

Global Memory Tech

Investor concern, GS24 upside, spot-price strength, Hynix guidance

Industry Overview

Double-dip frequently asked by Asian investors

We met investors in Singapore and HK to discuss the memory cycle this week (15-19 Jan). The most frequently asked question was potential double-dip. Investor concerns (about memory cycle) were utilization increase (driven by Samsung Electronics), muted chip price (no further increase from 2Q), peak in HBM demand/price and high P/B multiple. That said, our bullish thesis was well discussed: 1) significant capacity contraction due to HBM (larger chip size and longer manufacturing cycle time vs DDR4); 2) even 10%+ capacity contraction with DDR5 (vs DDR4); 3) 100%+ growth in 2024 HBM orders; 4) more diversified memory demand (LPDDR5, GDDR6) besides HBM to run AI GPU (see our [AI semis exert call takeaways](#)); 5) per box memory content increase (up 10-20% YoY); 6) disciplined supply (no significant production increase); 7) memory chip price hike even in 2Q and 2H; 8) 2025 memory upturn (sales up by 20%+ even after 50%+ in 2024; non-HBM growth also assumed); and 9) P/B rerating at 2x (2+ years long upcycle).

Samsung's GS24 looks better due to AI features

We are now more positive on Samsung Electronics' GS24 given well-demonstrated on-device AI functions for "Live Translate", "Circle to Search", "Provisual Engine", etc. Initial orders will likely be upbeat to expect low- to mid-30mn shipment units (30-31mn only for GS23/22; our current estimate 32mn) at US\$800 ASP and 15% OPM. We also see 15%+/- memory content increase with 12GB DRAM and 512GB/1TB-centric promotion (see page 2 for further details on GS24).

Notable spot price recovery seen including NAND

Memory chip spot-price firmly recovered this week, led by DDR5 (+3%) and even NAND (+4% on average). This is completely different vs bearish camp's expectations on spot-price correction after 2H23 rally, particularly for NAND. Since Korean memory chipmakers still retain low utilization (profit focus strategy), we believe spot price will rebound further (+5-10%) easily by Chinese New Year holiday (10 Feb).

Hynix's bullish guidance and positive implications of TSMC

SK Hynix will host its 4Q23 earnings call on 25 Jan. We expect good results, meeting/exceeding consensus based on HBM (which can make DRAM more profitable at 20%+ OP margin) and NAND (stronger ASP hike). Management guidance for 1Q and full-year of 2024 will also likely be bullish (ASP hike, strongly growing HBM/DDR5 orders, disciplined chip supply). TSMC's 2024 guidance should also imply strong growth in AI memory (HBM and even DDR5).

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Refer to important disclosures on page 9 to 11.

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Exhibit 1: Spot-market prices

DDR5, DDR4, NAND prices all recovered

US\$	Current	WoW	QoQ	YoY
DRAM spot				
16Gb DDR5	4.4	3%	7%	-14%
16Gb DDR4	3.6	2%	24%	-11%
8Gb DDR4	1.9	3%	21%	0%
NAND spot				
512Gb wafer	3.2	2%	65%	80%
256Gb wafer	1.7	6%	47%	60%
LCD street				
65" LCD	163	0%	-4%	48%
55" LCD	122	0%	-3%	47%
14" LCD	27	0%	0%	1%

Source: DRAMeXchange, WitsView, BofA Global Research

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AI: Artificial intelligence

ASP: Average selling price

DRAM: Dynamic random-access memory

DDR4/5: 4th/5th gen of double-data rate DRAM

LPDDR5: Low-power DDR5

GDDR6: 6th gen graphics double-data rate DRAM

HBM: High memory bandwidth

GPU: Graphics processing unit

NAND: Not-AND memory

SSD: Solid state drive

More details on Samsung's Galaxy S24

Samsung's "Galaxy AI" powered by its internally developed LLM 'Gauss platform' available in its new smartphone Galaxy S24 is clearly one of the biggest differentiators compared to its predecessor (GS23). The latest smartphone is focused on enhancing user productivity by providing a number of on-device AI features that enables lower latency and increased privacy, including "Live Translate", "Circle to Search", "Provisual Engine", etc.

AI feature #1: "Live translate" and "Interpreter"

Simply put, users essentially have their own personal interpreters on their calls/texts. "Live translate" provides real-time voice/text translations of phone calls in 13 languages, including English, Korean, Spanish, French, etc. It eliminates the need to download third-party apps and on-device AI ensures privacy given the data is handled from the device itself without going through the cloud server. Further, "Interpreter" allows live conversations to be instantly translated on a split-screen view without internet access.

AI feature #2: "Circle to Search"

Through collaboration with Google, Samsung has developed a convenient method to make visual searches extremely simple. With a long press on the home button, users can circle, highlight or tap anything on the phone screen to see relevant, high-quality search results. For eg, users can circle pancakes in a photo and Google will instantly suggest recommendations for brunch restaurants nearby.

