



Technology Committee

Cameron Ninneman
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NASDAQ: AMKR

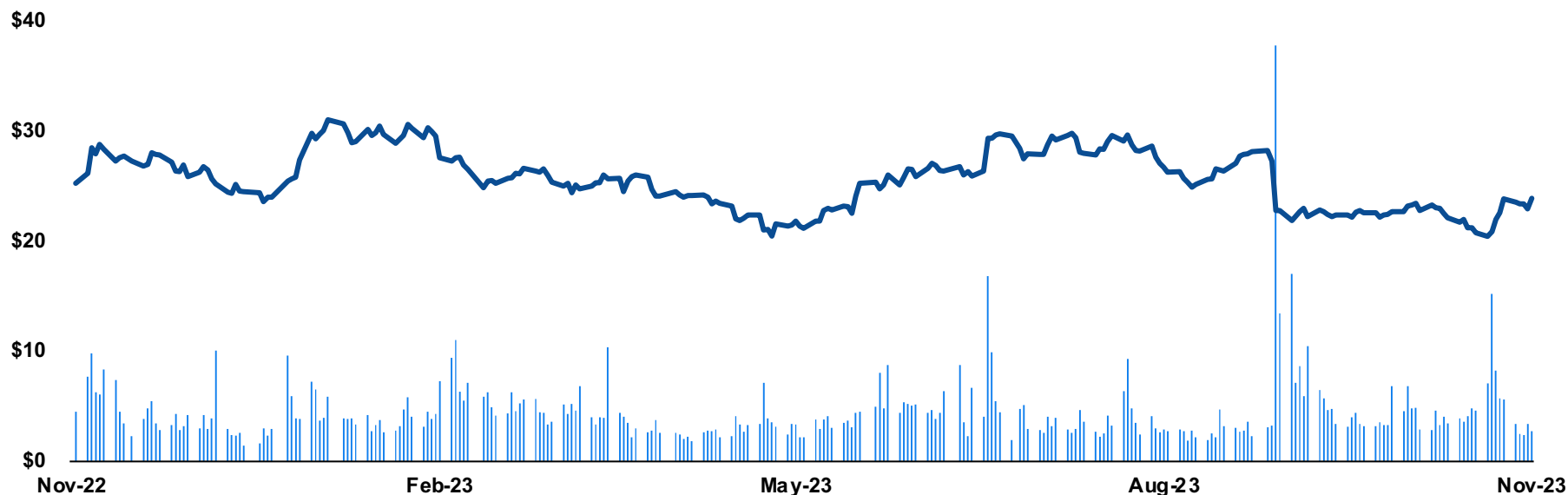


Market Cap	\$5,878.8
11/13 Open	\$23.72
52 Week Range	\$17.58 - \$31.38

Recommendation: **BUY** with a **PT of \$32.60**, representing an upside of **37.44%** from 11/13 open – **5% weight**

Investment Thesis Introduction

1. TSMC's advanced packaging capacity issue provides Amkor a clear opportunity for **furthered advanced packaging** commitments
2. Amkor is positioned to see benefits from **5G-enabled smartphones** that need advanced packaging and sustained mandates from TSMC's inability to meet near-term demand
3. Despite declining revenue in Automotive segment, Amkor stands to capitalize on their **leading positioning** in auto and a **long runway** from ADAS and EV products



Industry Overview



What is an OSAT?



OSAT stands for Outsourced Semiconductor Assembly and Test



OSATs are primarily responsible for 3 tasks: Packaging, Validation Testing, and Assembly



OSAT market expected to grow with a CAGR of 8.9% through 2027

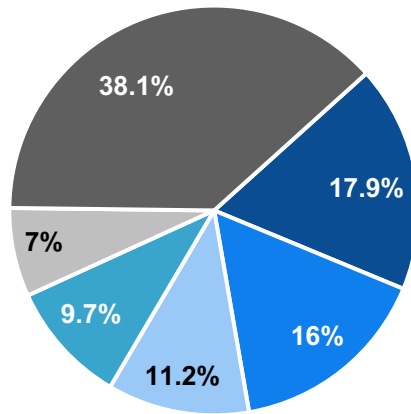


Amkor is the only large U.S. based OSAT, with over 72% of other vendors located in East Asia



Work on two types of packaging, traditional (since the 50s) and advanced for modern chips

