

Global Memory Tech

Weekly theme: HBM3e shipment, hybrid bonding, China smartphone, dull spot

Industry Overview

Hynix's HBM3e shipment kick-off in either March or April

As it takes over four months to fabricate HBM3e from 12" silicon wafer input (in the fab) to TSV/TCB packaging, recent comments by memory chipmakers (Micron, Samsung Electronics; [see report](#)) on "production start (8-die stacked)" or "sampling (12-die)" will not warrant immediate delivery (HBM3e) to NVIDIA, we believe. That said, NVIDIA is still expected to launch its new GPUs (H200, GH200) using HBM3e instead of old HBM3 in 2Q24. As such, investors' question should be how NVIDIA can get meaningful volume of HBM3e. We believe the answer is SK Hynix, which can deliver large volume of HBM3e from March or April. This is consistent with our check for Hynix's HBM3e fabrication (wafer input already started in 4Q23 using 1b EUV node and TSV MR-MUF). Hynix's press release (March or April) is also likely to confirm mass supply of HBM3e, in our view. Hynix also targets cross-over through 2H24 (HBM3e sales to exceed HBM3's).

Hybrid bonding delay possible; TCB for HBM4 likely

[ASMT \(522 HK\)](#) said that 16 DRAM dies (for HBM4) can be stacked using currently available TCB. This is different vs consensus – HBM4 requires hybrid bonding (chip-to-chip without using bump). In fact, hybrid bonding offers market-share gain opportunity for Hynix's competitors given bonding materials (either film or MR-MUF) are no longer used. Hynix's MR-MUF is generally considered as superior vs film. Our check with other equipment vendors also addressed TCB with MR-MUF or film for HBM4, but the risk is the height of HBM4 can be just close to NVIDIA's allowed level for next-generation GPUs vs far below (lower height) using hybrid bonding. Net-net, we tentatively conclude the shift from TCB to hybrid bonding for HBM4 will be slower (2026-27E).

Weak Feb China smartphone, but spec upgrade on track

We have been hearing about weak sell-through of China smartphones (including Huawei phones) during Lunar New Year holidays (mid-Feb). This is completely different vs Jan upturn (total domestic shipments ~30mn units, up 10% MoM / +61% YoY, based on MIIT data). We also observe more meaningful memory content increase for Huawei's new flagship model P70 (March launch; high-end DRAM content likely 16GB vs a year ago 12GB for P60). Huawei's new Mate 70 (Aug-24) can also embed 24GB as max (16GB for Mate 60) if on-device AI functions are added. Samsung's GS24 seems to be well in demand (shipment growth 10%+ YoY likely due to on-device AI functions). Net-net, smartphone industry (China, Samsung) still offers upside to memory chip demand.

DRAM spot broadly dull this week, but March upside seen

We acknowledge the muted DRAM and NAND spot market sentiment with low trading volume and flattish price this week. China's weak retail tech demand (Feb) seems to have affected spot market demand. That said, we still expect spot price increase (5%+) in March given chipmakers' supply cut (low utilization for commodity DRAM and NAND) and per-box memory content increase (led by new PCs and smartphones).

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Refer to important disclosures on page 7 to 9.

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Exhibit 1: Spot-market prices

DRAM and NAND prices remained flat

US\$	Current	WoW	QoQ	YoY
DRAM spot				
16Gb DDR5	4.7	0%	12%	8%
16Gb DDR4	3.7	0%	15%	3%
8Gb DDR4	2.0	-1%	14%	10%
NAND spot				
512Gb wafer	3.4	0%	20%	101%
256Gb wafer	1.8	0%	23%	75%
LCD street				
65" LCD	166	1%	0%	51%
55" LCD	124	1%	0%	49%
14" LCD	27	0%	0%	1%