AI feature #3: "Provisual Engine"

The new "Provisual Engine" is a comprehensive suite of AI-powered tools that elevates Galaxy S24's photography capabilities such as enhanced zoom qualities, convenient photoshop skills, night photography, etc. Galaxy AI editing tools run by generative AI including "Edit Suggestion" (automatically recommends minor edits that could be made to make the photo look better) and "Generative Edit" (fills in parts of an image background) are available on the new GS24.

Samsung, the first mover in on-device AI smartphone

Similar to Google's LLM 'Gemini', Samsung has developed its own generative AI machine learning platform 'Gauss'. Although China smartphone OEMs have developed their own LLMs (OPPO's AndesGPT and Huawei's Pangu), we note that Samsung has been the first mover in incorporating generative AI capabilities in smartphones with much more diverse generative AI functions that can perform tasks from the device itself, rather than sending data to cloud servers.

Expect 3-year high GS24 shipments at 32mn+

We assume 3-year high annual shipment of SEC's new flagship smartphone GS24 at 32mn+ units in 2024 (vs 31mn units in 2023) with US\$800 ASP and mid-teen% OPM. This should lead to 5-10% revenue growth vs GS23 due to higher volume (+7%) and better mix (Ultra 45%+ of total shipments possible). Overall, we expect total sales/OP of GS24 to reach US\$26bn (W33tn at W1,300 USD/KRW) / US\$4bn (W5tn). This accounts for nearly 40%/45% of company-wide total smartphone sales/OP (2024E).

Exhibit 2: Samsung Electronics (SEC) –GS24 spec comparison vs GS23

Higher DRAM and NAND content seen, as well as new on-device AI functions including “Live Translate” and “Circle to Search” appear interesting

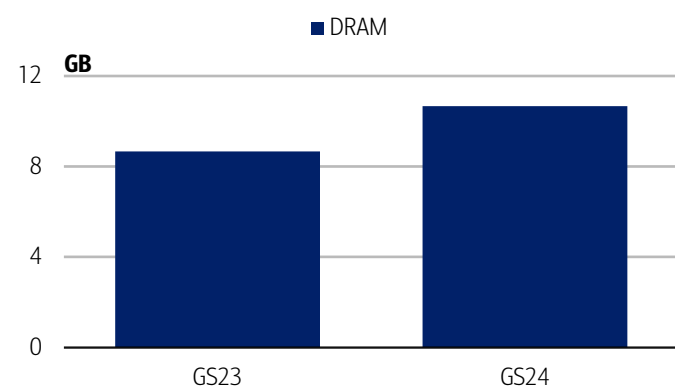
	Galaxy S24 Ultra	Galaxy S24 Plus	Galaxy S24	Galaxy S23 Ultra	Galaxy S23 Plus	Galaxy S23
Launch date	Jan-24	Jan-24	Jan-24	Feb-23	Feb-23	Feb-23
Display	6.8" Dynamic AMOLED	6.7" Dynamic AMOLED	6.2" Dynamic AMOLED	6.8" Dynamic AMOLED (3.1k x 1.4k)	6.6" Dynamic AMOLED (2.3k x 1.1k)	6.1" Dynamic AMOLED (2.3k x 1.1k)
AP	Snapdragon 8 Gen 3	Exynos 2400	Exynos 2400	Snapdragon 8 Gen 2	Snapdragon 8 Gen 2	Snapdragon 8 Gen 2
DRAM	12GB LPDDR5X	12GB LPDDR5X	8GB LPDDR5X	8GB/12GB LPDDR5X	8GB LPDDR5X	8GB LPDDR5X
NAND	256GB/512GB/1TB	256GB/512GB	128GB/256/512GB	256GB/512GB/1TB	256GB/512GB	128GB/256GB
Front cam	12MP	12MP	12MP	12MP	12MP	12MP
Rear cam	Quad (200/12/10/50MP)	Triple (50/12/10MP)	Triple (50/12/10MP)	Quad (200/12/10/10MP)	Triple (50/12/10MP)	Triple (50/12/10MP)
Battery	5,000mAh	4,900mAh	4,000mAh	5,000mAh	4,700mAh	3,900mAh
Price	\$1,379	\$1,079	\$949	\$1,379	\$1,119	\$859

Source: Company, BofA Global Research

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Exhibit 3: SEC – DRAM content comparison b/w GS24 vs GS23

~20% increase in DRAM content seen on a weighted average basis

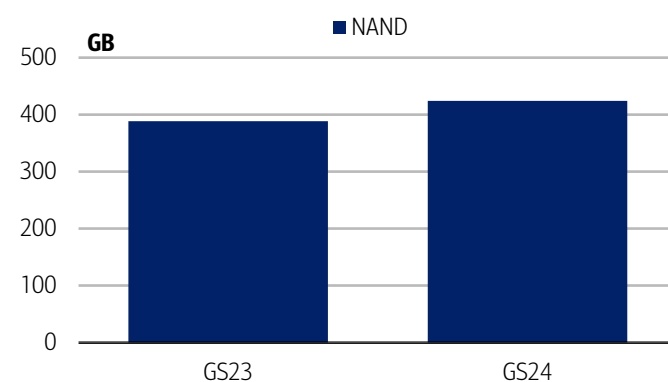


Source: Company, BofA Global Research

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Exhibit 4: SEC – NAND content comparison b/w GS24 vs GS23

