



## Memory sector

### Spot price upcycle has begun

#### Overweight • Maintained

##### Key message

Since August, spot prices of DDR4 8Gb and 512 Gb TLC NAND flash wafers have risen a respective 4% and 21% to US\$1.50 and US\$1.69, marking the start of an upcycle due to tightening supply and demand dynamics which are the result of deep production cuts by leading manufacturers. We are upbeat on the earnings outlooks for memory makers as rising spot prices will likely boost contract prices, especially for module makers that will benefit from inventory reductions in 4Q23 due to rising spot prices.

##### Event

Since August, spot prices of DDR4 8Gb and 512 Gb TLC NAND flash wafers have risen a respective 4% and 21% to US\$1.50 and US\$1.69, marking the start of an upcycle due to tightening supply and demand dynamics which are the result of deep production cuts by leading manufacturers. We believe rising DRAM and NAND flash spot prices will boost contract prices from 4Q23.

##### Impact

**Tighter spot goods supply.** The majority of memory manufacturers have been limiting spot goods supply to module makers since the beginning of September. Measures include: (a) raising DRAM and NAND flash quotes to a respective US\$1.65 and US\$2.0, up a hefty 15% and 43% from troughs of US\$1.45 and US\$1.40 in August; (b) reducing supply to potential buyers whose inquiries are below quotes; and (c) demanding eTT and rebal (low-price specs) buyers purchase original specs simultaneously. Factors tightening the spot market are: (1) following Samsung's (KR) 4Q23F expansion of production cuts for NAND flash and DRAM, SK Hynix (KR), Kioxia (JP), and Micron (US) will increase their output cuts for NAND flash from a respective 25%, 23%, and 27% in 3Q23 to 30%, 27%, and 35% in 4Q23F; (2) as memory makers cap supply, module makers that just started NAND flash restocking in late August will only be able to boost inventory to around 13 weeks, a far cry from the goal of 15-18 weeks, leaving room for a catch-up price rally in 4Q23F; (3) some memory makers have unpackaged products in inventory, and will thus be unlikely to supply the downstream segment in a timely manner; and (4) module OEM capacity shortages during the peak production season for consumer electronics are restraining branded module shipments.

**Rising spot prices to boost contract prices.** In late September, spot prices of DDR4 and NAND flash wafers had respective premiums of 13% and discounts of 10% over contract prices. Since spot prices will be a key reference for memory makers in 4Q23F contract price negotiations, we believe rising spot prices will boost contract prices QoQ from 4Q23. Cash costs of leading DRAM and NAND flash makers are a respective US\$0.9 and US\$1.8, and their production costs are around US\$1.3 and US\$3.2. We forecast contract prices will rise to just US\$2.2 and US\$3.0 in 4Q24, and production cuts will extend into 3Q24 and 4Q24.

**Revise down 2024F capex.** Leading manufacturers have been lowering 2024 capex estimates significantly since September, with total DRAM capex reversing from 19% YoY growth to a 3% YoY decline, except 4% YoY growth at SK Hynix. Meanwhile, total NAND flash capex has reversed from 19% YoY growth to a 16% YoY decline, implying that manufacturers can expand bit supply by simply easing output cuts. Besides leading manufacturers, Yangtze Memory (CN) will likely keep capex flattish YoY in 2024 after a YoY cut of 76% in 2023. This is the result of the company's shift in focus to improve product yield for 128- and 176-layer nodes, while reducing investment in 96-layer and lower nodes.

##### Stocks for Action

We are upbeat on the earnings outlooks for memory makers as rising spot prices will likely boost contract prices, especially for module makers that will benefit from inventory reductions in 4Q23 due to rising spot prices.

##### Risks

Slower-than-expected production node migration; weakening market demand.