Source: DRAMeXchange, WitsView, BofA Global Research

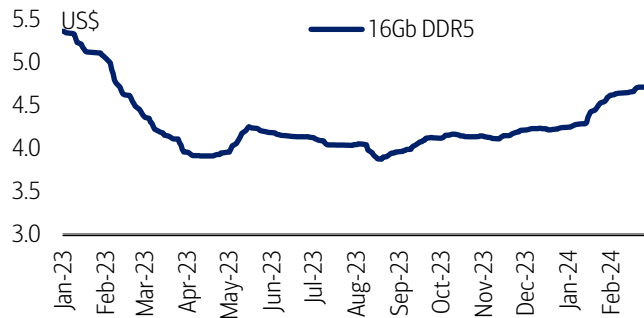
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DRAM: Dynamic random-access memory
DDR4/5: 4th/5th gen double-data rate DRAM
HBM: High bandwidth memory using DRAM
HBM3/3e/4: 4th/5th/6th gen HBM
GPU: Graphics processing unit
H200: Hopper 200
GH200: Grace hopper 200
TSV: Through-silicon via
TCB: Thermal compression bonding
MR-MUF: Mass reflow molded underfill
EUV: Extreme ultraviolet lithography
MIIT: Ministry of Industry & Inform Tech
NAND: Not-AND memory

Charts that we use for our Weekly

Exhibit 2: 16Gb DDR5 spot price - daily

Slightly muted after two consecutive weeks of recovery (after CNY holidays); recovery possible through Mar

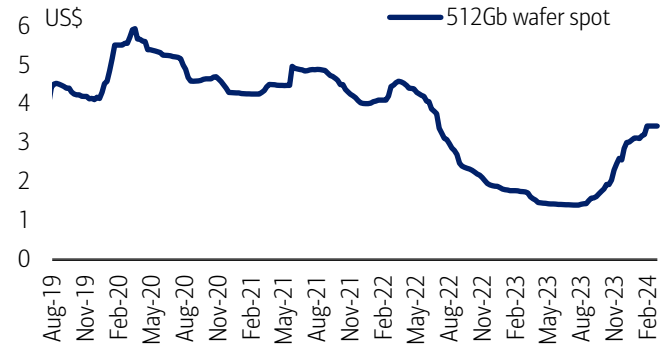


Source: DRAMeXchange, BofA Global Research

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Exhibit 3: 512Gb NAND wafer spot price - weekly

NAND remained mostly flat after Asia holidays vs strong Dec-Jan rally

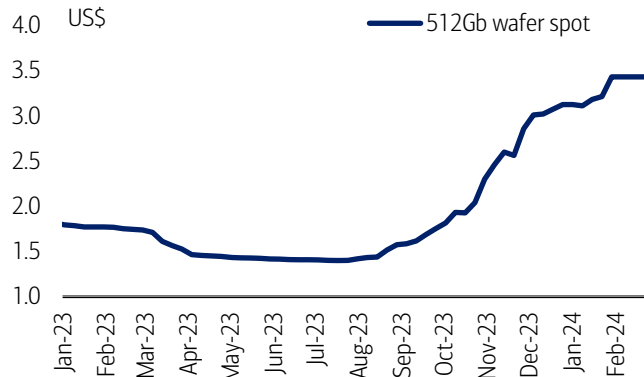


Source: DRAMeXchange, BofA Global Research

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Exhibit 4: NAND wafer spot from Jan 2023 to Feb 2024

Slightly muted in Feb after 2H23 rally

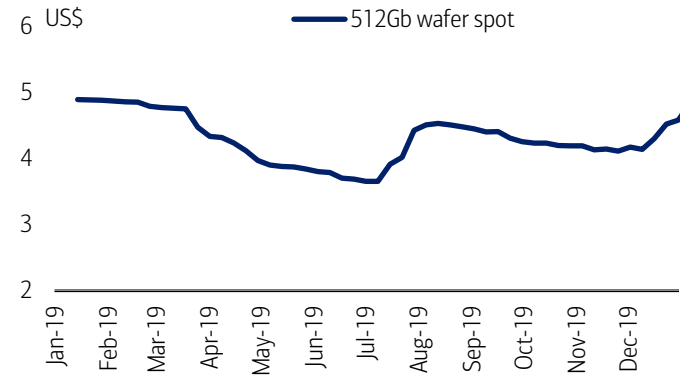


Source: DRAMeXchange, BofA Global Research

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Exhibit 5: NAND spot price comparison with 2019 turnaround period