Also, ~10% higher NAND content on a weighted average basis



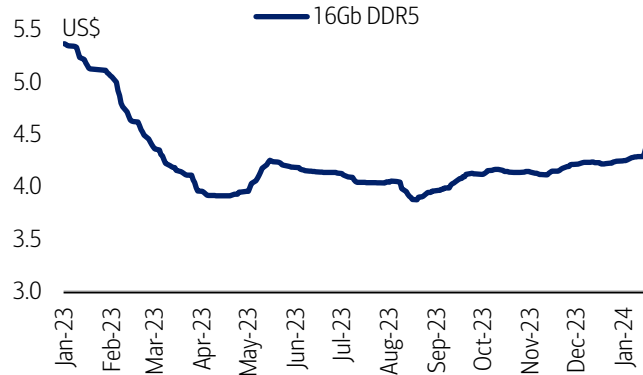
Source: Company, BofA Global Research

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Charts that we use for our Weekly

Exhibit 5: 16Gb DDR5 spot price - daily

Recovered well this week (15-19 Jan); further upside expected in 2H-Jan

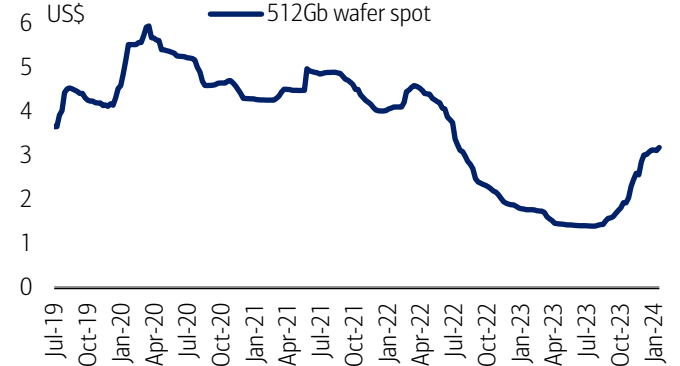


Source: DRAmEXchange, BofA Global Research

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Exhibit 6: 512Gb NAND wafer spot price - weekly

NAND also recovered this week after flattish 1H-Jan

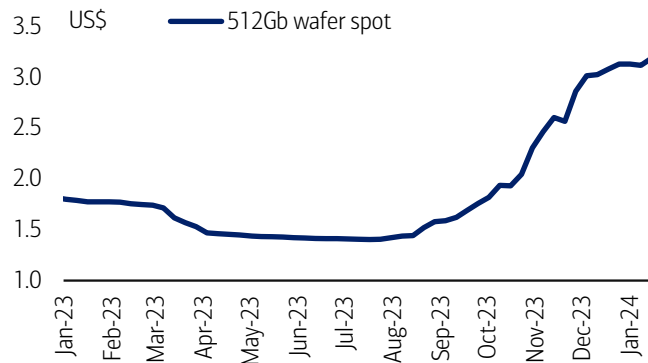


Source: DRAmEXchange, BofA Global Research

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Exhibit 7: NAND wafer spot from Jan 2023 to Jan 2024

Much stronger rally seen vs 2019 upturn

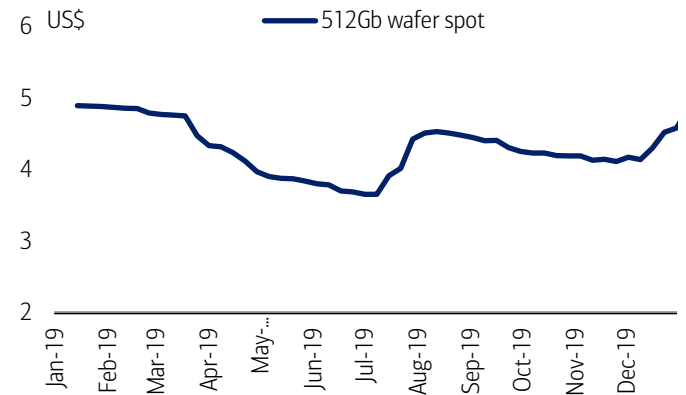


Source: DRAmEXchange, BofA Global Research

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Exhibit 8: NAND spot price comparison with 2019 turnaround period