OSAT Market Share¹

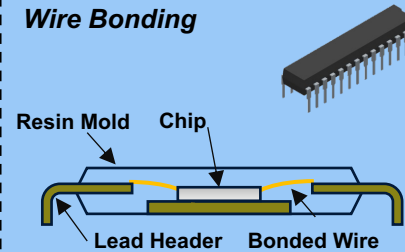


■ ASE ■ AMKOR ■ JCET ■ SPIL ■ Tongfu ■ Others

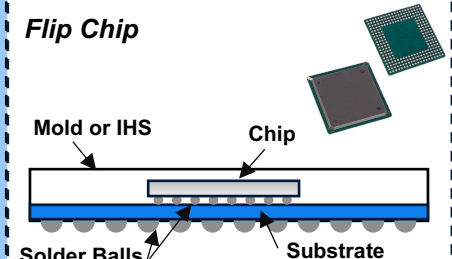
(1) Morgan Stanley Equity Research

Types of Packaging

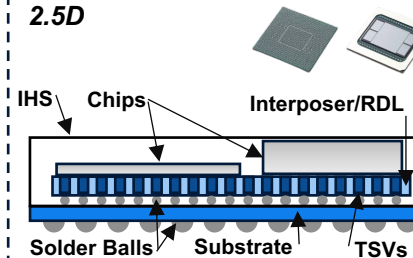
Wire Bonding



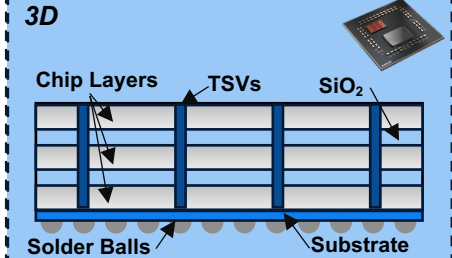
Flip Chip



2.5D



3D



The Move to Advanced Packaging

Moore's Law

Clock frequencies at 5 GHz, require chips to perform tasks every 0.2 nano seconds. Advanced packaging shortens the distance electrons flow, for improved performance.



Mobile Tech

Improved mobile products require far more transistors than ever in denser clusters, prompting companies to use advanced packaging.



HPC

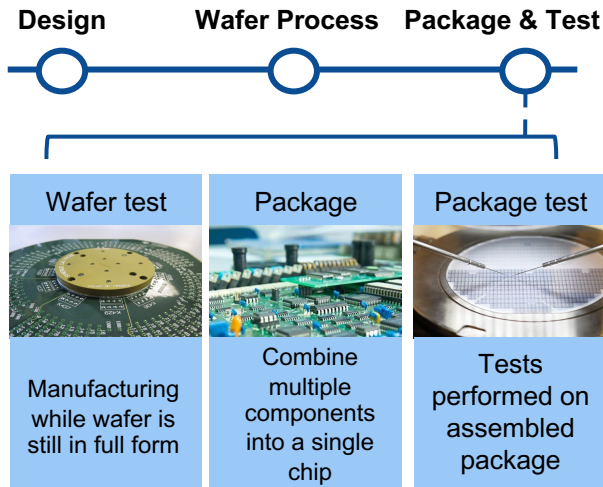
High Performance Computing (HPC), is used for everything from hyperscalers and LLMs to advanced research and CGI. These chips need advanced packaging for their speed.





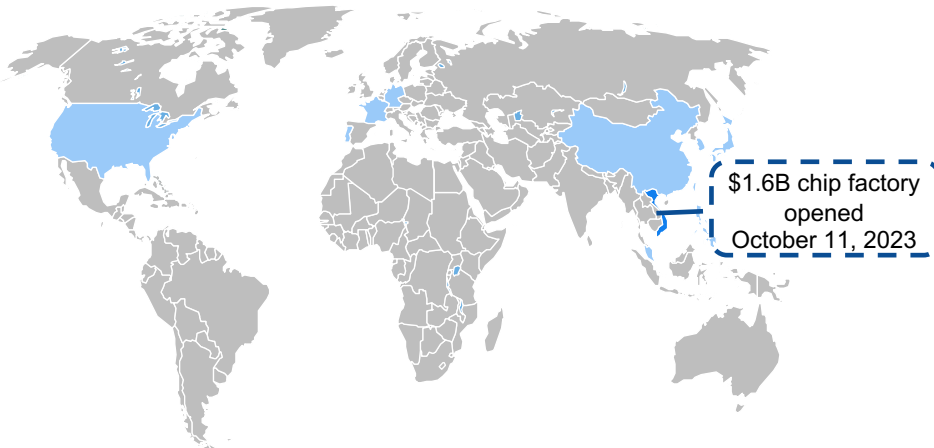
Amkor Company Overview

Providing Packaging & Test Solutions to Four Major Lines of Products



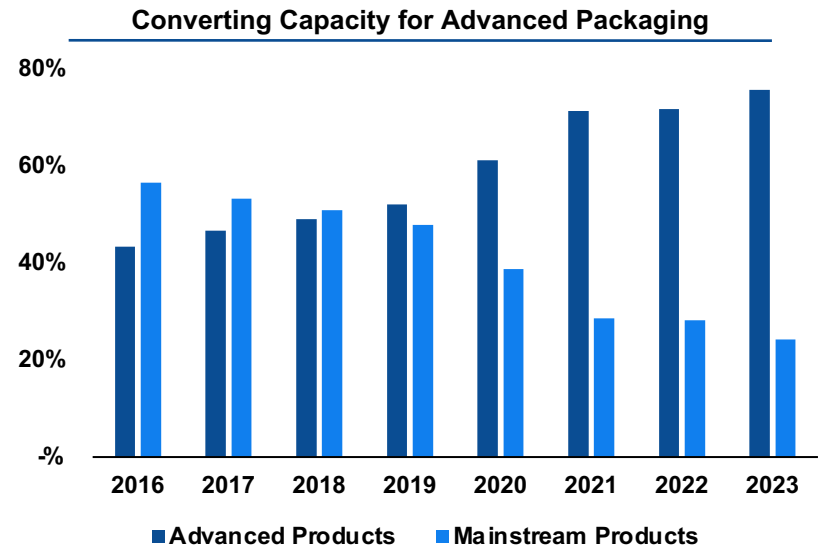
Communications	Automotive & Industrial	Consumer	Computing
44% of Revenue	20% of Revenue	20% of Revenue	16% of Revenue
Applications, features, and functionalities in smartphone markets	Packages for advanced systems and sensors in motor vehicles	Everyday electronics for entertainment, recreation, and information	Advanced computing in the areas of AI, Data Center, PCs and laptops