2019 NAND spot rally was relatively limited versus 2H23/Jan upturn

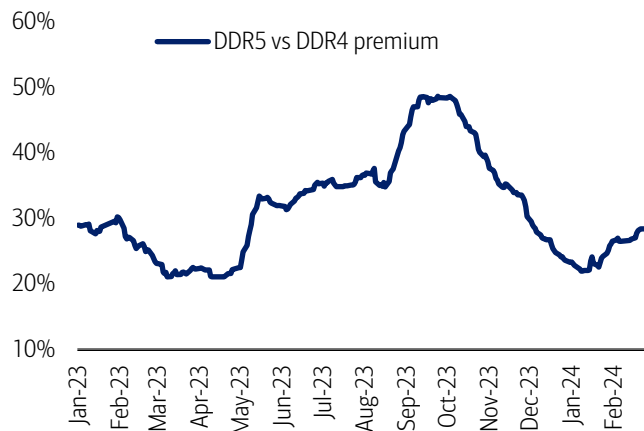


Source: DRAMeXchange, BofA Global Research

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Exhibit 6: DDR5 spot-price premium versus DDR4

Back to 30% price premium (vs DDR4) following DDR5 rebound

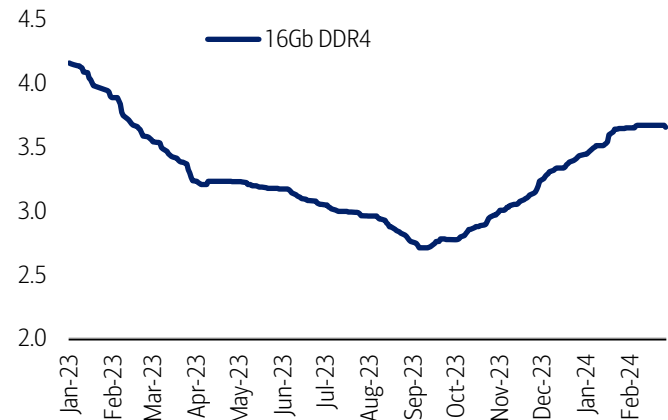


Source: DRAMeXchange, BofA Global Research

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Exhibit 7: 16Gb DDR4 spot price trend

Legacy DDR4 price rallied throughout Jan/Feb, mostly supply cut-driven; upside still seen due to low capex and utilization

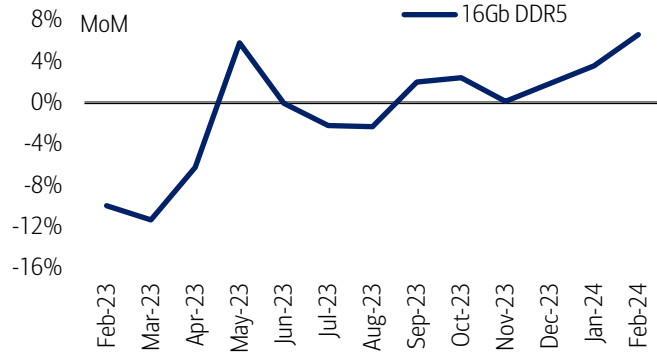


Source: DRAMeXchange, BofA Global Research

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Exhibit 8: 16Gb DDR5 spot month-average price – MoM change

Jan/Feb MoM change much better (+4-7% MoM) vs 2H23

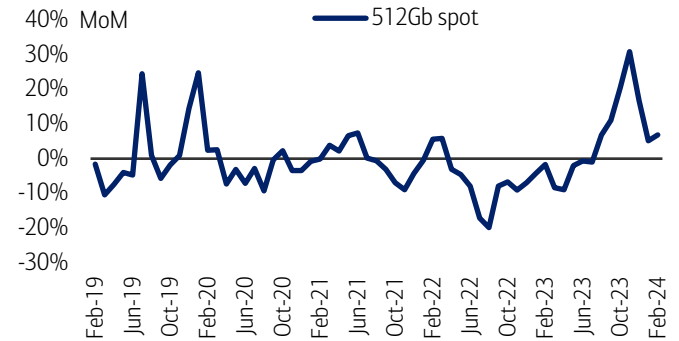


Source: DRAmEXchange, BofA Global Research

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Exhibit 9: 512Gb NAND wafer spot month-average – MoM change

Jan/Feb price shows just marginal increase MoM (+5-7%) following strong rebound (15-30% MoM) in Nov/Dec 2023