2019 NAND spot rally was relatively limited vs 2H23 upturn

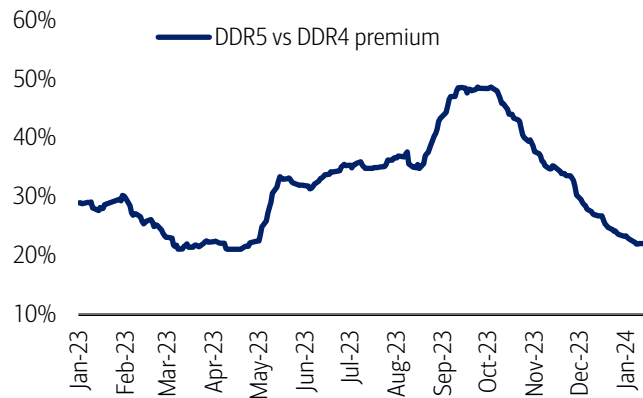


Source: DRAmEXchange, BofA Global Research

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Exhibit 9: DDR5 spot-price premium versus DDR4

DDR5 price premium (vs DDR4) erosion notable as of Jan-24 after Oct-23 peak, but slightly recovered this week following DDR5 recovery

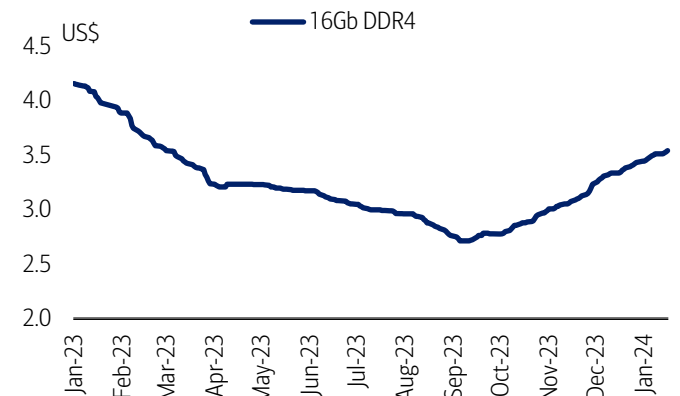


Source: DRAmEXchange, BofA Global Research

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Exhibit 10: 16Gb DDR4 spot price trend

Legacy DDR4 price rally continued into mid Jan; mostly supply cut-driven

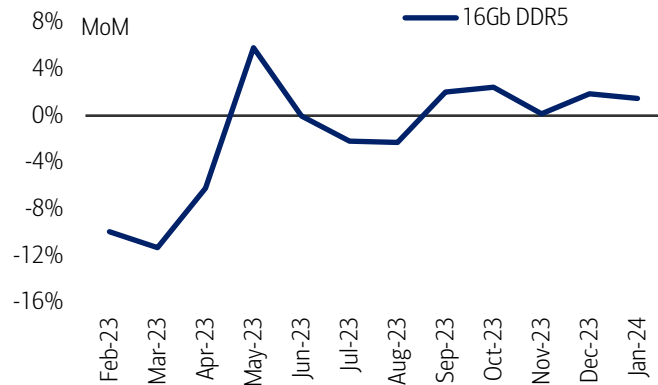


Source: DRAmEXchange, BofA Global Research

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Exhibit 11: 16Gb DDR5 spot month-average price – MoM change

Dec/Jan MoM change turned positive (+1-2%) vs flat Nov

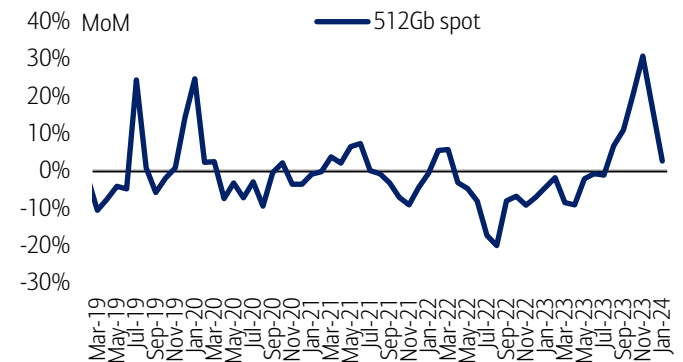


Source: DRAmEXchange, BofA Global Research

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Exhibit 12: 512Gb NAND wafer spot month-average – MoM change

Jan price shows just marginal increase MoM following strong rebound (15-30% MoM) in Nov/Dec-23

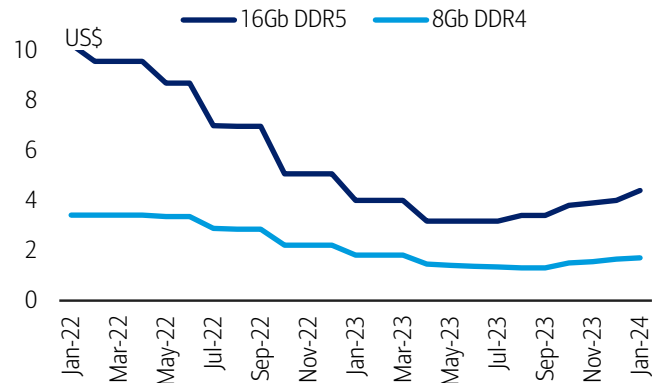


Source: DRAmEXchange, BofA Global Research

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Exhibit 13: DRAM contract price trend – 16Gb DDR5 and 8Gb DDR4

