

Memory sector

DDR5 & HBM to cap DRAM bit supply in 2024F

Overweight • Maintained

Key message

1. DRAM bit demand is set to grow at a faster pace as penetration rates of DDR5 and HBM will rise alongside AI server shipments in 2024F.
2. Given larger die sizes, we believe higher penetration of DDR5 and HBM will cap DRAM bit supply.
3. We think DDR5 and HBM demand will add to DRAM supply tightness in 2024F, consequently boosting DRAM makers' earnings and share valuations.

Event

We expect the penetration rates of DDR5 and high bandwidth memory (HBM) to rise alongside AI server shipments in 2024F. This in turn will cap the overall bit supply of DRAM, resulting in increased supply tightness in 2024F.

Impact

AI server to drive stronger DRAM demand growth. We estimate global shipments of AI training server will grow 200% YoY to 572k units in 2024F from 191k units in 2023F, representing 30% of AI server and 4% of total server shipments. DDR5, which is used in AI servers, will account for 8% of DRAM bit demand in 2024F, up markedly from 4% in 2023F. In the meantime, the weighting of HBM in DRAM bit demand will likely climb from 1.5% to 3.0%, driving total DRAM demand to grow 15% YoY, almost on par with bit supply growth, for a supply-demand ratio of 97%. To be able to run a neural processing unit (NPU) and inference software, an AI PC must be equipped with 16-32GB of DRAM (DDR5), above the average of 13.4GB for general PC in 2023F. We assume AI PC sales will total around 20mn units in 2024, boosting PC's weighting in DRAM bit demand from 12% in 2023 to 13% in 2024.

DDR5 & HBM to cap DRAM bit supply. The die size of DDR5 is 15% larger than that of DDR4, and AI servers, as well as new platforms like Eagle Stream and Meteor Lake CPU are all designed to work with DDR5. We forecast that the penetration rate of DDR5 in server market will rise from 14% in 2023F to 44% in 2024F. Notably, DDR5 penetration will overtake that of DDR4 in 3Q24 and we estimate the weighting of server DDR5 in DRAM bit supply will arrive at 17% in 2024F, consuming around 20% of wafer starts. The die size of HBM is twice that of DDR5, with longer production cycle time, and HBM requires TSV (Through Silicon Via) stacking, making the current production yield at only 50-65%. We expect leading DRAM makers to expand HBM capacity by 143% in 2024F in order to fulfill demand from AI servers. We predict that HBM will account for 3% of total DRAM bit supply, and consume 8.7% of wafer starts next year. Due to insufficient funding, leading DRAM maker SK Hynix (KR) plans to allocate the bulk of its 1beta node capacity to the production of HBM3e in 2024F, which will cannibalize capacity for DDR5 under 1beta node. We estimate global DRAM bit supply will grow only 15% next year, almost on par with wafer start growth, reflecting higher penetration of DDR5 and HBM, which in turn will offset the benefits of production node migrations.

Stocks for Action

We think DDR5 and HBM demand will add to DRAM supply tightness in 2024F, consequently boosting DRAM makers' earnings and share valuations. Our preference for memory sub-sectors is foundry over module makers, and DRAM over NAND flash.

Risks

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

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)	7,430	75.00	OP	85	13	4.72	(2.10)	2.83
2344 TT	Winbond	DRAM(43)	3,789	28.35	NR	N.A.	N.A.	3.22	0.20	1.84
3260 TT	ADATA	DRAM module(40)	938	100.00	NR	N.A.	N.A.	3.12	4.78	7.44

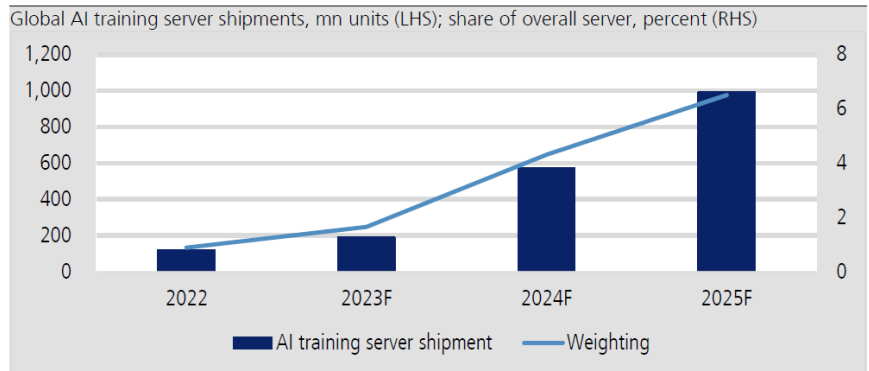
Source: Bloomberg KGI Research

Figure 1: DRAM supply, demand & pricing outlook

%	2023				2024				2022	2023	2024
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q			
DRAM											
Bit supply growth									19	(4)	15
Wafer output YoY growth									7	(15)	15
Wafer output QoQ/YoY growth (kwpm)	(84)	(201)	(25)	50	66	101	124	73	98	(237)	197
Bit demand growth									12	8	15
Sufficiency rate	113	105	89	83	91	95	98	102	108	97	97
DDR4 8Gb contract price QoQ growth	(18)	(22)	(6)	12	10	10	15	15			