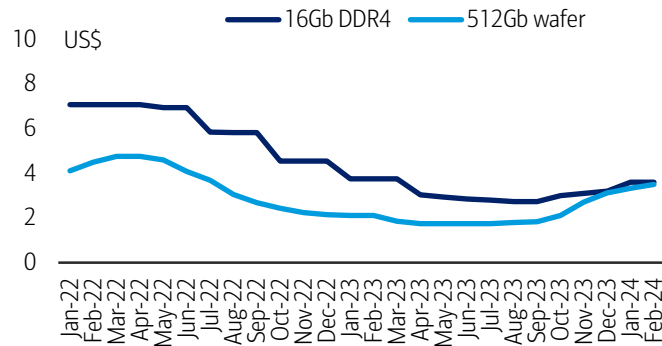


Source: DRAmEXchange, BofA Global Research

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Exhibit 10: Monthly contract price trend – DRAM (16Gb) and NAND (512Gb)

Rally continued for five consecutive months – Oct-23 – Feb-24 for NAND, while DRAM turned flat in Feb after recovering for four months (Oct-Jan)

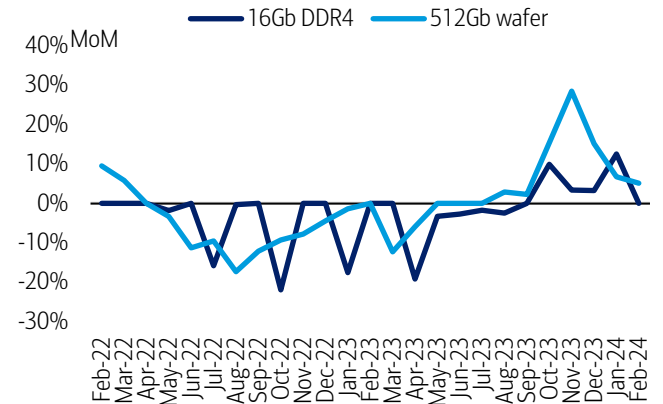


Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 11: MoM change of DRAM and NAND contract prices

NAND up +5% MoM, while DRAM turned flat; NAND is now up more than 65% YoY, while DRAM decline narrowed to -4% YoY

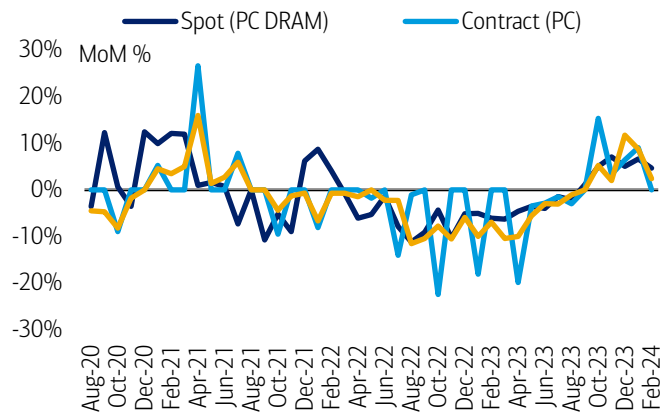


Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 12: DRAM month-average price MoM; spot vs contract

PC spot and server contract up +2-5% MoM, while PC contract turned flat



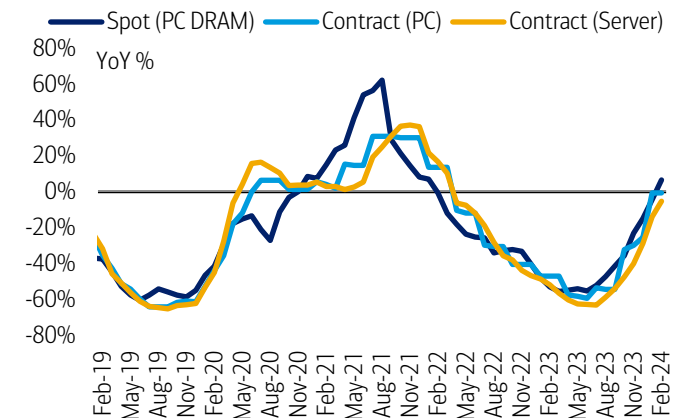
Jan-24 contract price updated on 28th Feb

Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 13: DRAM month-average price YoY; spot vs contract

YoY price turning positive vs Jun-23 bottom (down 60% YoY)



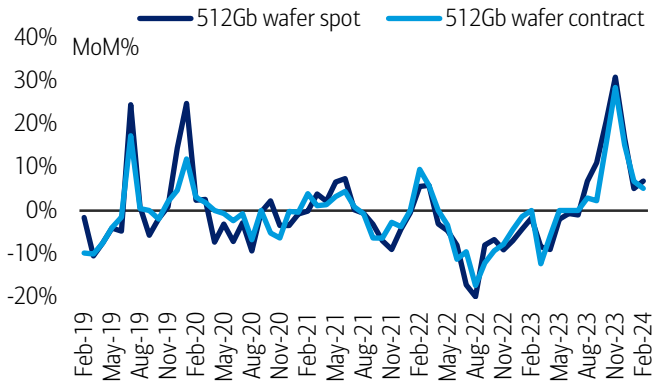
Jan-24 contract price updated on 28th Feb

Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 14: NAND month-average spot & contract price – MoM YoY

512Gb wafer spot and contract price further up +5-7% MoM in Jan/Feb even after Nov/Dec rally (15-30% MoM)

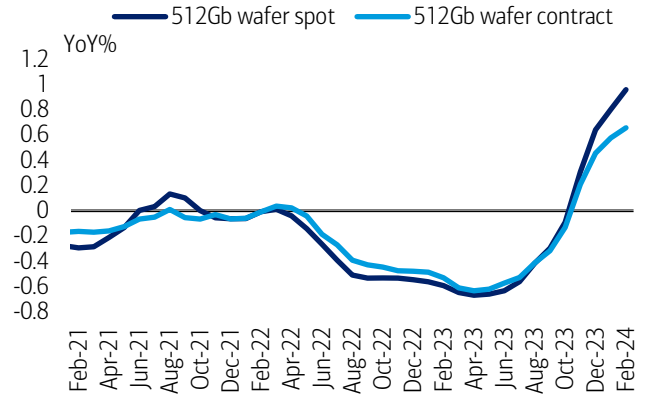


Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 15: NAND month-average spot & contract price - YoY change

Up 60%+ in Feb-24; strongest YoY turnaround in more than 3 years

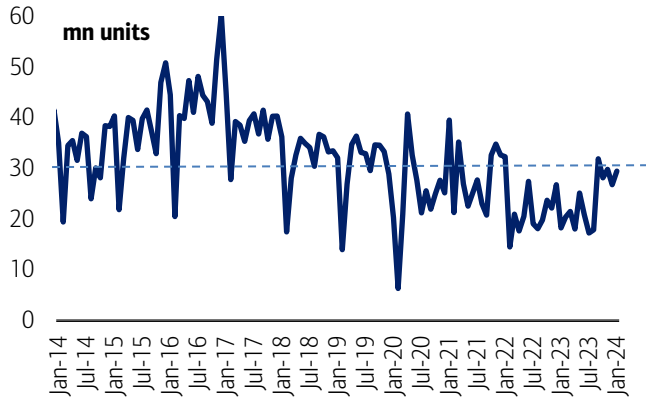


Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 16: China smartphone – monthly shipment

Jan-24 shipment (29.5mn units) near the historical average of 30mn units

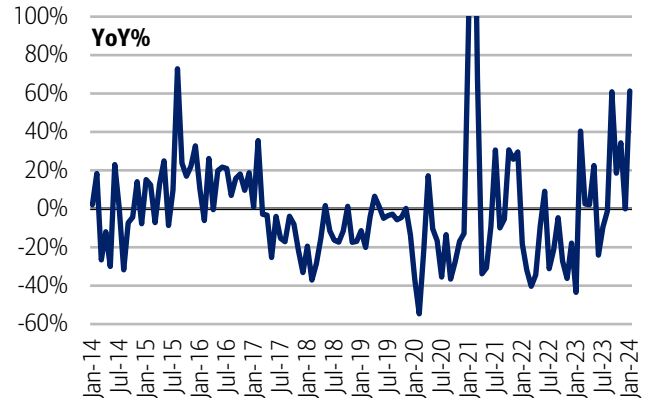


Source: MIIT/CAICT, BofA Global Research

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Exhibit 17: China smartphone – monthly shipment YoY