TrendForce expects DRAM contract price recovery to continue into Jan-24



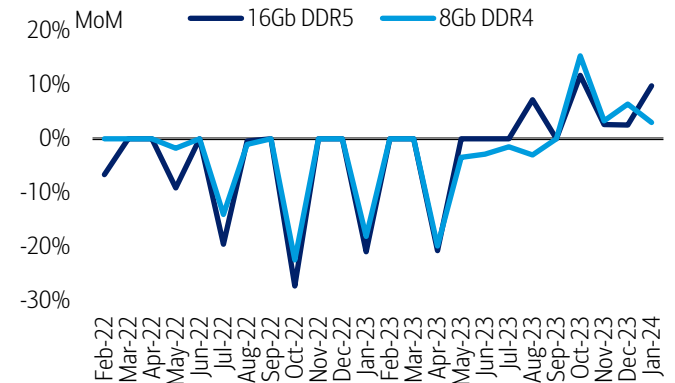
Jan-24 data is based on TrendForce's estimate

Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 14: DRAM contract price trend – MoM change

DDR5 price expected to rise +10% MoM vs DDR4 up +3% in Jan-24



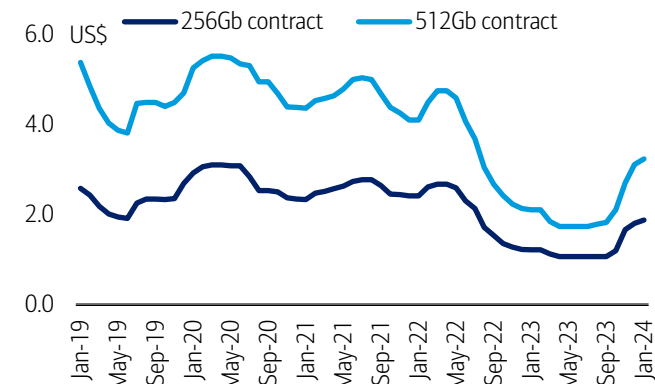
Jan-24 data is based on TrendForce's estimate

Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 15: NAND wafer contract price trend – 256/512Gb wafer

NAND contract price recovery too to continue in Jan, according to TrendForce



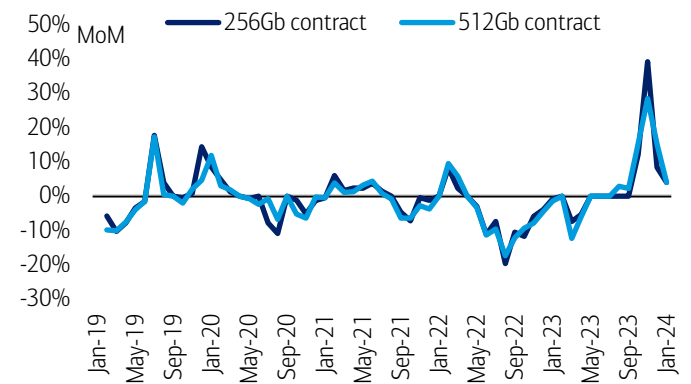
Jan-24 data is based on TrendForce's estimate

Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 16: NAND wafer contract price trend – MoM change

But Jan price recovery lower (+4% MoM) vs Oct-Dec (+15-30% MoM)



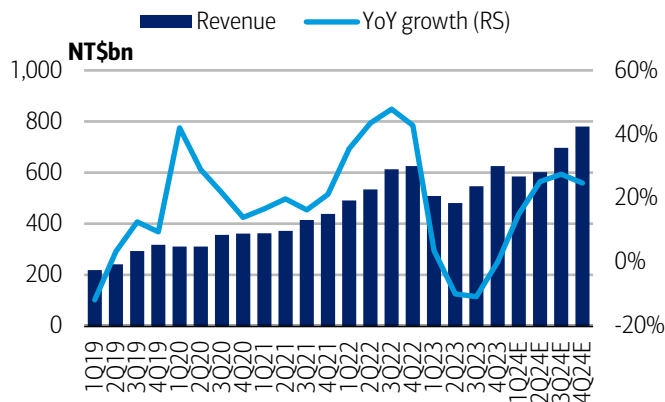
Jan-24 data is based on TrendForce's estimate

Source: TrendForce, DRAmEXchange, BofA Global Research

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Exhibit 17: TSMC – Revenue and YoY growth trend

TSMC expects its revenue to grow in the low-to-mid 20% YoY in 2024 on the back of robust AI related demand

