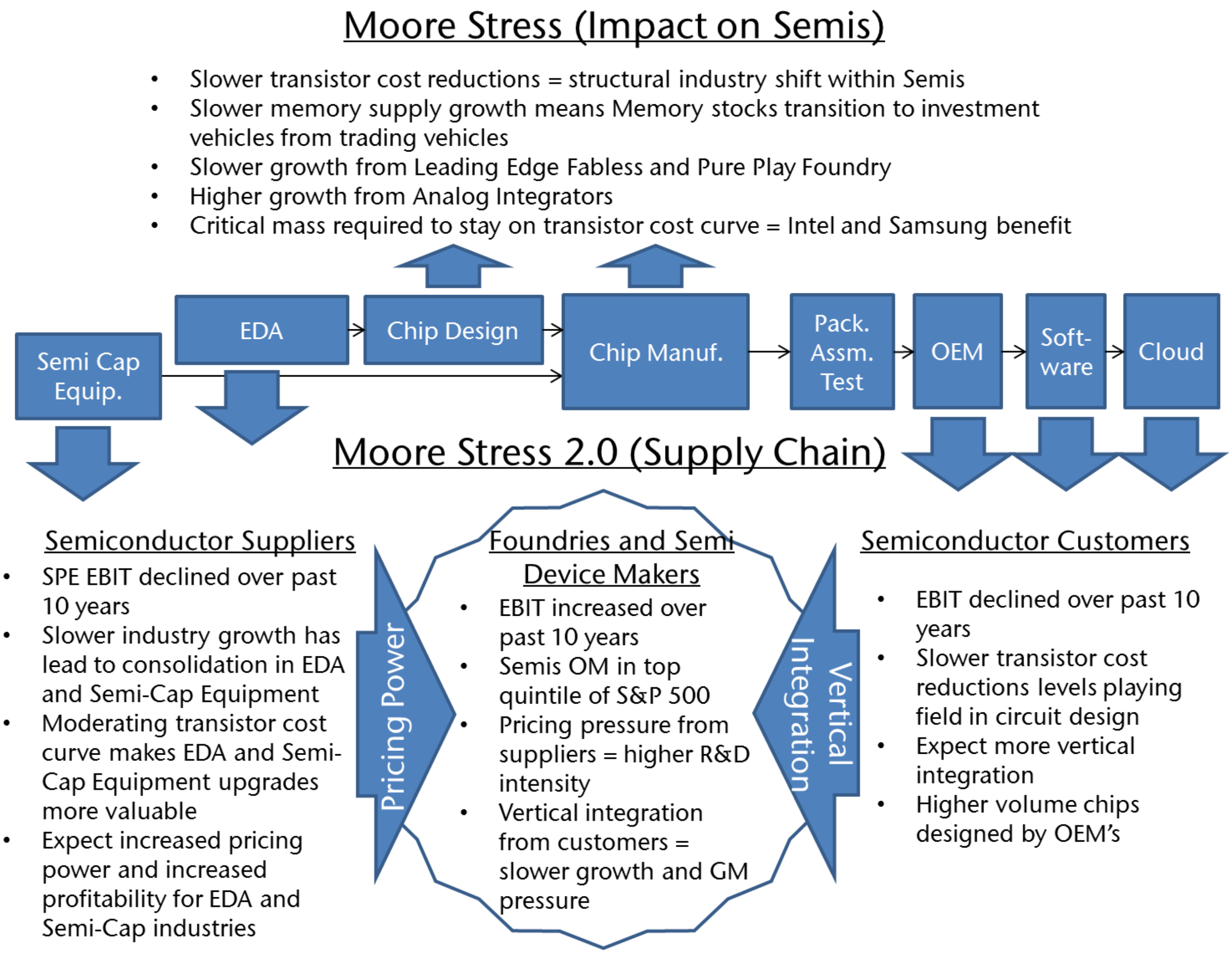
Chart 1: Moore Stress and Moore Stress 2.0 Summary