Growing Global Presence in Chip Production and OSAT



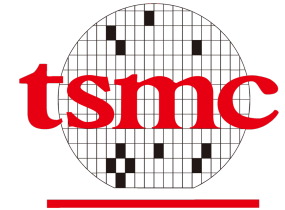
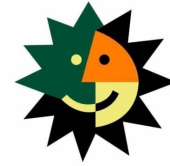
"This state-of-the-art factory in Vietnam will help Amkor ... [provide a] **secure and reliable supply chain** our customers need—in communications, automotive, high-performance computing, and other key industries..." - CEO, Giel Rutten

Increasing Focus and Delivery of Advanced Chips





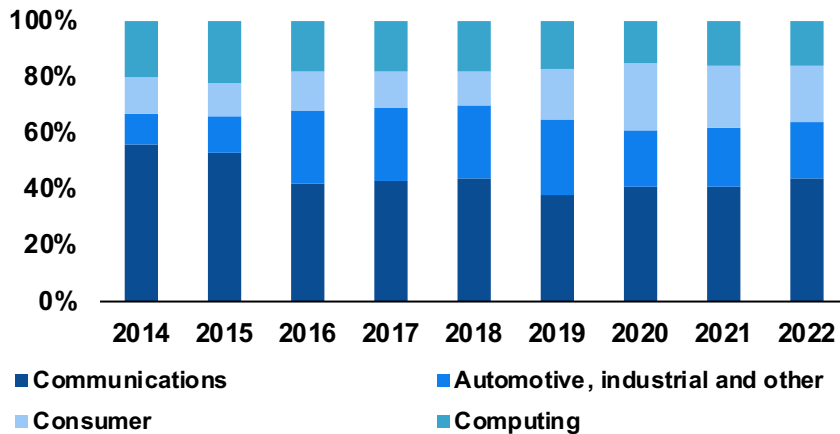
Competitor Overview



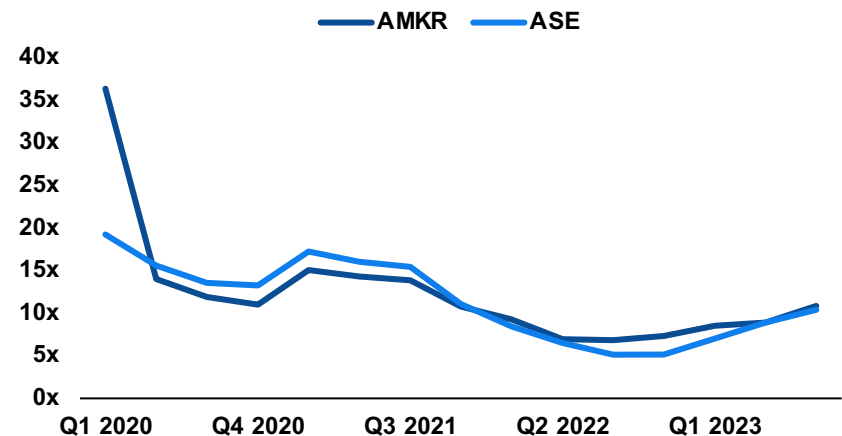
(as of FY 2022, in \$USD mm)

Revenue	\$7,091.6	\$21,831.2	\$2,263,891.3
Gross Margin	18.8%	20.1%	59.6%
Operating Margin	12.7%	12.1%	49.6%
P/E	9.65x	9.32x	14.13x
LTM EV/EBITDA	4.35x	4.88x	8.65x
Market Cap¹	\$5,878.8	\$15,680.0	\$447,420.0
Headquarters	USA	Taiwan	Taiwan