Robust YoY recovery seen in Jan-24 (+61.4%) due to Jan-23 low-base

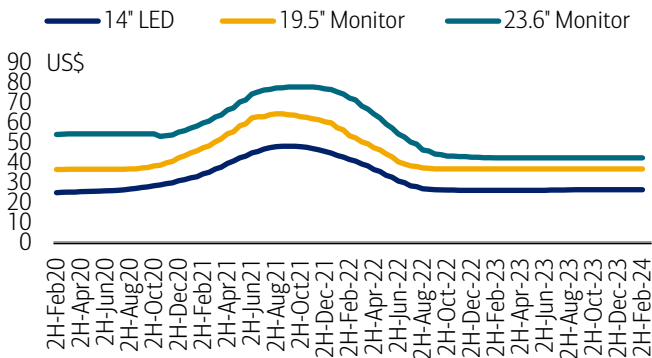


Source: MIIT/CAICT, BofA Global Research

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Exhibit 18: IT panel price trend – US\$/panel

IT panel prices remained flat; no recovery even as of Feb-24



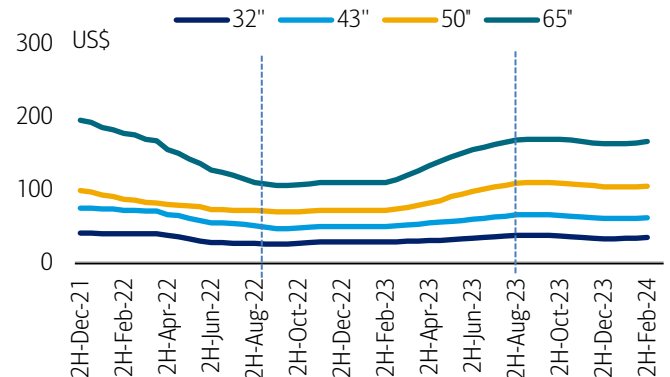
Panel price update from WitsView as of 20 Feb 2024

Source: WitsView, BofA Global Research

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Exhibit 19: TV panel price trend – US\$/panel

TV panel price slightly recovered in Feb vs Jan (flat) and Oct-Dec (slightly down)



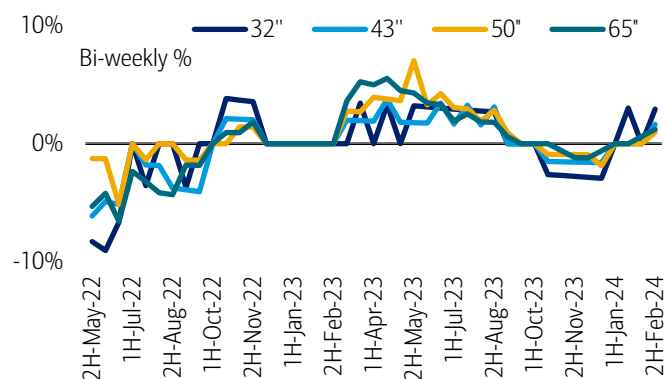
Panel price update from WitsView as of 20 Feb 2024

Source: WitsView, BofA Global Research

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Exhibit 20: LCD TV panel price trend (bi-weekly sequential)

Slightly recovered in 2H-Jan/Feb vs correction period (4Q23, Jan-24); previous price rebound period was Mar-Sept 2023

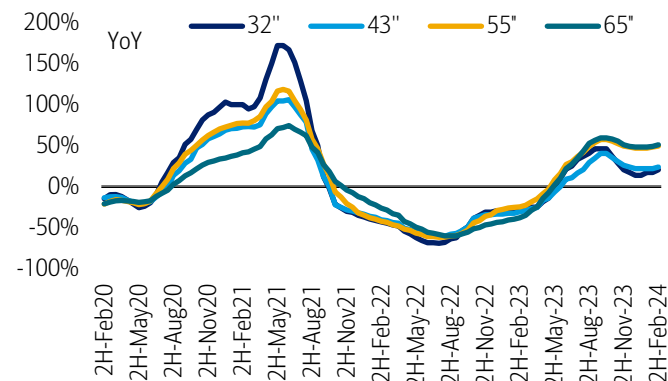


Source: WitsView, BofA Global Research

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Exhibit 21: LCD TV panel price trend (YoY)