Source: Jefferies

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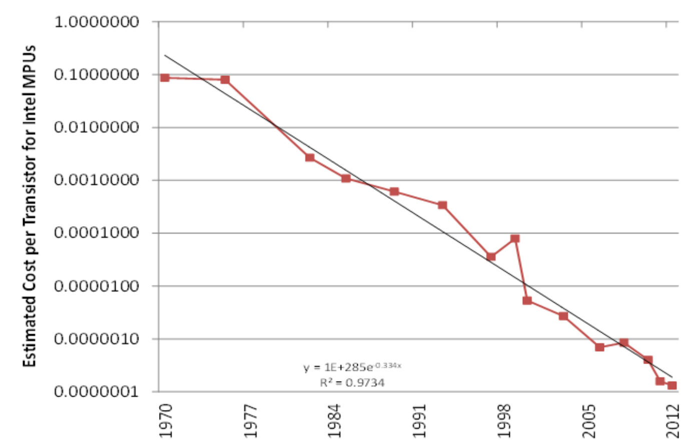
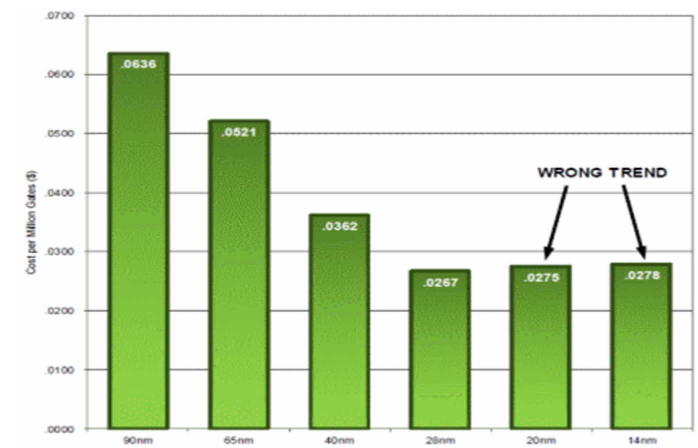
Chart 2: Changing Transistor Cost Curve = Changing Competitive Dynamics in the Supply Chain

Moore's Law: Transistor Cost Curve 1965-2011



- Over the past 40 years, the number of transistors per chip doubled every 18 months, and the cost / transistor declined at a CAGR of 25-30%
- Leading edge semiconductor companies developed competencies around keeping up with the rapid pace of advancements in transistor technology, and integrating more functionality into chips
- In this environment, semis have extracted value from the supply chain. Semiconductor operating margins have increased over the past 10 years. The margins of many semiconductor device companies are in the 20-30% range, which is in the top quintile of the S&P 500

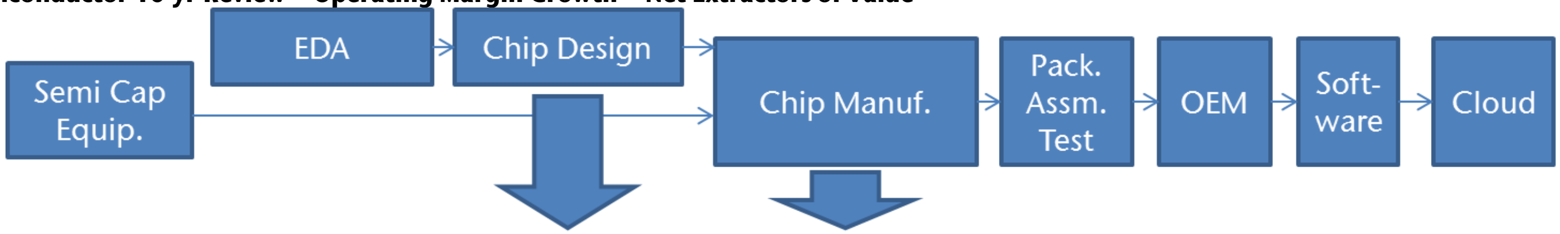
Moore Stress: Transistor Cost Curve 2012-Future

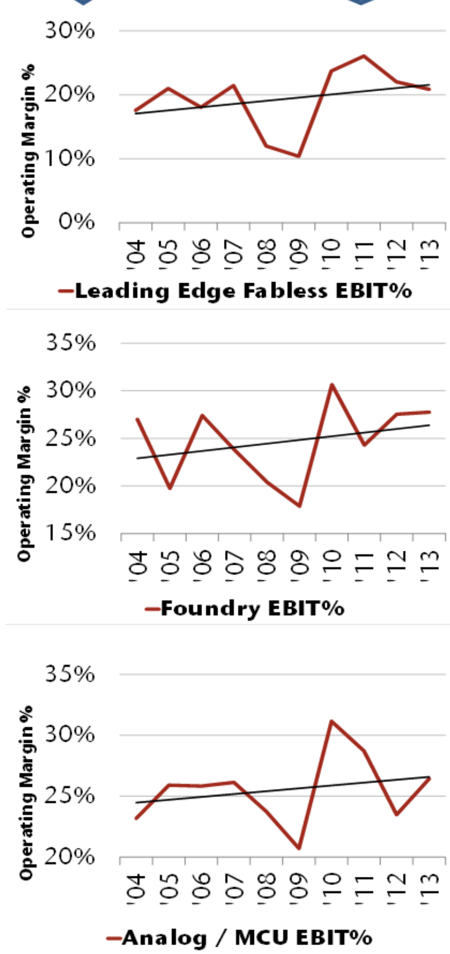


- Going forward, we think the transistor cost curve will not decline at the same historical rate, at least not broadly for all semiconductor device companies
- We think this will have a "leveling-the-playing-field" effect. Already we see evidence of traditional semiconductor customers vertically integrating into the semiconductor design
- At the same time consolidation at semiconductor companies has put downward pressure on margins and growth rates at their suppliers, which in turn has led to consolidation at EDA and cap equipment makers. We think these suppliers will see increased pricing power which will translate to an upward bias on R&D intensity at device makers
- We think this will necessarily put downward pressure on semiconductor growth rates, and profitability