Source: TrendForce; KGI Research

Figure 2: In 2024F, AI will account for 4% of overall server shipments



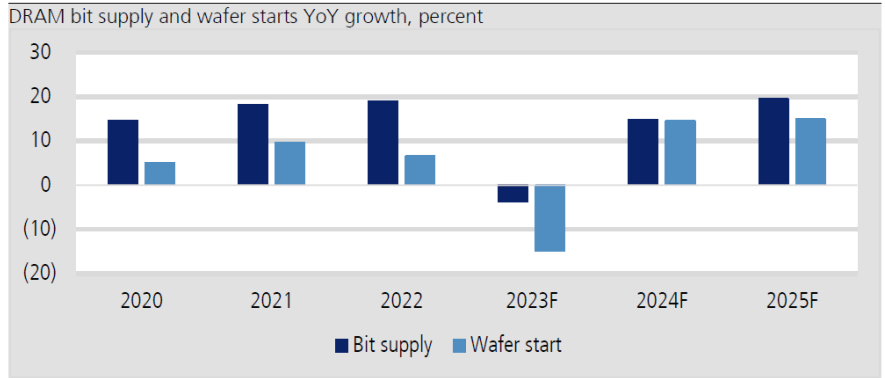
Source: Gartner KGI Research

Figure 3: Demand for DRAM from AI server

	Training AI server				All server			
	2022	2023	2024	2025	2022	2023	2024	2025
DRAM density of each server (GB)	1,584	2,136	2,848	3,520	632	834	868	926
CPU related	1,024	1,536	2,048	2,560	632	834	868	926
Number of DDR module	16	16	16	16				
DRAM density per module (DDR)	64	96	128	160				
Training chip related	560	600	800	960				
Number of training chip	7.0	7.5	8.0	8.0				
DRAM density per training chip (HBM)	80	80	100	120				
Server shipment (k)	123	191	572	993	13,815	11,532	13,262	15,251
YoY growth (%)		56	200	74		(17)	15	15
DRAM bit demand (mnGB)	570	1,402	3,204	5,940	8,725	9,619	11,507	14,121
DDR	369	1,008	2,304	4,320	8,524	9,225	10,607	12,501
HBM	202	394	900	1,620	202	394	900	1,620
DRAM bit demand YoY growth (%)		146	129	85	18	10	20	23
DDR		173	129	88		8	15	18
HBM		95	129	80		95	129	80
Share of global DRAM demand (%)	2.4	5.4	10.7	16.9	36.0	36.8	38.5	40.2
DDR	1.5	3.9	7.7	12.3	35.1	35.3	35.4	35.6
HBM	0.8	1.5	3.0	4.6	0.8	1.5	3.0	4.6

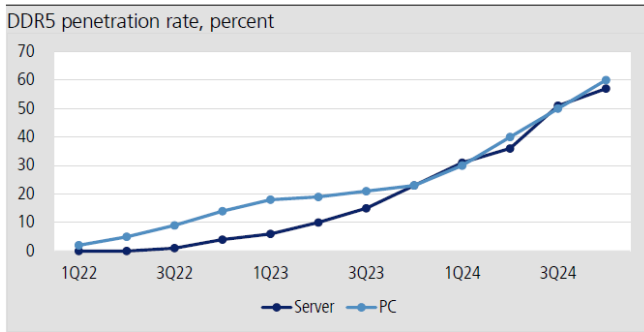
Source: TrendForce; KGI Research

Figure 4: Given larger die sizes of DDR5 & HBM, prevalence of these two memory products will likely cap DRAM bit supply in 2024F