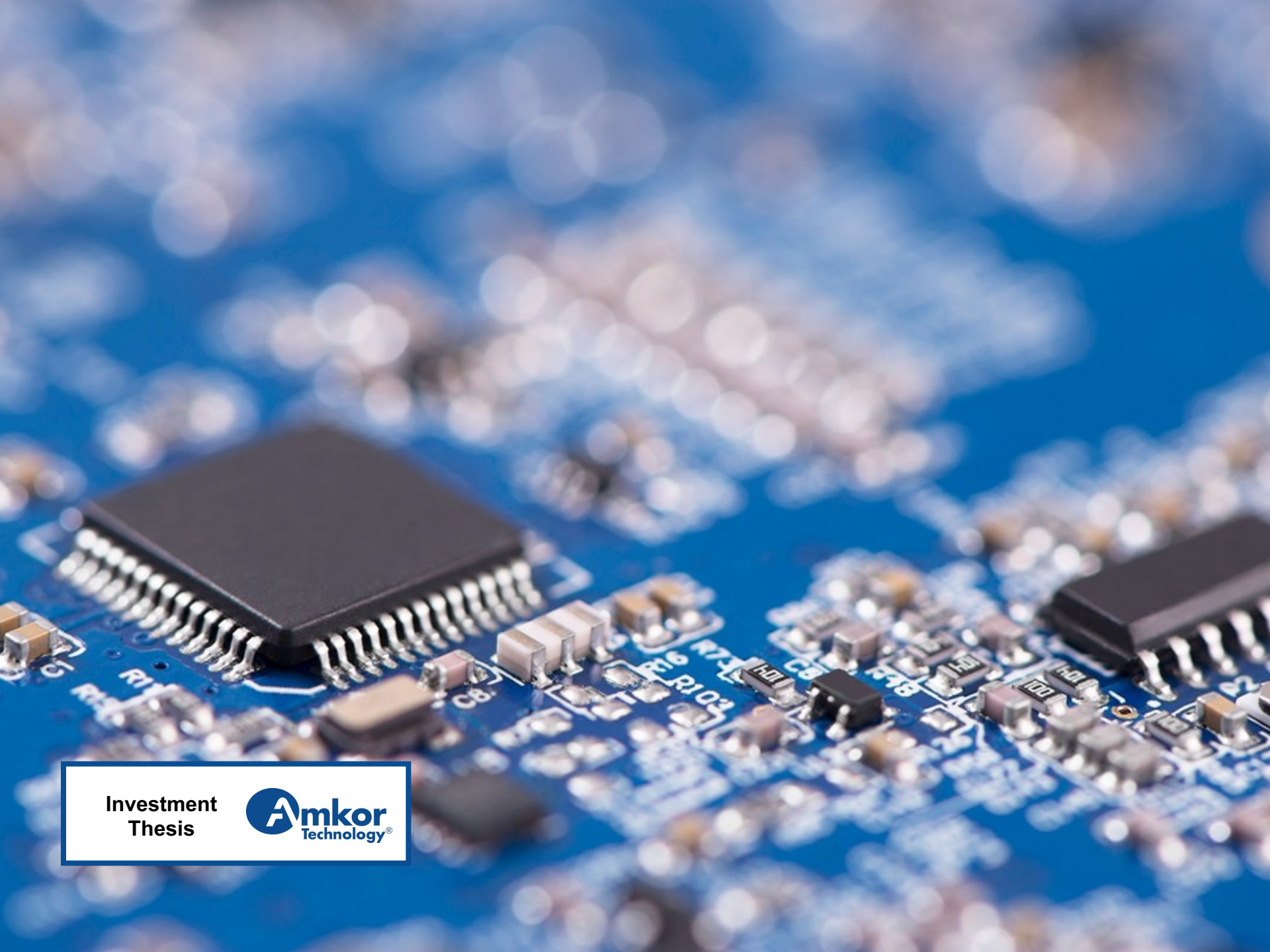
Amkor Revenue by End Market



Industry P/E Multiples



(1) Market Cap as of November 10, 2023



Investment
Thesis

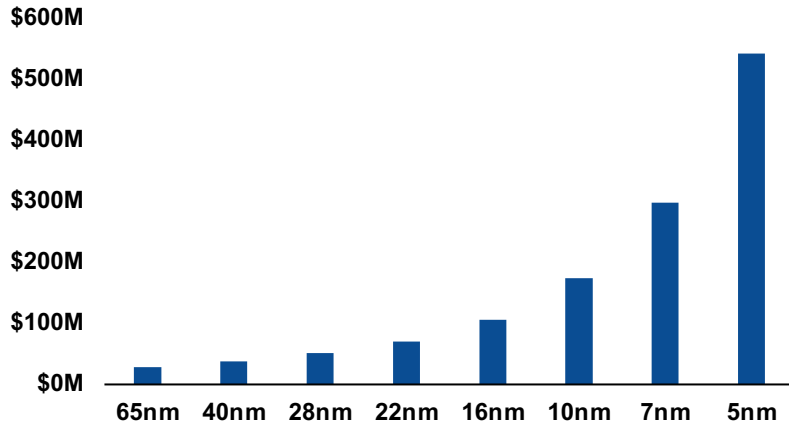




TSMC's Transition is Not the End of OSAT's, It's an Opportunity

Increase costs to Maintain Moore's Law has Forced TSMC to Seek Back-End Improvements...