Source: Jefferies, company data, IBS

Chart 3: Semiconductor 10-yr Review – Operating Margin Growth – Net Extractors of Value





- Semiconductor device component and Foundries have been net extractors of value from the supply chain
- Over the past 10 years, their operating margins have increased
- With operating margins in the 20%-to-30% range, many semiconductor companies are amongst the most profitable in the S&P500

Source: Jefferies, company data, (Leading Edge Fabless = NVDA, ALTR, XLNX), (Foundry = TSMC, SMIC, UMC), (Analog = TXN, MXIM, ADI, MCHP, LLTC)

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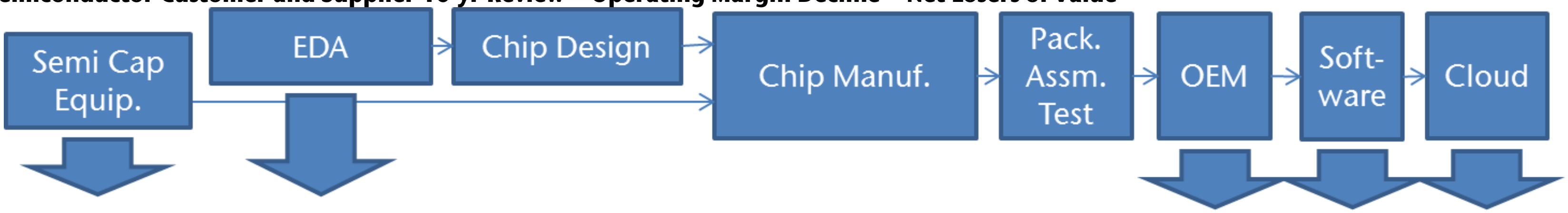
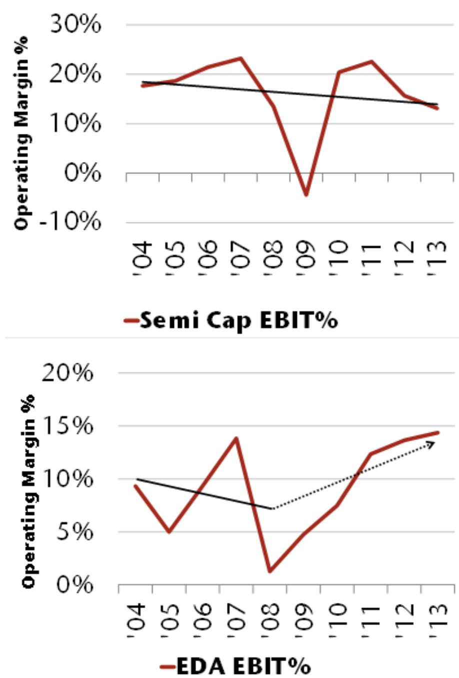
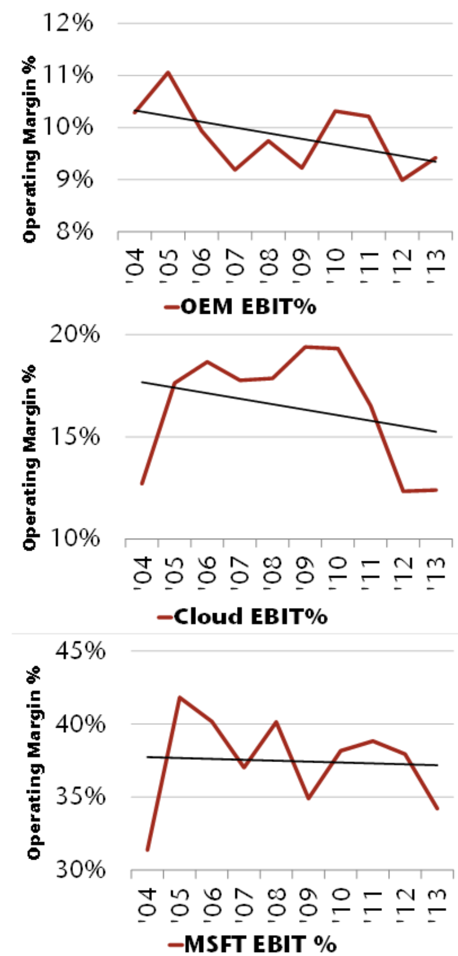
Chart 4: Semiconductor Customer and Supplier 10-yr Review – Operating Margin Decline – Net Losers of Value





- At the same time that Semi-Device and Foundries have seen increasing profitability, their customers and suppliers have seen profitability decline
- Over the past 10 years, OEM and Cloud profitability has declined
- Semi-Cap Equipment margins have also declined over the past 10 years
- EDA margins declined up until 2008, but have rebounded after the industry consolidated



Source: Jefferies, company data, (Semi Cap = ASML, AMAT, LRCX, KLAC, TEL), (EDA = CDNS, SNPS, MENT), (OEM = DELL, HP, CSCO, ALU, ERIC), (Cloud = AMZN, GOOG, FB)