Figure 1: Comparison – Stock valuations

Ticker	Company	Revenue contribution of related products(%)	Market cap (US\$m)	Price (NT\$)	Rating	Target price (NT\$)	Upside/downside(%)	EPS (NT\$)		
								2022	2023F	2024F
2408 TT	Nanya Technology	DRAM(100)	6,301	65.60	OP	85	30	4.72	(1.75)	2.81
2344 TT	Winbond	DRAM(29), NAND Flash(6)	3,122	25.30	NR	N.A.	N.A.	3.25	0.18	2.04
3260 TT	ADATA	DRAM module(45), SSD module(36)	769	84.50	NR	N.A.	N.A.	3.12	2.72	4.09
8299 TT	Phison	SSD module(80), controller IC(17)	2,847	456.00	NR	N.A.	N.A.	27.71	12.33	26.85

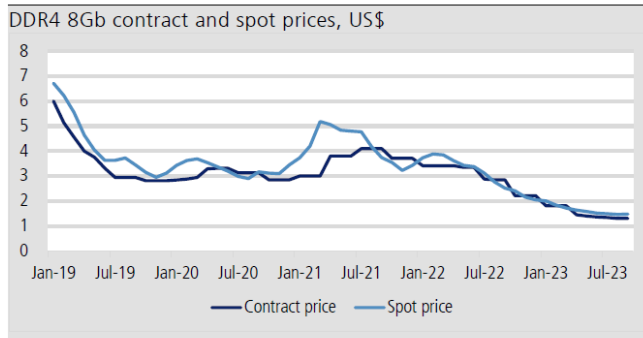
Source: Bloomberg; KGI Research

Figure 2: Breakdown of DRAM &amp; NAND flash supply, demand, &amp; pricing outlooks

%	2023				2024				2022	2023	2024
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q			
<b>DRAM</b>											
Bit supply growth									19	(4)	11
Wafer output YoY growth									7	(16)	14
Wafer output QoQ/YoY growth (kwpm)	(84)	(201)	(25)	3	89	95	139	92	99	(249)	192
Bit demand growth									12	6	12
Sufficiency rate	113	105	93	83	95	92	99	101	108	98	97
DDR4 8Gb contract price QoQ growth	(18)	(22)	(3)	5	10	20	10	10			
<b>NAND Flash</b>											
Bit supply growth									30	(1)	2
Wafer output QoQ/YoY growth									5	(18)	(4)
Wafer output growth (kwpm)	(66)	(101)	(265)	(110)	15	85	156	131	81	(299)	(51)
Bit demand growth									19	10	14
Sufficiency rate	120	112	88	78	84	84	88	93	110	98	88
512Gb TLC wafer contract price QoQ growth	(11)	(14)	5	10	10	20	10	5			

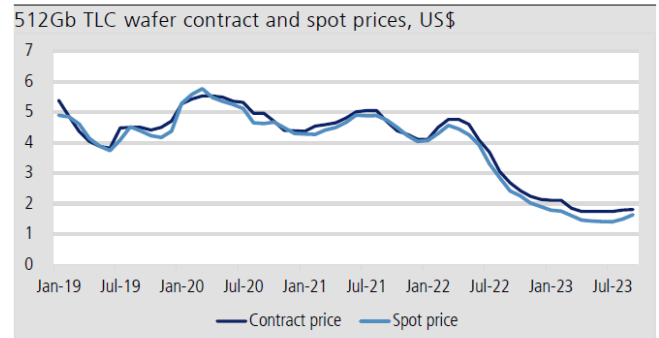
Source: TrendForce; KGI Research

Figure 3: DDR4 spot price started rising in September; contract prices will start to rise in 4Q23F