Total Cost of Design Per Transistor Benchmark⁽¹⁾



TSMC's Encroachment on Back-End Production

- 2016** – Uses **back-end technology** to win **Apple Contract** for iPhone 7 Plus
- 2020** – Launches **“3D Fabric Platform”** planning vertically integrated production
- 2023** – Opens **\$10B packaging & testing facility** (*Backend Fab 6*) in Taiwan

...but TSMC Can't Meet Back End Demand

The NVDA H100 Case Study⁽²⁾⁽³⁾

2023

2024

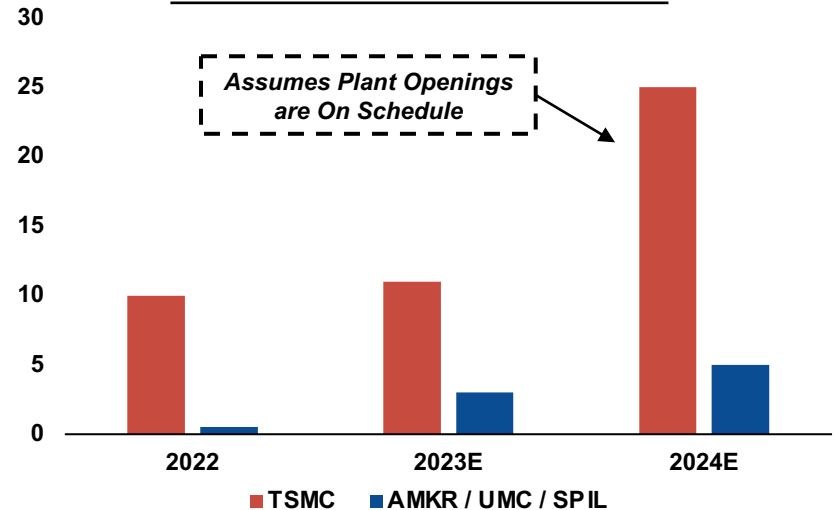
NVDA H100 Ideal Production

690K ——— 3.2x ———> 1.75M

TSMC Projected Production

550K ——— 2.3x ———> 1.3M

CoWoS Capacity (in kwpm)⁽³⁾



Mark Liu – TSMC's Executive Chairman

“Currently, we can't fulfill 100% of our customers' needs [...] After our expansion of CoWoS, it should be alleviated in one and a half years.”

(1) International Business Strategies (2) NVDA Keynote (3) Morgan Stanley ER



TSMC's Transition is Not the End of OSAT's, It's an Opportunity

Two Plans for Expansion before 2025, Two Different Timelines

AMKR's Plan

- **\$1.6B Investment** in Vietnamese Plant
- Will Lead to **Triple the Advanced Capacity** Before the End of 2024
- **Factory Opened October 2023**

TSMC's Plan

- **\$2.9B Investment** in Taiwanese Plant
- Substantial Advanced Packaging Increases
- Planned Late 2024 to Early 2025, but **Local Media Predicts a 2027 Opening**



Issues with Delays for the Arizona Project



May 2020: TSMC announces a new **\$12M chip fabrication & packaging** facility in Chandler, **Arizona**

May 2021: TSMC breaks ground and begins construction with the goal of **coming online early 2024**

July 2023: TSMC delays plant opening to **2025** and announces an expansion, bringing the project to a **total of \$40B**



A New Opportunity for OSATs



OSAT Value Proposition
Cost-Effectiveness

TSMC Value Proposition
Technology Innovation

OSAT Margin Profile & Multiple
20% Gross Margin / ~8.5x LTM EV/EBIT

TSMC Margin Profile & Multiple
50% Gross Margin / ~12x LTM EV/EBIT

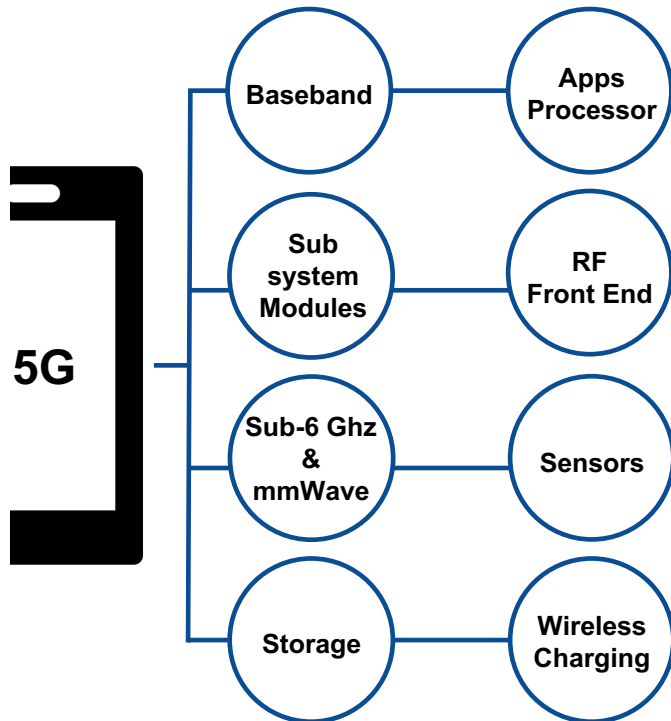
Our Argument

OSAT's have been worse businesses due to lack of IP, a **lack of TSMC capacity** over the next two years provides AMKR with **opportunity to enter advanced packaging**, yielding **higher margins** and **larger barriers to entry**