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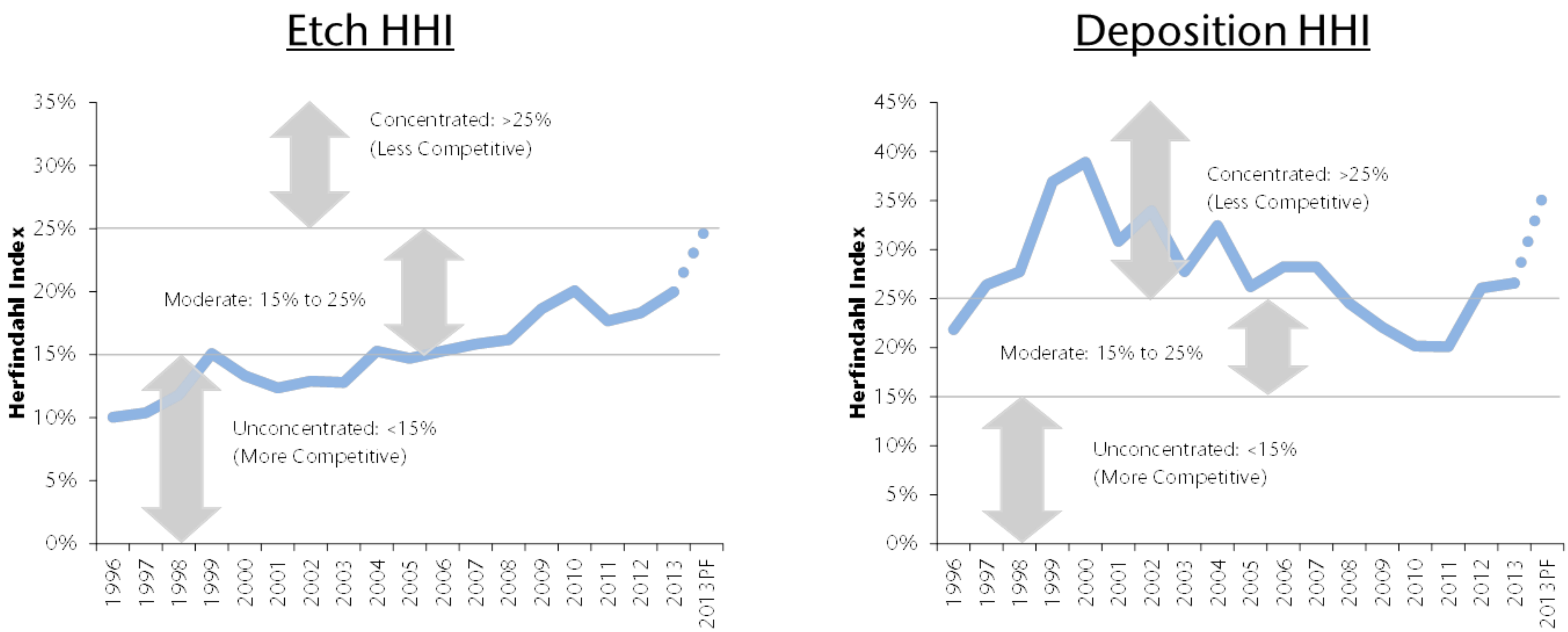
Chart 5: Herfindahl Index for Semi-Cap Equipment Segments



Looking forward, we think combination of:

1) Consolidation
2) Moore Stress
3) Increasing Foundry Competition

will translate to pricing power for Semi-Cap Equipment players…
…and increasing R&D expenses for semis