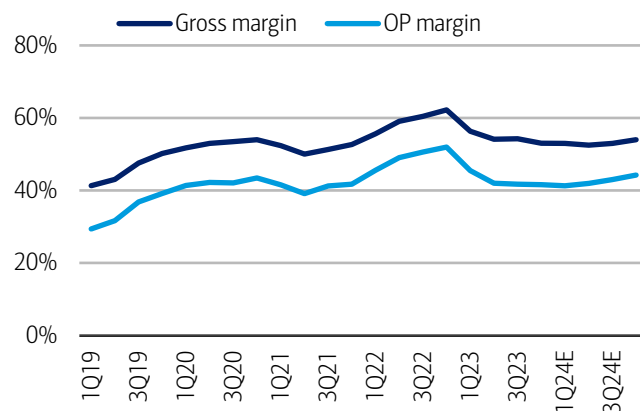


Source: Company, BofA Global Research estimates

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Exhibit 18: TSMC – Gross margin and OP margin trend

Stable GM (53%) and OP margin (41%) trend likely to continue

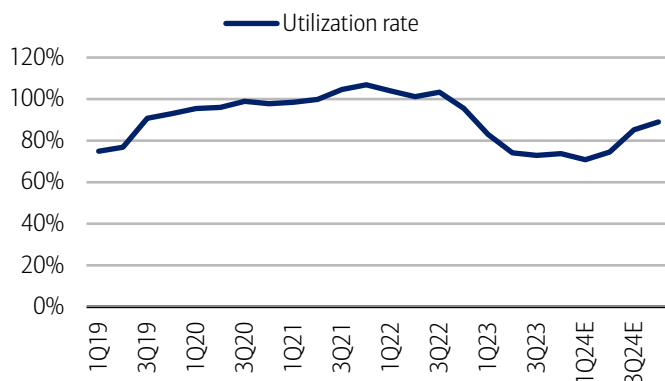


Source: Company, BofA Global Research estimates

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Exhibit 19: TSMC – Utilization rate trend

TSMC expects utilization rate to pick up in 2024 following severe cut in 2023

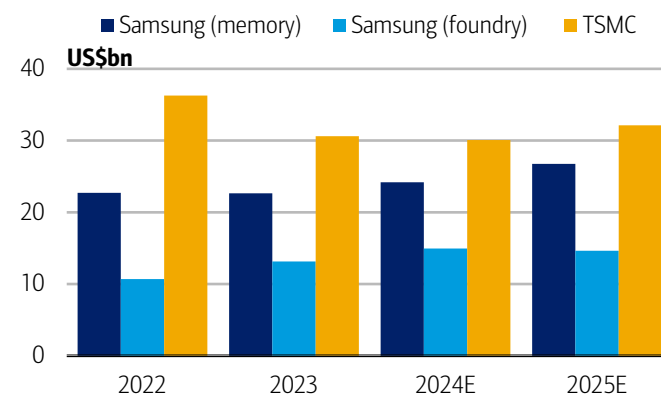


Source: Company, BofA Global Research estimates

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Exhibit 20: Capex trend – Samsung (memory & foundry) vs TSMC

TSMC's 2024 capex guidance is in the range of US\$28-32bn

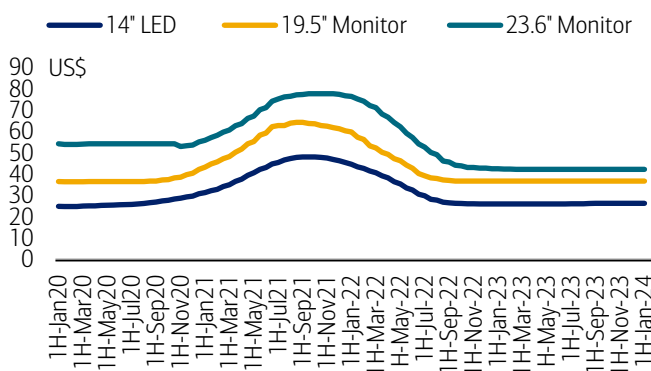


Source: Company, BofA Global Research estimates

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Exhibit 21: IT panel price trend – US\$/panel

IT panel prices remained flat; no recovery even as of Nov/Dec 23 (high season)



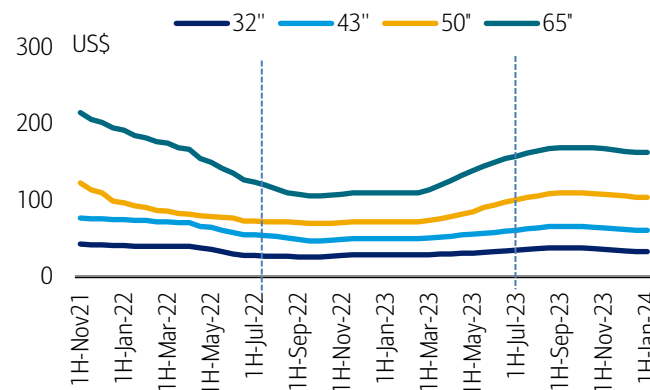
Panel price update from WitsView as of 5 Jan 2023

Source: WitsView, BofA Global Research

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Exhibit 22: TV panel price trend – US\$/panel