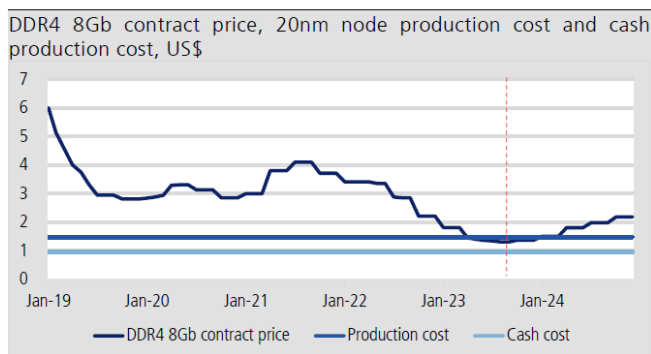
Source: TrendForce; KGI Research

Figure 4: NAND flash spot &amp; contract prices started rising in 3Q23



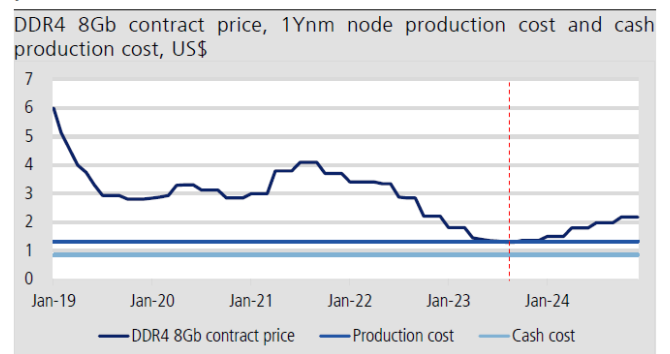
Source: TrendForce; KGI Research

Figure 5: DRAM prices to rise to production costs of 20nm node in 3Q24F



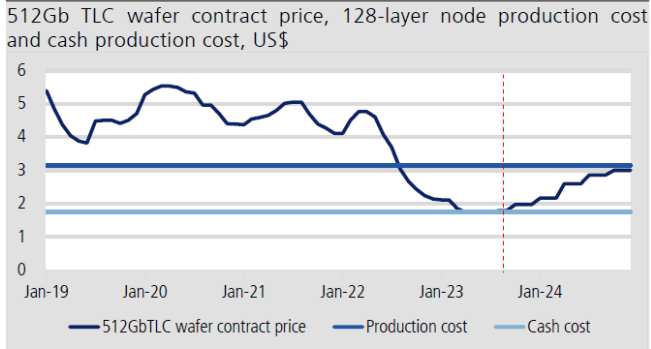
Source: TrendForce; KGI Research

Figure 6: DRAM prices to rise above 1Ynm node production costs in 1Q24F



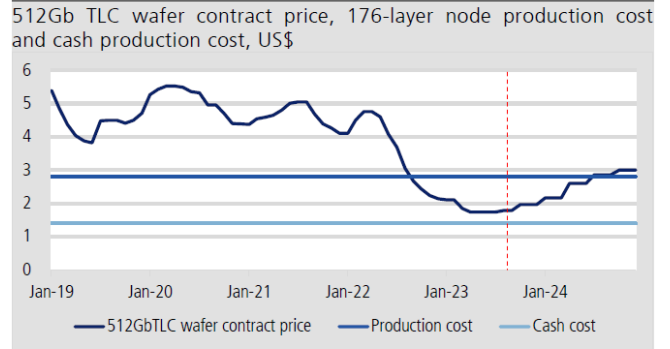
Source: TrendForce; KGI Research

**Figure 7: NAND flash prices to rise above cash costs of 128-layer node in 1Q24F**



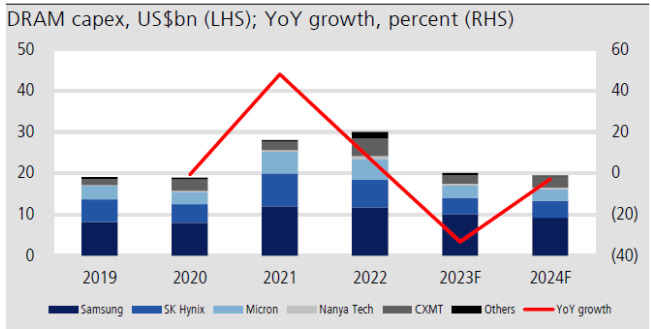
Source: TrendForce; KGI Research

**Figure 8: NAND flash prices to rise to 176-layer node production costs in 4Q24F**



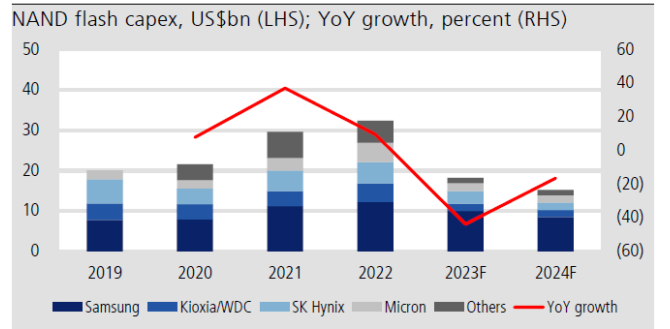
Source: TrendForce; KGI Research

**Figure 9: 2023F & 2024F DRAM capex to fall respective 33% & 3% YoY**



Source: TrendForce; KGI Research

**Figure 10: NAND flash capex to fall respective 44% & 16% YoY in 2023F & 2024F**



Source: TrendForce; KGI Research

**Figure 11: Overview of DRAM producers' 2016-24 annual production capacity outlooks**

(k piece/month)	2016	2017	2018	2019	2020	2021	2022	2023F	2024F
<b>Capacity</b>	<b>962</b>	<b>1,066</b>	<b>1,191</b>	<b>1,298</b>	<b>1,364</b>	<b>1,495</b>	<b>1,594</b>	<b>1,345</b>	<b>1,537</b>
Samsung	336	305	415	463	495	584	653	527	610
SK Hynix	255	310	325	349	344	356	393	346	368
Micron	245	320	310	341	349	355	353	270	286
Nanya	60	60	65	71	71	71	68	54	58
Winbond	17	21	26	27	27	26	22	25	27