Source: Jefferies, company data, Gartner

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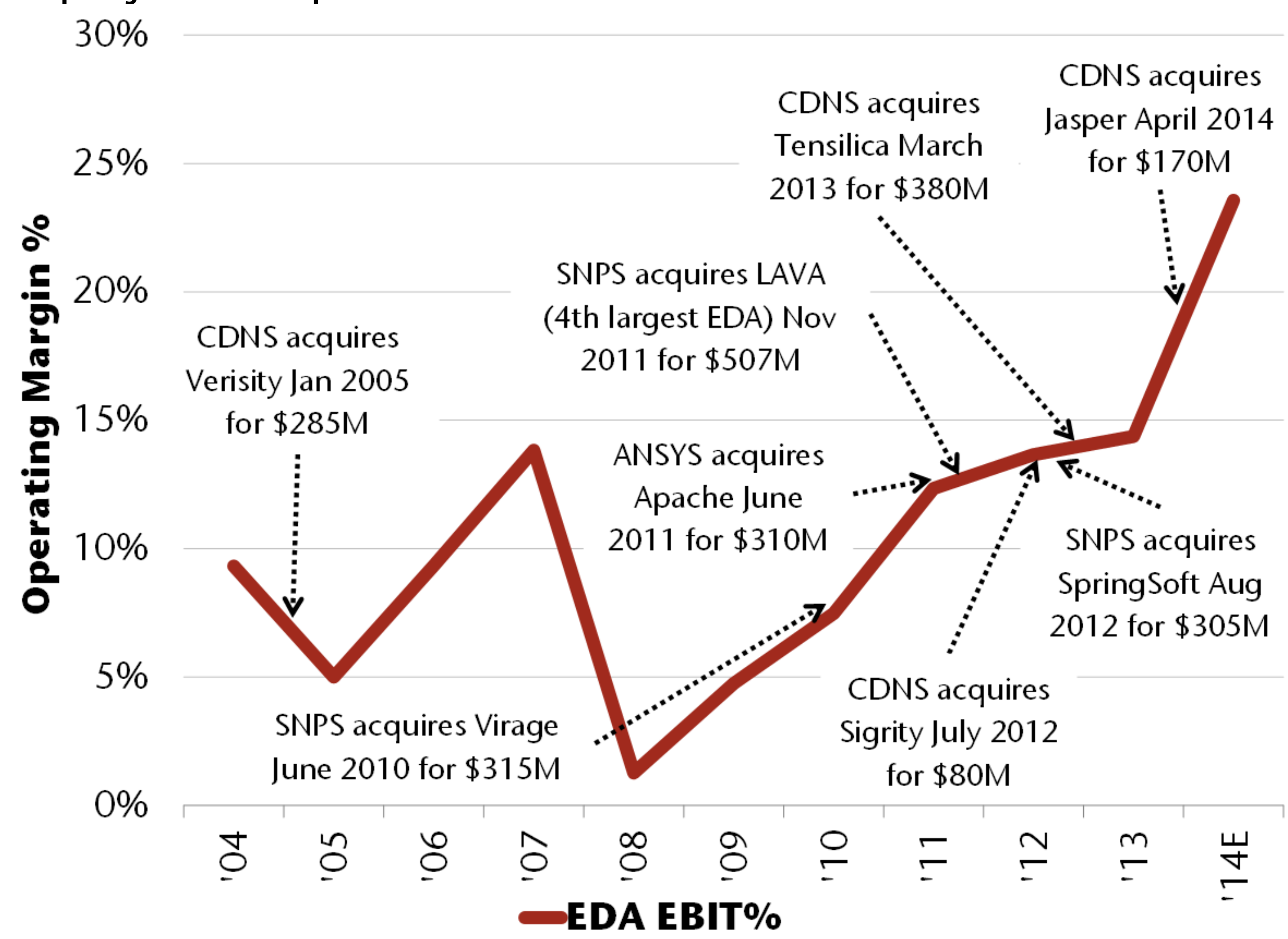
Chart 6: Acquisition and Op Margins for EDA Companies



- We think Semi Cap profitability will follow consolidation similar to EDA names

Source: Jefferies, company data, (EDA = CDNS, SNPS, MENT)

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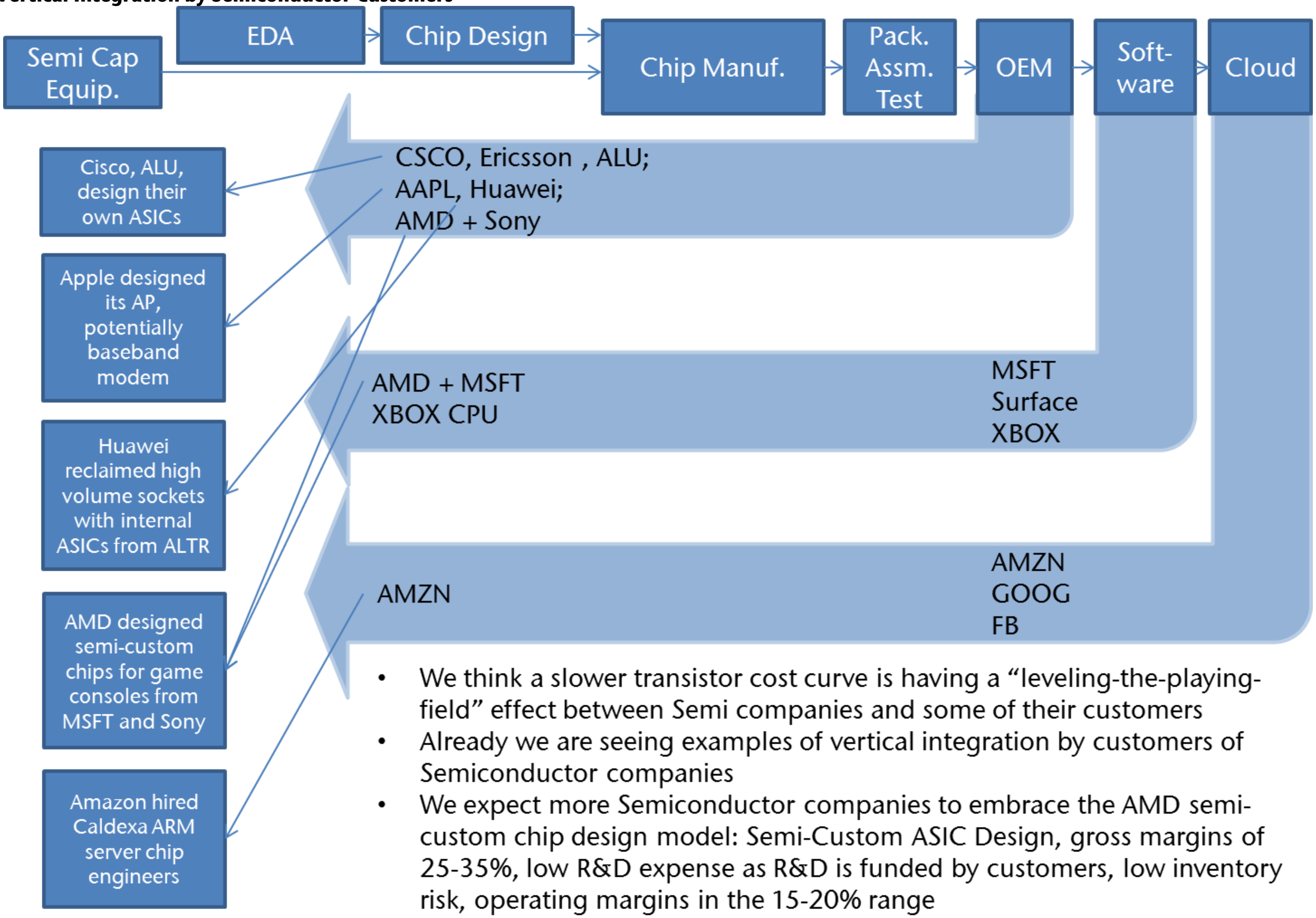
Chart 7: Vertical Integration by Semiconductor Customers