Current prices still slightly higher than year ago but upside still low

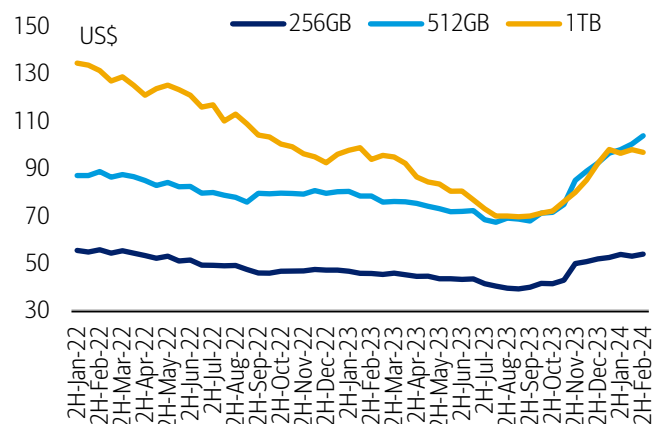


Source: WitsView, BofA Global Research

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Exhibit 22: Solid-state drive (SSD) price trend

SSD price recovery continued through 4Q23 and Jan-Feb

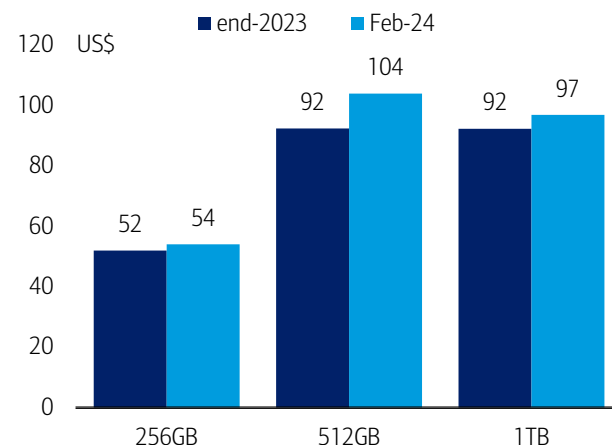


Source: DRAMeXchange, BofA Global Research

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Exhibit 23: SSD price comparison – current versus end-2023

SSD product price also shows gradual recovery YTD



Note: SSD prices are as of 28 Feb 2024, reported by DRAMeXchange

Source: DRAMeXchange, BofA Global Research

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Exhibit 24: Valuation comparison among memory stocks

SK Hynix resumed its rally; mostly HBM3e (for NVIDIA's new GPUs) driven – re-rating at 2x P/B possible