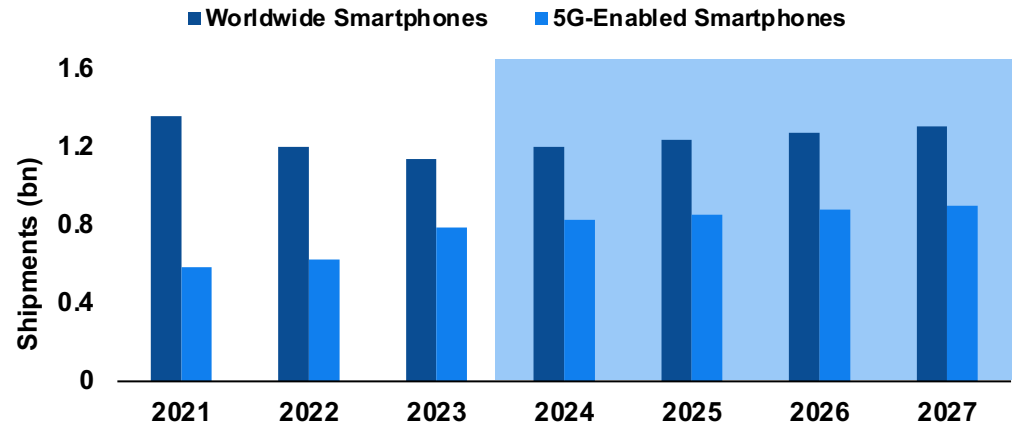


Amkor's Unique Opportunity within Communications

Amkor's Role in the Smartphone



Worldwide Smartphone Forecast^{1,2}



5G smartphone penetration in 2023 is **69%**, holding this constant, AMKR has an opportunity within **3.47bn** 5G-enabled smartphones from 2024-2027

TSMC Bottleneck Feeds Amkor's Topline

TSMC is the bottleneck in the system

Apple's been cited to have bought **90-100% of TSMC's 3nm capacity for 2023**

Nvidia will **begin using TSMC's 3nm node in 2024** for their Blackwell Architecture

TSMC will not be able to fulfill both client's needs fully in the near term, thus an **opportunity is presented for Amkor to capitalize on the 2.5D advanced packaging needs for the space**

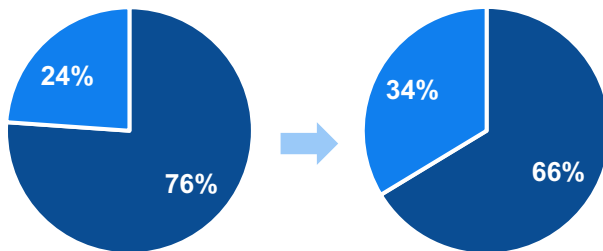
Amkor has online capacity

Diversification is not an issue if technology is equivalent

Communication Revenue Share Gains

2018

2022



■ Amkor ■ ASE

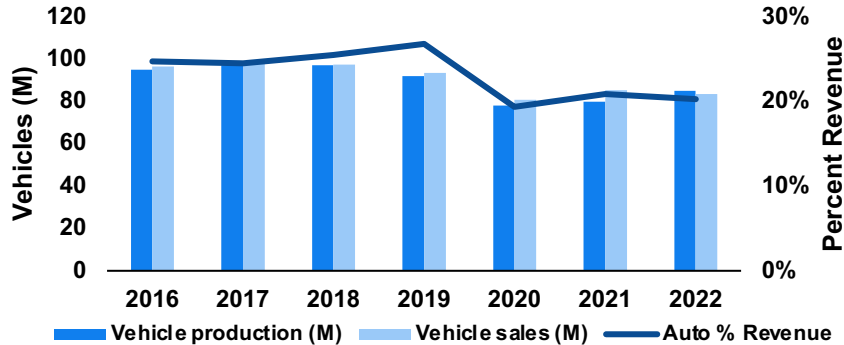
(1) IDC (2) Statista (3) Amkor Investor Presentation



Driving Growth from Leading Capacity in Auto

Industry Headwinds Misrepresents Auto Segment¹

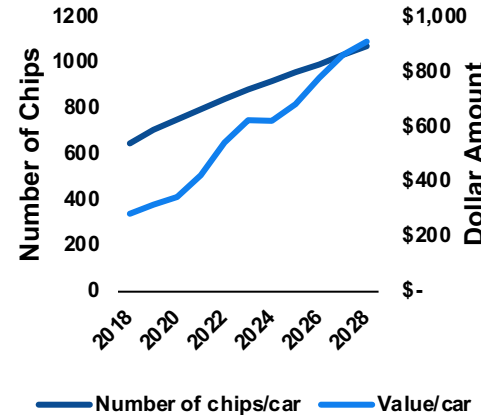
Automotive Revenue Matching Industry Tailwinds



A decrease in auto as a percent of revenue reflects industry trends, not a dying commitment

Advanced Vehicles Require Increased Chips²

Increasing Number of Chips per Vehicle

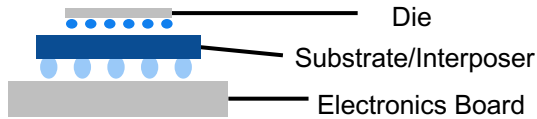


Complex safety and ease of driving features require large counts of smaller, higher performance chips