- We think a slower transistor cost curve is having a "leveling-the-playing-field" effect between Semi companies and some of their customers
- Already we are seeing examples of vertical integration by customers of Semiconductor companies
- We expect more Semiconductor companies to embrace the AMD semi-custom chip design model: Semi-Custom ASIC Design, gross margins of 25-35%, low R&D expense as R&D is funded by customers, low inventory risk, operating margins in the 15-20% range

Source: Jefferies, company data

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Chart 8: Data Points on OEMs Moving to Chip Design (click underlined text for link to article)

Microsoft & Sony	• Engaged AMD to design custom chips for Xbox One and PS4	Moor Insights: The Real Reasons Microsoft, Sony Chose AMD For The Xbox One And PS4
Apple	• Acquired SoC designer PA Semi (April 2008) • Acquired core accelerator chip designer Intrinsity (April 2010)	Wired: Four Reasons Apple Bought PA Semi The New York Times: Apple Buys Intrinsity, a Maker of Fast Chips
Amazon	• Hired former Calxeda engineers • Posted job openings for CPU Architects (April 2014)	GigaOm: Amazon joins other web giants trying to design its own chips
Google	• Acquired Agnilux (April 2010) • Designed data center switches	Ars Technica: Google Buys Secret Chip Startup Wired: Mystery Google Device Appears in Small-Town Iowa
Huawei	• Huawei's internal ASIC design team, HiSilicon, licensed ARM (2011) • Captured high-volume design wins from Altera (2H12)	ARM: HiSilicon Licenses ARM Technology for use in Innovative 3G/4G Base Station, Networking Infrastructure and Mobile Computing Applications eetimes: Huawei Using ASICs for First Time
Facebook	• Collaborates with Intel on server chip designs	Wired: The Facebook Special: How Intel Builds Custom Chips for Giants of the Web
ZTE	• Licenses CEVA DSP cores in internal ASIC designs	eetimes: Ceva-ZTE Deal Hints Home-Grown ASIC Is Back
Cisco	• Large internal team engaged in ASIC design	Seeking Alpha: Cisco announces new network processor, EZchip tumbles
Alcatel-Lucent	• Also has an internal ASIC design team	Itweb: Alcatel-Lucent Enterprise to address network application challenge with new access switch, added analytics, SDN capabilities

Source: Jefferies, company data, media reports

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Chart 9: Semi & Semi Cap Coverage Comp Table