Powerchip	49	50	50	49	44	47	43	26	30
CXMT	0	0	0	0	31	50	54	87	148
JHICC	0	0	0	0	3	6	9	10	10
<b>YoY growth</b>		<b>104</b>	<b>125</b>	<b>107</b>	<b>66</b>	<b>131</b>	<b>99</b>	<b>(249)</b>	<b>192</b>
Samsung		(31)	110	48	33	89	69	(125)	83
SK Hynix		56	15	24	(5)	12	37	(47)	23
Micron		75	(10)	31	8	6	(2)	(84)	17
Nanya		0	5	6	(0)	0	(3)	(14)	4
Winbond		4	5	1	1	(1)	(4)	3	2
Powerchip		1	0	(2)	(4)	3	(4)	(17)	4
CXMT		0	0	0	31	19	4	34	60
JHICC		0	0	0	3	3	3	1	0

Source: TrendForce; KGI Research

Figure 12: Overview of DRAM producers' 1Q22-4Q24 quarterly production capacity outlooks

	2022				2023				2024			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
<b>Total wafer output (k)</b>	1,575	1,591	1,614	1,591	1,507	1,306	1,281	1,284	1,373	1,468	1,607	1,699
Samsung	635	640	665	670	651	513	490	455	530	575	650	685
SK Hynix	380	390	390	410	378	333	333	338	338	353	378	403
Micron	360	360	360	333	303	260	250	265	265	280	295	305
Nanya	71	71	71	60	53	58	54	52	53	55	60	65
Winbond	24	23	21	17	21	25	27	28	26	26	27	29
Powerchip	47	47	43	34	26	26	24	26	26	29	32	32
CXMT	50	52	55	57	65	81	93	110	125	140	155	170
JHICC	8	8	9	10	10	10	10	10	10	10	10	10
<b>QoQ growth</b>	22	16	23	(23)	(84)	(201)	(25)	3	89	95	139	92
Samsung	10	5	25	5	(19)	(138)	(23)	(35)	75	45	75	35
SK Hynix	10	10	0	20	(32)	(45)	0	5	0	15	25	25
Micron	5	0	0	(27)	(30)	(43)	(10)	15	0	15	15	10
Nanya	0	0	0	(11)	(7)	5	(4)	(2)	1	2	5	5
Winbond	(3)	(1)	(2)	(4)	4	4	2	1	(2)	0	1	2
Powerchip	(1)	0	(4)	(9)	(8)	0	(2)	2	0	3	3	0
CXMT	0	2	3	2	8	16	12	17	15	15	15	15
JHICC	1	0	1	1	0	0	0	0	0	0	0	0