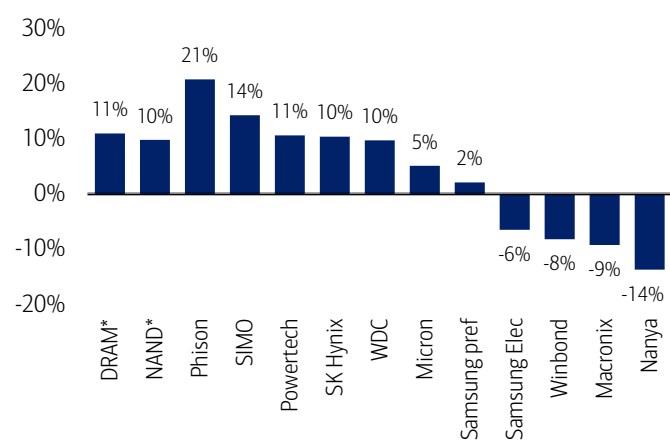
	Ticker	Rating	Price (Local)	Mcap (\$bn)	P/E			P/Book			EV/EBITDA		EV/Sales		ROE			Div. yield	
					FY23E	FY24E	FY25E	FY23E	FY24E	FY25E	FY23E	FY24E	FY23E	FY24E	FY23E	FY24E	FY25E	FY23E	FY24E
Samsung Elec	SSNLF	A-1-7	73,400	328.6	34.4	18.5	10.6	1.4	1.3	1.2	9.6	6.0	1.7	1.5	4.1%	7.4%	11.9%	2.0%	2.0%
Samsung Pref	SSNNF	A-1-7	63,600	39.2	29.8	16.0	9.2	1.2	1.1	1.0	9.6	6.0	1.7	1.5	4.1%	7.4%	11.9%	2.3%	2.3%
SK Hynix	HXSCF	B-1-8	156,200	85.3	NM	14.9	8.3	2.1	1.9	1.6	24.7	5.9	4.1	2.6	-15.6%	13.1%	20.0%	0.8%	0.8%
Micron	MU	B-1-7	89.71	99.0	NM	NM	15.1	2.2	2.2	1.9	36.5	18.6	6.9	4.7	-10.3%	-1.3%	14.1%	0.5%	0.5%
Nanya	NNYAF	B-1-9	67.30	6.6	NM	135.8	16.6	1.2	1.2	1.2	171.3	9.9	5.1	2.9	-4.3%	0.9%	7.2%	0.0%	0.0%
Winbond	WBEKF	B-1-8	27.95	3.7	NM	29.6	8.6	1.3	1.2	1.1	14.8	8.5	2.0	1.6	-1.2%	4.0%	12.6%	0.0%	1.1%
Macronix	MXICF	B-2-8	28.45	1.7	NM	NM	18.6	1.1	1.1	1.1	36.2	29.7	2.4	2.3	-3.4%	-3.8%	6.0%	0.0%	0.7%
Powertech	XPPZF	B-2-8	156.00	3.7	14.6	15.2	13.4	2.2	2.0	1.8	5.9	5.0	1.8	1.6	14.9%	13.2%	13.8%	4.5%	4.5%
Silicon Motion	SIMO	B-1-7	70.02	2.3	44.5	23.0	21.0	3.1	3.0	2.8	32.6	14.5	3.2	2.5	7.2%	13.6%	14.1%	0.7%	2.9%
Phison	PISNF	B-3-8	628.00	4.1	47.9	35.1	27.8	3.0	2.9	2.8	24.9	20.5	2.4	2.1	6.7%	8.6%	10.4%	1.4%	1.6%
Western Digital	WDC	C-1-9	57.46	18.7	NM	NM	8.4	1.6	1.7	1.4	105.5	21.7	2.0	2.0	-9.5%	-3.1%	18.8%	0.0%	0.0%

Source: Company reports, BofA Global Research estimates; Mcap = market capitalization, ROE = return on equity, Div = dividend.

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Exhibit 25: Share-price performance – 2024 YTD (current vs end-2023)

Hynix and NAND supply stocks outperformed Samsung Electronics common and preferred shares – mostly driven by HBM3e and NAND spot strength



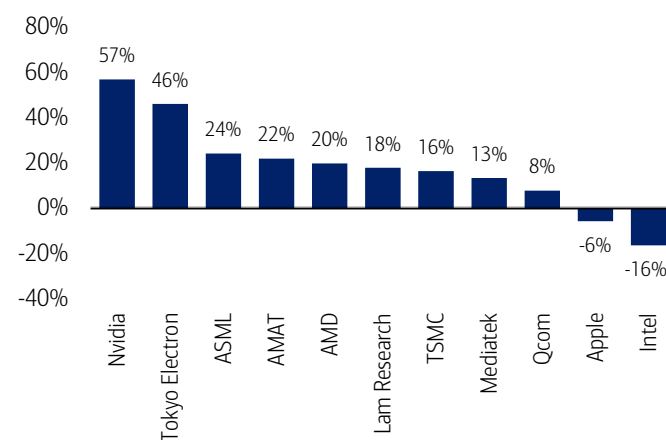
*DRAM: 16Gb DDR5; NAND: 512Gb wafer

Source: Bloomberg, DRAmExchange

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Exhibit 26: Share-price performance – 2024 YTD (current vs end-2023)

AI thematic/logic stock rally continued YTD



Source: Bloomberg, DRAmExchange

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Investment rating	Total return expectation (within 12-month period of date of initial rating)	Ratings dispersion guidelines for coverage cluster ^{R1}
Buy	≥ 10%	≤ 70%
Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

^{R1} Ratings dispersions may vary from time to time where BofA Global Research believes it better reflects the investment prospects of stocks in a Coverage Cluster.

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