Ticker		Rating	Price Target	5/30/14 Price	Market Cap (m)	Cash (m)	Debt (m)	Net Debt (m)	Net Debt /Shr	EV/FCF 2014	EV/FCF 2015	Jeff EPS 2014	Jeff EPS 2015	Consensus EPS 2014	Consensus EPS 2015	P/E 2014	P/E 2015	P/TanBk
PC:																		
AMD	*	Buy	$ 6.00	$ 4.00	$ 3,048	$ 902	$ 2,138	$ 1,236	$ 1.62	27x	15x	$0.48	$0.65	$ 0.18	$ 0.23	22x	18x	n.m.
INTC	*	Buy	$ 35.00	$ 27.32	$ 135,999	$ 19,046	$ 13,208	$ (5,838)	$ (1.17)	19x	15x	$2.08	$2.47	$ 1.89	$ 2.02	14x	14x	3x
MRVL	*	Hold	$ 17.00	$ 15.57	$ 7,907	$ 2,146	$ 29	$ (2,117)	$ (4.17)	9x	9x	$1.18	$1.30	$ 1.15	$ 1.22	13x	13x	3x
NVDA	*	Hold	$ 19.00	$ 19.00	$ 10,601	$ 4,348	$ 1,380	$ (2,968)	$ (5.32)	12x	11x	$0.93	$1.03	$ 0.90	$ 0.98	21x	19x	3x
PLDs:																		
ALTR	*	Hold	$ 38.00	$ 33.13	$ 10,378	$ 2,995	$ 1,492	$ (1,503)	$ (4.80)	17x	14x	$1.56	$1.85	$ 1.52	$ 1.79	22x	18x	3x
LSCC	**	Buy	$ 9.50	$ 7.91	$ 931	$ 220	$ -	$ (220)	$ (1.87)	n.a.	n.a.	$0.32	$0.37	$ 0.37	$ 0.44	22x	18x	3x
XLNX	*	Hold	$ 53.00	$ 46.96	$ 12,623	$ 2,457	$ 1,559	$ (898)	$ (3.34)	14x	13x	$ 2.32	$2.44	$ 2.34	$ 2.60	20x	18x	5x
Analog:																		
ADI	*	Buy	$ 60.00	$ 52.38	$ 16,455	$ 4,807	$ 873	$ (3,935)	$ (12.53)	16x	15x	$2.53	$2.93	$ 2.46	$ 2.72	21x	19x	4x
LLTC	*	Buy	$ 52.00	$ 46.16	$ 10,919	$ 1,763	$ 843	$ (920)	$ (3.89)	17x	16x	$2.05	$ 2.52	$ 2.05	$ 2.33	23x	20x	9x
MCHP	*	Buy	$ 53.00	$ 47.60	$ 9,479	$ 1,345	$ 1,021	$ (324)	$ (1.63)	17x	12x	$2.68	$2.93	$ 2.69	$ 2.99	18x	16x	7x
MTSI	*	Buy	$ 23.00	$ 18.29	$ 865	$ 63	$ 250	$ 186	$ 3.94	20x	25x	$1.31	$1.65	$ 1.31	$ 1.53	14x	12x	41x
MXIM	*	Buy	$ 39.00	$ 34.25	$ 9,683	$ 1,231	$ 1,003	$ (228)	$ (0.81)	13x	12x	$1.95	$2.18	$ 1.92	$ 2.21	18x	15x	7x
NXPI	*	Buy	$ 72.00	$ 62.10	$ 15,634	$ 720	$ 3,583	$ 2,863	$ 11.37	16x	14x	$4.56	$5.59	$ 4.44	$ 5.08	14x	12x	n.m.
ONNN	*	Hold	$ 10.00	$ 8.69	$ 3,832	$ 617	$ 920	$ 303	$ 0.69	12x	12x	$0.76	$0.86	$ 0.80	$ 0.97	11x	9x	3x
TXN	*	Buy	$ 55.00	$ 46.98	$ 50,708	$ 4,032	$ 5,652	$ 1,620	$ 1.50	18x	16x	$2.33	$2.68	$ 2.31	$ 2.63	20x	18x	13x
Comms:																		
AVGO	*	Hold	$ 76.00	$ 70.67	$ 17,644	$ 1,126	$ 2	$ (1,124)	$ (4.50)	20x	10x	$4.36	$3.75	$ 4.33	$ 5.43	16x	13x	8x
BRCM	*	Buy	$ 37.00	$ 31.87	$ 18,644	$ 2,933	$ 1,395	$ (1,538)	$ (2.87)	11x	11x	$2.46	$ 2.82	$ 2.50	$ 2.67	13x	12x	5x
CAVM	**	Buy	$ 52.00	$ 48.98	$ 2,588	$ 124	$ 45	$ (79)	$ (1.49)	48x	33x	$1.49	$2.06	$ 1.41	$ 1.80	35x	27x	14x
EZCH	**	Hold	$ 29.00	$ 24.51	$ 713	$ 210	$ -	$ (210)	$ (7.22)	30x	31x	$1.44	$1.79	$ 1.41	$ 1.75	17x	14x	3x
IPHI	**	Buy	$ 17.00	$ 15.06	$ 472	$ 117	$ -	$ (117)	$ (3.74)	n.a.	n.a.	$0.43	$0.71	$ 0.40	$ 0.64	38x	24x	3x
PMCS	**	Hold	$ 7.50	$ 7.07	$ 1,378	$ 92	$ 5	$ (87)	$ (0.45)	18x	17x	$0.36	$0.45	$ 0.37	$ 0.46	19x	15x	8x
Memory:																		
CODE	**	Hold	$ 18.50	$ 19.05	$ 1,150	$ 289	$ 408	$ 119	$ 1.97	20x	11x	$1.40	$2.31	$ 1.25	$ 1.94	15x	10x	6x
MU	**	Buy	$ 32.00	$ 28.59	$ 30,602	$ 4,504	$ 6,638	$ 2,134	$ 1.99	16x	14x	$4.01	$5.18	$ 3.04	$ 3.21	9x	9x	3x
SNDK	**	Buy	$ 95.00	$ 96.63	$ 21,859	$ 2,810	$ 2,007	$ (803)	$ (3.55)	19x	17x	$6.26	$6.89	$ 6.10	$ 6.61	16x	15x	3x
005930-KR	**	Buy	₩1,800	$ 1,414	$ 185,204	$ 57,756	$ 11,724	$(46,032)	$ (313)	6x	10x	$ 208	$ 229	$ 193	$ 197	7x	7x	1x
RMBS	**	Hold	$ 13.00	$ 12.10	$ 1,376	$ 403	$ 319	$ (85)	$ (0.74)	17x	11x	$0.23	$0.56	$ 0.25	$ 0.42	48x	29x	11x
Semi Cap:																		
AMAT	**	Buy	$ 28.00	$ 20.19	$ 24,579	$ 2,599	$ 1,947	$ (652)	$ (0.54)	16x	14x	$1.14	$1.61	$ 1.11	$ 1.33	18x	15x	8x
LRCX	**	Buy	$ 75.00	$ 62.04	$ 10,059	$ 2,754	$ 1,512	$ (1,242)	$ (7.66)	16x	11x	$4.92	$5.72	$ 4.56	$ 5.04	14x	12x	4x
KLAC	**	Hold	$ 69.00	$ 65.52	$ 10,865	$ 3,027	$ 748	$ (2,279)	$ (13.74)	12x	12x	$4.00	$4.57	$ 4.01	$ 4.46	16x	15x	3x