HEV, EV, and blended vehicle models are heavily equipped with chips for advanced demands

The OSAT of Choice for Outsourced Auto Packaging

The Demand for New Technology



Flip chip manufacturing

Ability to handle **high temperatures**
Increased **signal integrity**
92% of new vehicles have features that require advanced chips

Requires **specialized packaging** from select providers

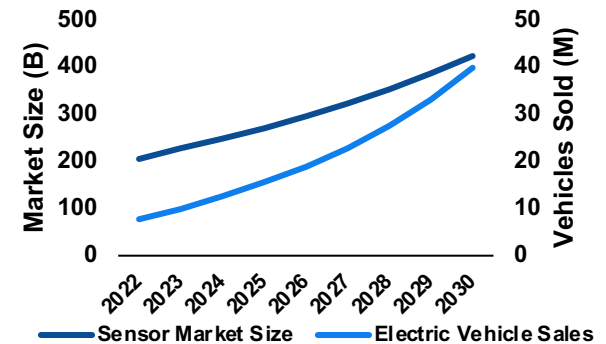
The Leader in the Auto Supply Chain³



98% greater auto capacity than closest competitor

The Demand for New Technology⁴

Growing Numbers in ADAS and EV



Growing demand for EVs and ADAS drives continual AMKR opportunity

(1) Automotive Sales Survey (2) Yole Group (3) Company Data (4) Precedence Research



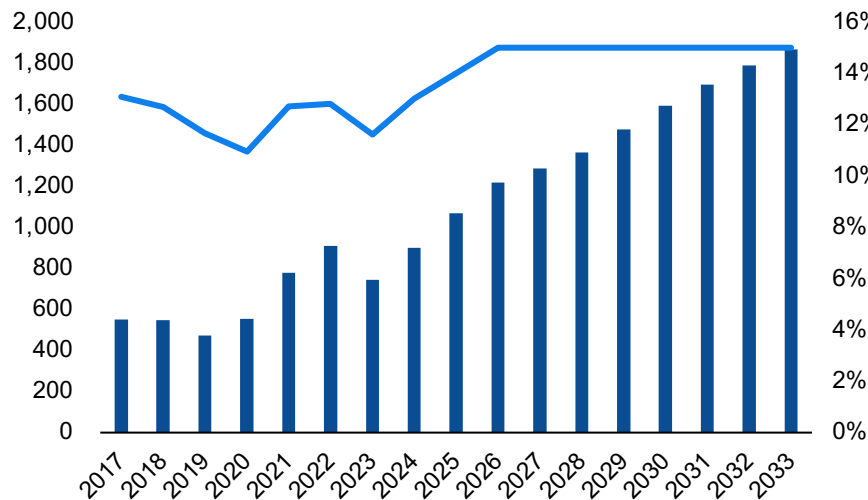
Recommending BUY at 5% Weight @ 37.44% Upside

Cover Valuation

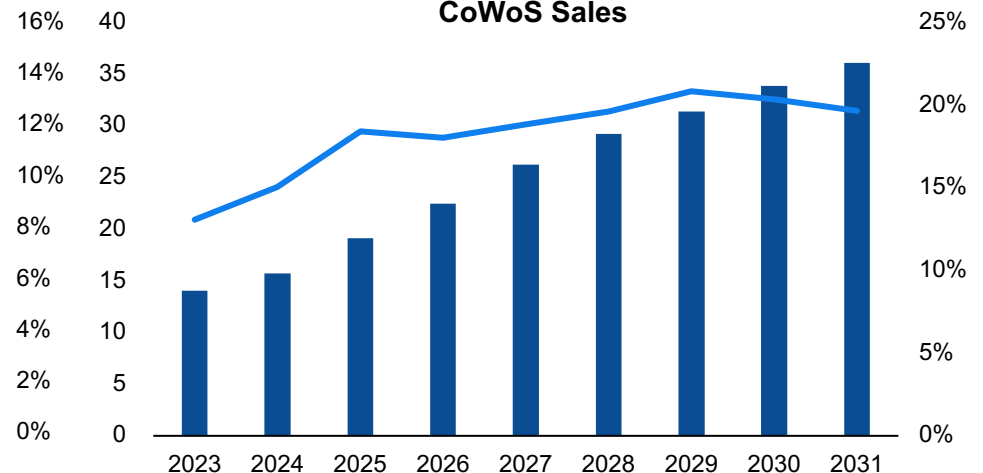
Terminal Multiple EV/EBIT		Long Term Growth Rate Method		Blended Upside		Catalysts
Terminal Value	\$ 11,492	Terminal Value	\$ 4,511	Multiple Valuation	\$ 33.13	
PV of Terminal Value	\$ 8,431	PV of Free Cash Flow	\$ 3,656	LTGR Valuation	\$ 32.07	
Enterprise Value	\$ 8,431	Enterprise Value	\$ 8,168	Multiple Weight	50%	2) Cyclical recovery in foundry utilization rates and decrease in broader semiconductor industry
Less: Debt	\$ 947	Less: Debt	\$ 947	LTGR Weight	50%	
Less: Preferred / Other	\$ 31	Less: Preferred / Other	\$ 31	Implied Share Price	\$ 32.60	Long Term Drivers
Plus: Cash	\$ 736	Plus: Cash	\$ 736	Current Share Price	\$ 23.72	
Implied Equity Value	\$ 8,188	Implied Equity Value	\$ 7,925	<i>Upside / (Downside)</i>	37.44%	1) Higher CapEx and R&D to support more advanced product mix
Diluted Shares Outstanding	247	Diluted Shares Outstanding	247	Assumptions		
Implied Share Price	\$ 33.13	Implied Share Price	\$ 32.07	Discount Rate	10%	2) Topline growth driven by increasing product sophistication and end market growth
<i>Upside / (Downside)</i>	39.68%	<i>Upside / (Downside)</i>	35.19%	Long Term Growth Rate	2%	
Implied Long Term Growth Rate	1.68%	Implied 2025 EBIT Multiple	9x	Terminal Multiple	12x	
				Current Share Price	\$ 23.72	
				Tax Rate	21%	