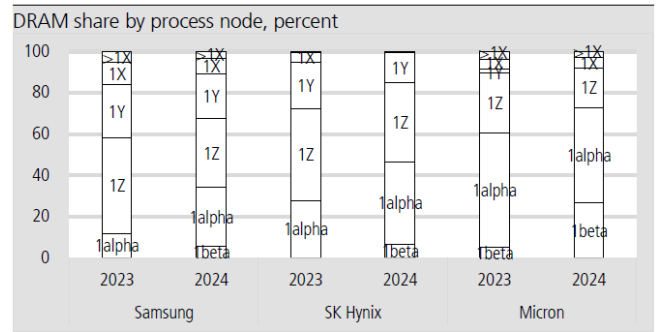
Source: TrendForce; KGI Research

Figure 5: Server & PC platform upgrades to push DDR5 penetration above 50%



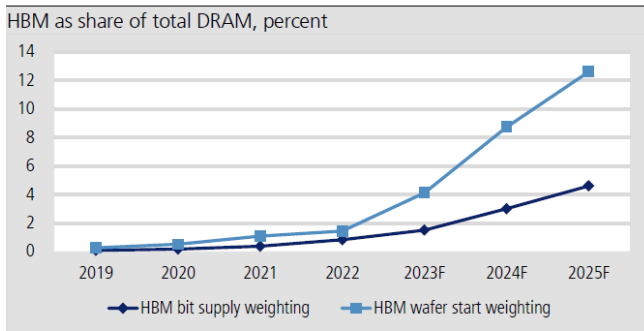
Source: TrendForce; KGI Research

Figure 6: DRAM makers are migrating from 1y and 1z nodes to 1-alpha and 1-beta, but the benefits for bit supply will be offset by increasing penetration of DDR5 & HBM



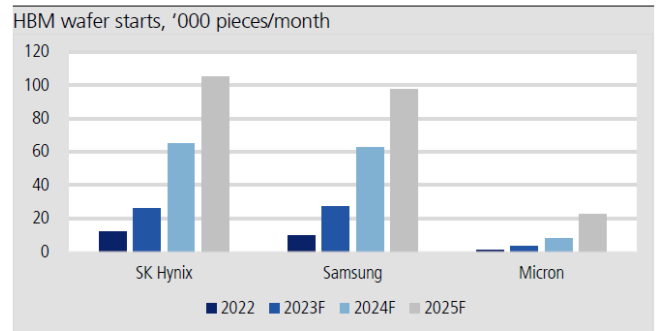
Source: TrendForce; KGI Research

Figure 7: HBM to account for 3.0% of 2024F DRAM bit supply & 8.7% of 2024F DRAM wafer starts

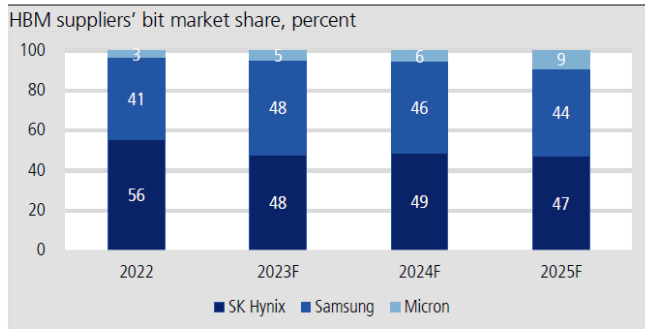


Source: TrendForce; KGI Research

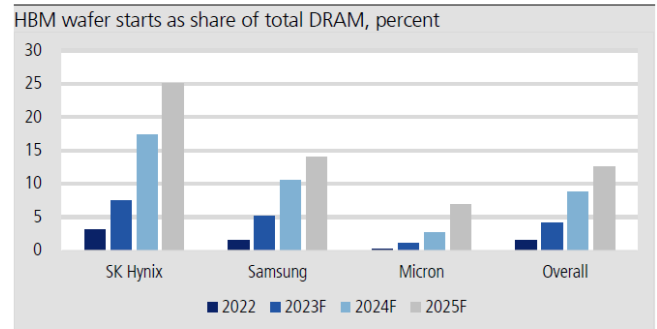
Figure 8: The Big Three memory makers are all expanding HBM production capacity



Source: TrendForce; KGI Research

Figure 9: SK Hynix is the top HBM supplier by market share, and Micron (US) is gaining market share


Source: TrendForce; KGI Research

Figure 10: SK Hynix has highest HBM share by wafer starts


Source: TrendForce; KGI Research

Figure 11: Specs & launch dates of individual vendors' HBM products

HBM GPU		HBM2e		HBM3		HBM3e	
		A100, MI200		H100, MI300		B100, MI350	
SK Hynix	Die density (Gb)	16	16	16	16	24	24
	Stacking	4	8	8	12	8	12
	Density (GB)	8	16	16	24	24	36
	Node	1y	1y	1z	1z	1beta	1beta
	Mass production	3Q20	3Q20	4Q22	4Q23	2Q24	4Q24
Samsung	Die density	16	16	16	16	24	24
	Stacking	4	8	8	12	8	12
	Density	8	16	16	24	24	36
	Node	1y	1y	1z	1z	1alpha	1alpha
	Mass production	4Q20	4Q20	4Q23	4Q23	3Q24	3Q24
Micron	Die density	16				24	24
	Stacking	8				8	12
	Density	16				24	36
	Node	1z				1beta	1beta
	Mass production	1Q21				2Q24	1Q25