*Covered by Mark Lipacis **Covered by Sundeep Bajikar

Source: Jefferies, company data

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Hold - Describes stocks that we expect to provide a total return (price appreciation plus yield) of plus 15% or minus 10% within a 12-month period.

Underperform - Describes stocks that we expect to provide a total negative return (price appreciation plus yield) of 10% or more within a 12-month period.

The expected total return (price appreciation plus yield) for Buy rated stocks with an average stock price consistently below $10 is 20% or more within a 12-month period as these companies are typically more volatile than the overall stock market. For Hold rated stocks with an average stock price consistently below $10, the expected total return (price appreciation plus yield) is plus or minus 20% within a 12-month period. For Underperform rated stocks with an average stock price consistently below $10, the expected total return (price appreciation plus yield) is minus 20% within a 12-month period.

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Risk which may impede the achievement of our Price Target

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Other Companies Mentioned in This Report

- Advanced Micro Devices, Inc. (AMD: $3.97, BUY)
- Altera Corp (ALTR: $33.11, HOLD)
- Analog Devices, Inc. (ADI: $52.37, BUY)
- Applied Materials, Inc. (AMAT: $20.52, BUY)
- Avago Technologies (AVGO: $71.64, HOLD)
- Broadcom Corporation (BRCM: $34.84, BUY)
- Cavium Inc. (CAVM: $48.41, BUY)
- EZchip Semiconductor Ltd. (EZCH: $24.57, HOLD)
- Inphi Corporation (IPHI: $14.93, BUY)
- Intel Corporation (INTC: $27.26, BUY)
- KLA-Tencor Corporation (KLAC: $65.58, HOLD)
- LAM Research Corporation (LRCX: $62.31, BUY)
- Lattice Semiconductor Corporation (LSCC: $7.77, BUY)
- Linear Technology (LLTC: $45.99, BUY)
- M/A-COM Technology Solutions Holdings, Inc. (MTSI: $18.63, BUY)
- Marvell Technology Group Ltd. (MRVL: $15.92, HOLD)
- Maxim Integrated Products, Inc. (MXIM: $34.20, BUY)
- Microchip Technology Inc. (MCHP: $47.25, BUY)
- Micron Technology, Inc. (MU: $28.66, BUY)
- NVIDIA Corporation (NVDA: $18.94, HOLD)
- NXP Semiconductors NV (NXPI: $62.40, BUY)
- ON Semiconductor Corporation (ONNN: $8.66, HOLD)
- PMC-Sierra, Inc. (PMCS: $7.01, HOLD)
- Rambus, Inc. (RMBS: $11.77, HOLD)
- Samsung Electronics Co. Ltd. (005930 KS: KRW1,470,000, BUY)
- SanDisk Corporation (SNDK: $97.15, BUY)
- Spansion, Inc. (CODE: $19.80, HOLD)
- Texas Instruments Incorporated (TXN: $46.99, BUY)
- Xilinx Corp (XLNX: $46.37, HOLD)

Distribution of Ratings

			IB Serv./Past 12 Mos.	
Rating	Count	Percent	Count	Percent
BUY	900	50.48%	241	26.78%
HOLD	740	41.50%	122	16.49%
UNDERPERFORM	143	8.02%	5	3.50%

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