Source: TrendForce; KGI Research

Figure 13: Overview of NAND flash producers' 2019-24 annual production capacity outlooks

(k piece/month)	2019	2020	2021	2022	2023F	2024F
<b>Capacity</b>	<b>1,364</b>	<b>1,484</b>	<b>1,616</b>	<b>1,696</b>	<b>1,397</b>	<b>1,347</b>
Samsung	465	490	574	636	489	454
Kioxia/WDC	404	494	496	474	395	388
SK Hynix	221	198	195	293	234	224
Micron	154	165	170	169	134	144
Intel	85	85	89	0	0	0
YMTC	13	26	66	98	120	110
Powerchip	3	4	3	5	4	4
Winbond	5	7	6	7	8	8
Macronix	10	10	11	13	12	13
SMIC	5	5	5	4	3	3
<b>YoY growth</b>		<b>120</b>	<b>132</b>	<b>81</b>	<b>(299)</b>	<b>(51)</b>
Samsung		25	84	62	(147)	(35)
Kioxia/WDC		91	2	(23)	(79)	(8)
SK Hynix		(24)	(3)	98	(59)	(10)
Micron		11	5	(2)	(35)	10
Intel		0	4	(89)	0	0
YMTC		14	40	31	23	(10)
Powerchip		1	(1)	2	(1)	1
Winbond		2	(1)	1	1	1
Macronix		1	1	2	(1)	1
SMIC		0	0	(1)	(1)	0

Source: TrendForce; KGI Research

**Figure 14: Overview of NAND flash producers' 1Q22-4Q24 quarterly production capacity outlooks**

(k piece/month)	2022				2023				2024			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
<b>Total wafer output</b>	1,597	1,726	1,762	1,699	1,633	1,532	1,267	1,157	1,172	1,257	1,413	1,544
Samsung	612	630	645	655	656	555	415	330	355	415	485	560
Kioxia/WDC	404	510	520	460	435	435	360	350	350	360	405	435
SK Hynix	293	293	293	293	263	263	210	200	200	210	235	250
Micron	172	172	175	155	135	135	135	130	130	135	150	160
Intel	0	0	0	0	0	0	0	0	0	0	0	0
YMTC	90	95	100	105	120	120	120	120	110	110	110	110
Powerchip	4	4	5	5	3	3	4	4	4	4	4	4
Winbond	7	7	7	7	7	7	8	8	8	8	8	8
Macronix	11	11	13	15	11	11	12	12	12	12	13	14
SMIC	4	4	4	4	3	3	3	3	3	3	3	3
<b>QoQ growth</b>	(92)	129	36	(63)	(66)	(101)	(265)	(110)	15	85	156	131
Samsung	(3)	18	15	10	1	(101)	(140)	(85)	25	60	70	75
Kioxia/WDC	(101)	106	10	(60)	(25)	0	(75)	(10)	0	10	45	30
SK Hynix	98	0	0	0	(30)	0	(53)	(10)	0	10	25	15
Micron	2	0	3	(20)	(20)	0	0	(5)	0	5	15	10
Intel	(93)	0	0	0	0	0	0	0	0	0	0	0
YMTC	5	5	5	5	15	0	0	0	(10)	0	0	0
Powerchip	1	0	1	0	(2)	0	1	0	0	0	0	0
Winbond	0	0	0	0	0	0	1	0	0	0	0	0
Macronix	0	0	2	2	(4)	0	1	0	0	0	1	1
SMIC	(1)	0	0	0	(1)	0	0	0	0	0	0	0

Source: TrendForce; KGI Research

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