**INDUSTRY REPORT**

**Taiwan**

# 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 reball (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$mn) | Price (NT$) | 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 |

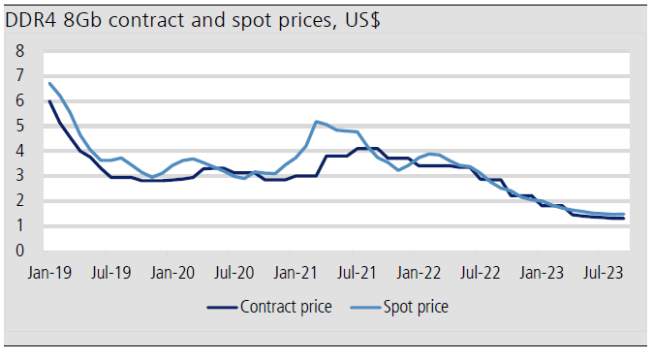
*Source: Bloomberg; KGI Research*

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

| % | 2023 1Q | 2Q | 3Q | 4Q | 2024 1Q | 2Q | 3Q | 4Q | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DRAM | | | | | | | | | | | |
| 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 | | | |
| NAND Flash | | | | | | | | | | | |
| 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 | | | |

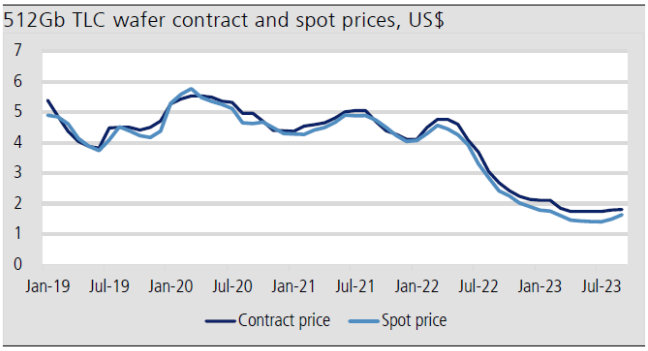
*Source: TrendForce; KGI Research*

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



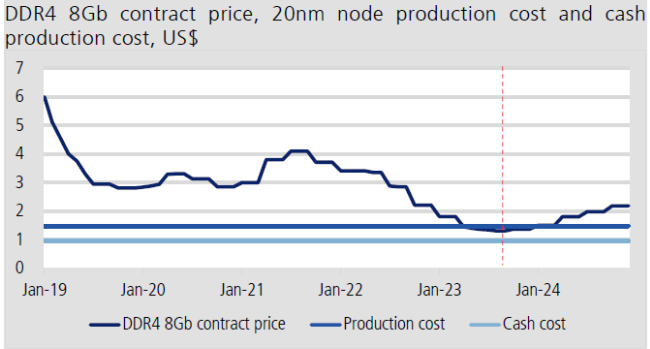

*Source: TrendForce; KGI Research*

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



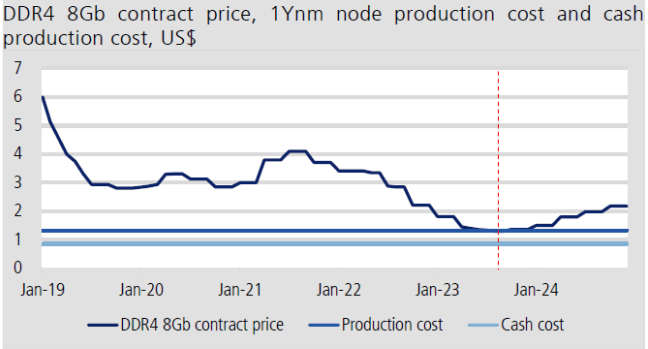

*Source: TrendForce; KGI Research*

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



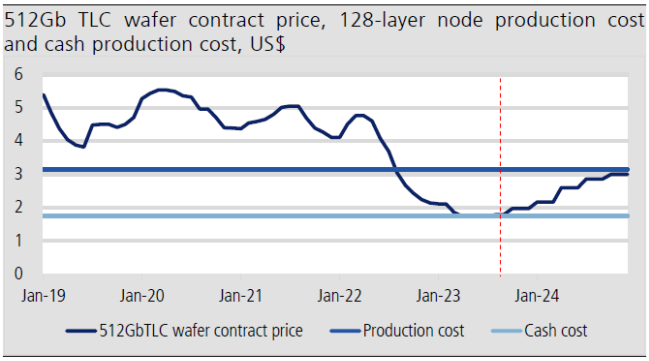

*Source: TrendForce; KGI Research*

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



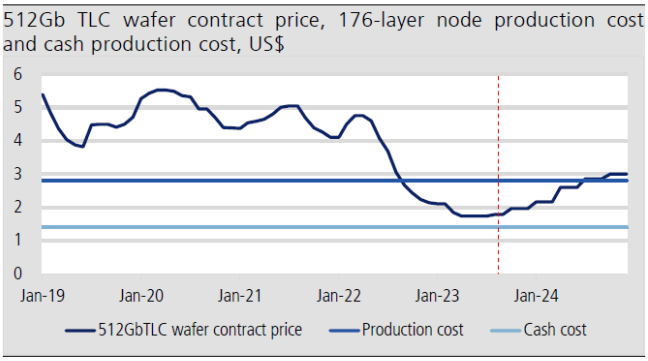

*Source: TrendForce; KGI Research*

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



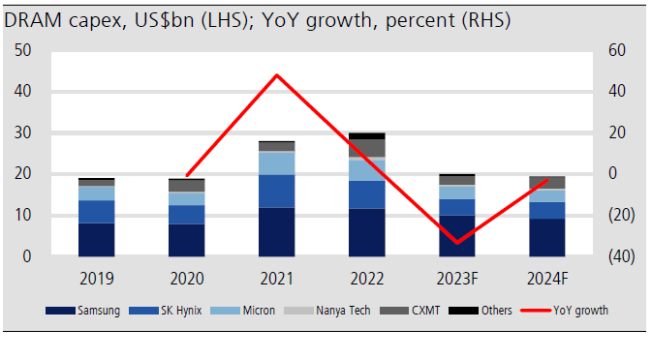

*Source: TrendForce; KGI Research*

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



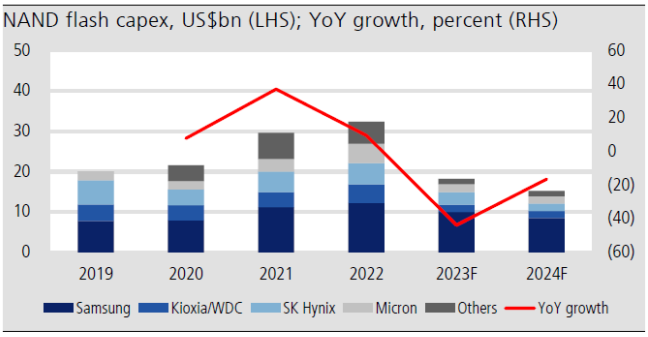

*Source: TrendForce; KGI Research*

**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 |
|---|---|---|---|---|---|---|---|---|---|
| **Capacity** | **962** | **1,066** | **1,191** | **1,298** | **1,364** | **1,495** | **1,594** | **1,345** | **1,537** |
| 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 |
| **YoY growth** | | **104** | **125** | **107** | **66** | **131** | **99** | **(249)** | **192** |
| 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 |
| **Total wafer output (k)** | 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 |
| **QoQ growth** | 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 |
|---|---|---|---|---|---|---|
| **Capacity** | **1,364** | **1,484** | **1,616** | **1,696** | **1,397** | **1,347** |
| 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 |
| **YoY growth** | | **120** | **132** | **81** | **(299)** | **(51)** |
| 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**

| | 2022 | | | | 2023 | | | | 2024 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (k piece/month) | 1Q | 2Q | 3Q | 4Q | 1Q | 2Q | 3Q | 4Q | 1Q | 2Q | 3Q | 4Q |
| **Total wafer output** | 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 |
| **QoQ growth** | (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*

**All the above named KGI analyst(s) is SFC licensed person accredited to KGI Asia Ltd to carry on the relevant regulated activities. Each of them and/or his/her associate(s) does not have any financial interest in the respectively covered stock, issuer and/or new listing applicant.**