TV panel price remained flat as of early Jan after Oct-Dec corrections



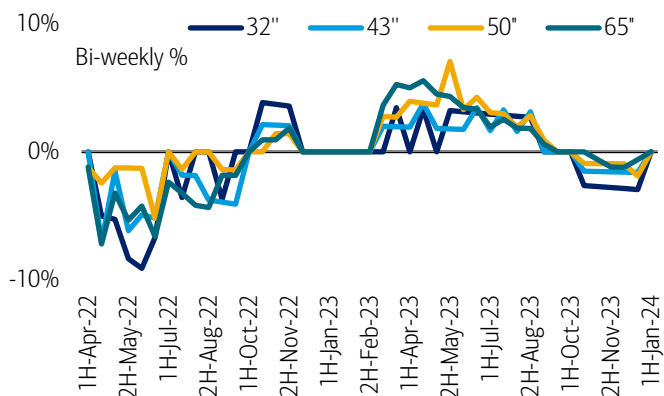
Panel price update from WitsView as of 5 Jan 2023

Source: WitsView, BofA Global Research

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Exhibit 23: LCD TV panel price trend (bi-weekly sequential)

Broadly weak (Oct-Dec and 1H-Jan) vs Mar-Sept 2023 recovery period

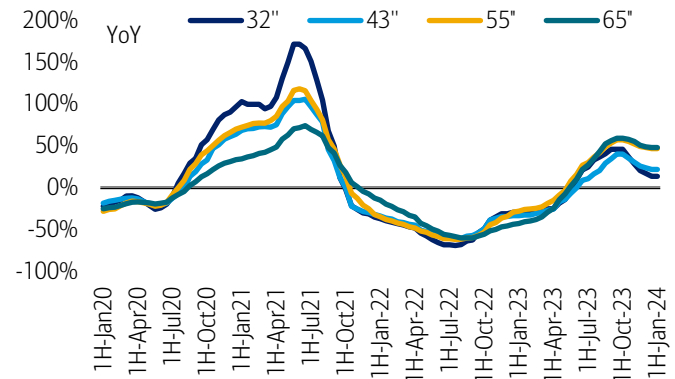


Source: WitsView, BofA Global Research

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Exhibit 24: LCD TV panel price trend (YoY)

Current prices still slightly higher than year ago but muted trend seen

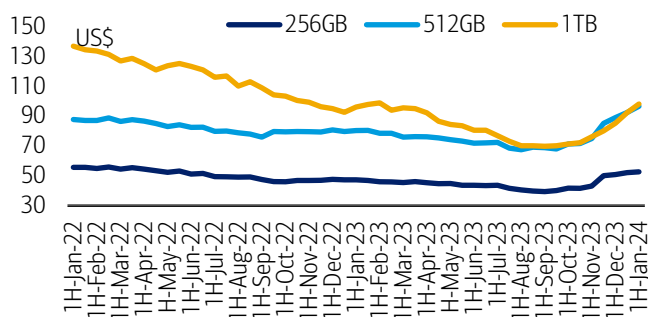


Source: WitsView, BofA Global Research

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Exhibit 25: Solid-state drive (SSD) price trend

SSD prices strongly recovered in Oct-Dec and even 1H-Jan, due to NAND spot strength

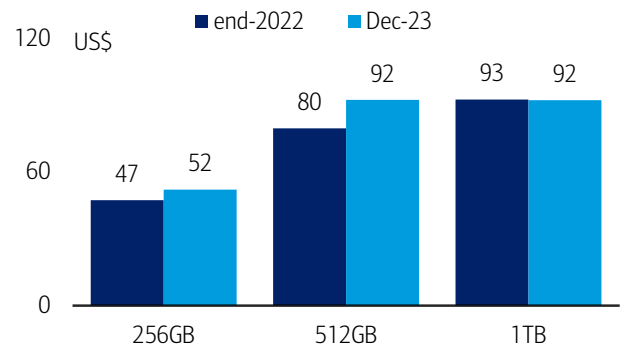


Source: DRAMeXchange, BofA Global Research

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Exhibit 26: SSD price comparison – current versus end-2022

Dec 2023 prices of 256/512GB SSD exceeded a year ago level, and 1TB price also recovered to near end-2022 level



Source: DRAMeXchange, BofA Global Research

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Exhibit 27: Valuation comparison among memory stocks

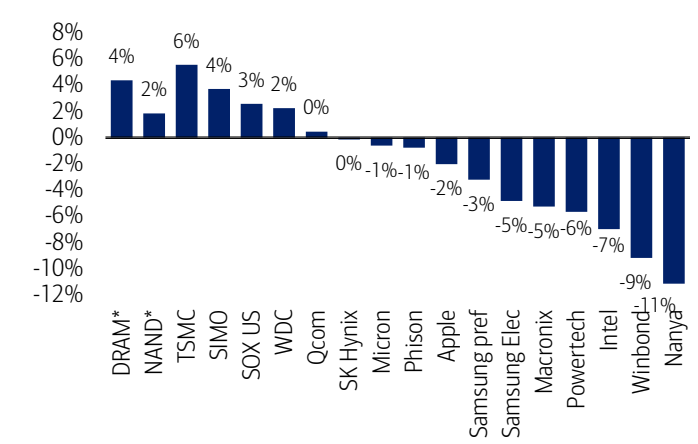
Samsung Electronics relatively outperformed vs pure memory stocks due to valuation (relatively low P/B) and potential market share gain (HBM3)