Source: TrendForce; KGI Research

Figure 12: Overview of individual vendors' HBM capacity, bit output & market share

	TSV capacity (kwpm)	Average stacking	Product output (kwpm of cube)	Product yield (%)	Die per wafer	Average density (GB)	Product output (mn GB)	Market share (%)
2022	23	4-8	3.8			8-16	202	100
SK Hynix	12	6	2.0	65	718	10	112	56
Samsung	10	6	1.7	60	689	10	83	41
Micron	1	8	0.1	50	583	16	7	3
2023	56	4-8	7.5			8-16	394	100
SK Hynix	26	8	3.3	65	616	12	188	48
Samsung	27	7	3.9	60	563	12	188	48
Micron	3	8	0.4	50	521	16	19	5
2024	136	8-12	14.5			16-24	900	100
SK Hynix	65	10	6.5	65	431	20	438	49
Samsung	63	9	6.9	60	413	20	413	46
Micron	8	8	1.0	50	414	20	50	6
2025	225	8-12	21.8			16-36	1,620	100
SK Hynix	105	11	9.5	65	365	28	761	47
Samsung	98	10	9.8	60	363	28	713	44
Micron	23	9	2.5	50	374	26	146	9

Source: TrendForce; KGI Research

Figure 13: Annual DRAM production capacity by company in 2016-24F

(kwpm)	2016	2017	2018	2019	2020	2021	2022	2023F	2024F
Wafer start	962	1,066	1,191	1,298	1,364	1,495	1,593	1,356	1,553
Samsung	336	305	415	463	495	584	653	527	598
SK Hynix	255	310	325	349	344	356	393	346	374
Micron	245	320	310	341	349	355	353	278	309
Nanya	60	60	65	71	71	71	68	54	58
Winbond	17	21	26	27	27	26	21	24	24
Powerchip	49	50	50	49	44	47	43	27	38
CXMT	0	0	0	0	31	50	54	90	143
JHICC	0	0	0	0	3	6	9	10	10
YoY growth		104	125	107	66	131	98	(237)	197
Samsung		(31)	110	48	33	89	69	(125)	70
SK Hynix		56	15	24	(5)	12	37	(47)	29
Micron		75	(10)	31	8	6	(2)	(75)	31
Nanya		0	5	6	(0)	0	(3)	(14)	4
Winbond		4	5	1	1	(1)	(5)	3	(0)
Powerchip		1	0	(2)	(4)	3	(4)	(16)	11
CXMT		0	0	0	31	19	4	37	52
JHICC		0	0	0	3	3	3	1	0

Source: TrendForce; KGI Research

Figure 14: Quarterly DRAM production capacity by company in 1Q22-4Q24F

	2022				2023				2024			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Wafer start (kwpm)	1,575	1,591	1,614	1,591	1,507	1,306	1,281	1,331	1,397	1,498	1,622	1,695
Samsung	635	640	665	670	651	513	490	455	505	570	640	675
SK Hynix	380	390	390	410	378	333	333	338	343	358	388	408
Micron	360	360	360	333	303	260	250	300	295	305	315	320
Nanya	71	71	71	60	53	58	54	52	53	55	60	65
Winbond	24	23	21	17	21	25	27	24	24	24	24	24
Powerchip	47	47	43	34	26	26	24	30	32	36	40	43
CXMT	50	52	55	57	65	81	93	122	135	140	145	150
JHICC	8	8	9	10	10	10	10	10	10	10	10	10
QoQ growth	22	16	23	(23)	(84)	(201)	(25)	50	66	101	124	73
Samsung	10	5	25	5	(19)	(138)	(23)	(35)	50	65	70	35
SK Hynix	10	10	0	20	(32)	(45)	0	5	5	15	30	20
Micron	5	0	0	(27)	(30)	(43)	(10)	50	(5)	10	10	5
Nanya	0	0	0	(11)	(7)	5	(4)	(2)	1	2	5	5
Winbond	(3)	(1)	(2)	(4)	4	4	2	(3)	0	0	0	0
Powerchip	(1)	0	(4)	(9)	(8)	0	(2)	6	2	4	4	3
CXMT	0	2	3	2	8	16	12	29	13	5	5	5
JHICC	1	0	1	1	0	0	0	0	0	0	0	0

Source: TrendForce; KGI Research

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