	Ticker	Rating	Price (Local)	Mcap (\$bn)	P/E FY23E	P/E FY24E	P/E FY25E	P/Book FY23E	P/Book FY24E	P/Book FY25E	EV/EBITDA FY23E	EV/EBITDA FY24E	EV/Sales FY23E	EV/Sales FY24E	ROE FY23E	ROE FY24E	ROE FY25E	Div. yield FY23E	Div. yield FY24E
Samsung	SSNLF	A-1-7	74,700	332.9	44.8	18.8	10.8	1.4	1.4	1.2	9.9	6.2	1.7	1.5	3.2%	7.4%	12.0%	1.9%	1.9%
Samsung Pref	SSNNF	A-1-7	60,300	37.0	36.2	15.2	8.7	1.2	1.1	1.0	9.9	6.2	1.7	1.5	3.2%	7.4%	12.0%	2.4%	2.4%
SK Hynix	HXSCF	B-1-8	141,300	76.8	NM	19.6	8.4	1.9	1.8	1.5	24.4	6.1	4.2	2.9	-14.2%	9.1%	18.5%	0.8%	0.8%
Micron	MU	B-1-7	84.82	93.6	NM	NM	14.3	2.1	2.1	1.8	34.6	17.6	6.5	4.5	-10.3%	-1.3%	14.1%	0.5%	0.5%
Nanya	NNYAF	B-1-9	69.30	6.8	NM	139.9	17.1	1.3	1.3	1.2	178.3	10.3	5.3	3.0	-4.3%	0.9%	7.2%	0.0%	0.0%
Winbond	WBEKF	B-1-8	27.65	3.7	134.2	13.0	8.0	1.2	1.1	1.0	12.1	6.1	1.8	1.4	0.9%	9.0%	13.4%	0.0%	2.5%
Macronix	MXICF	B-2-8	29.70	1.7	NM	144.5	15.7	1.1	1.1	1.1	26.2	14.2	2.3	2.1	-2.1%	0.8%	7.0%	0.0%	0.7%
Powertech	XPPZF	B-2-8	133.00	3.2	12.2	13.6	12.1	1.8	1.7	1.6	5.5	4.6	1.7	1.5	15.2%	12.9%	13.5%	5.3%	5.3%
Silicon Motion	SIMO	B-1-9	63.55	2.1	43.2	19.4	18.6	2.7	2.6	2.4	27.6	11.9	2.9	2.2	6.5%	13.7%	13.6%	0.8%	3.1%
Phison	PISNF	B-3-8	516.00	3.3	39.3	28.8	22.8	2.5	2.4	2.3	20.1	16.5	2.0	1.7	6.7%	8.6%	10.4%	1.7%	1.9%
Western Digital	WDC	C-1-9	53.55	17.4	NM	NM	9.3	1.5	1.6	1.4	99.5	25.4	1.9	1.9	-9.5%	-5.2%	16.5%	0.0%	0.0%

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

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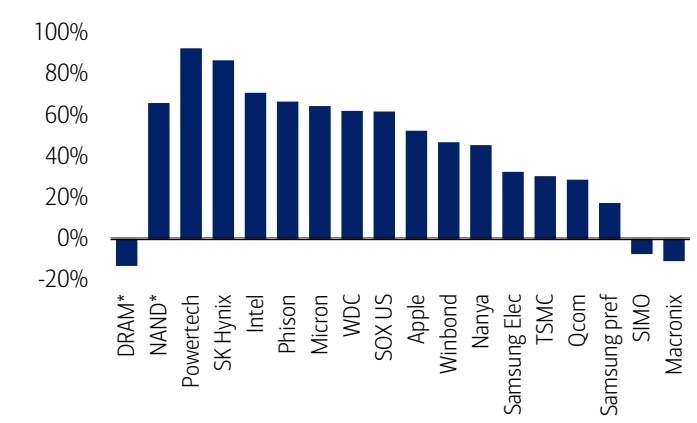
Exhibit 28: Share-price performance – 2024 YTD (current vs end-2023)
Memory stocks corrected in early Jan; different vs a year ago rally



*DRAM: 16Gb DDR5; NAND: 512Gb wafer
Source: Bloomberg, DRAmExchange

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Exhibit 29: 2023 Share-price performance
SK Hynix had been one of the best performing memory stocks due to HBM



*DRAM: 8Gb DDR4; NAND: 512Gb wafer
Source: Bloomberg, DRAmExchange

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Disclosures

Important Disclosures

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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%

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