Thesis in the Model

Structurally Higher CapEx



Gross Margin Improvement on Back of CoWoS Sales





Appendix



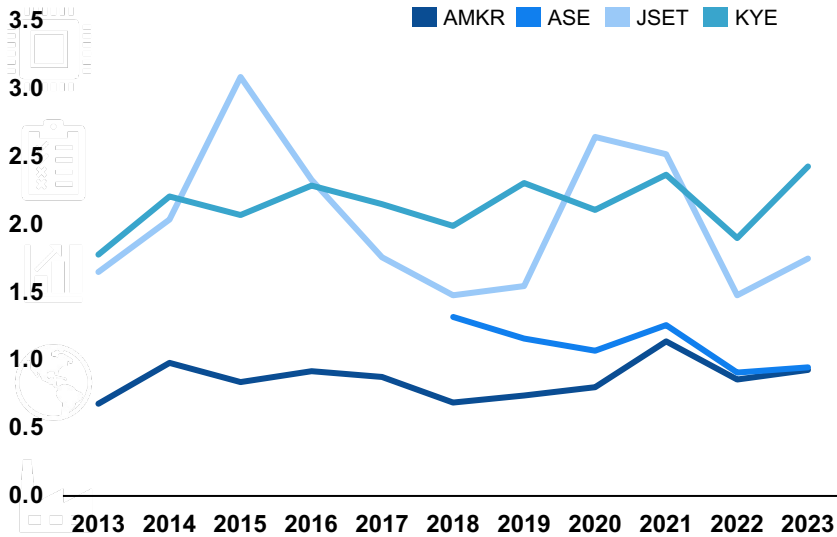


Calendar Ended	Dec-17	Dec-18	Dec-19	Dec-20	Dec-21	Dec-22	Dec-23	Dec-24	Dec-25	Dec-26	Dec-27	Dec-28	Dec-29	Dec-30	Dec-31	Dec-32	Dec-33
Fiscal Year Ended	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33
	A	A	A	A	A	A	E	E	E	E	E	E	E	E	E	E	E
Revenues	4,207	4,316	4,053	5,051	6,138	7,092	6,409	6,926	7,626	8,118	8,584	9,088	9,856	10,616	11,307	11,923	12,444
% Chg		3%	-6%	25%	22%	16%	-10%	8%	10%	6%	6%	6%	8%	8%	7%	5%	4%
COGS	3,446	3,606	3,403	4,150	4,913	5,762	5,572	5,886	6,223	6,658	6,970	7,306	7,804	8,457	9,089	9,872	10,626
% Revenue	82%	84%	84%	82%	80%	81%	87%	85%	82%	82%	81%	80%	79%	80%	80%	83%	85%
Gross Profit	761	711	649	901	1,226	1,330	837	1,040	1,403	1,461	1,614	1,782	2,052	2,159	2,218	2,051	1,818
Gross Margin	18%	16%	16%	18%	20%	19%	13%	15%	18%	18%	19%	20%	21%	20%	20%	17%	15%
Operating Expenses	356	452	416	444	462	433	464	476	488	501	514	528	542	557	573	589	606
% Revenue	8%	10%	10%	9%	8%	6%	7%	7%	6%	6%	6%	6%	6%	5%	5%	5%	5%
Operating Profit	406	258	233	457	763	897	373	564	915	960	1,100	1,254	1,509	1,602	1,646	1,462	1,213
Operating Margin	10%	6%	6%	9%	12%	13%	6%	8%	12%	12%	13%	14%	15%	15%	15%	12%	10%
Income Tax (Expense)	40	56	37	46	69	90	62	118	192	202	231	263	317	336	346	307	255
Income Tax Rate	9.81%	21.79%	15.95%	10.10%	9.10%	10.02%	16.64%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%
NOPAT	366	202	196	411	694	807	311	445	723	758	869	990	1,192	1,265	1,300	1,155	958
(+) D&A	582	572	524	510	564	613	635	630	747	852	901	954	1,035	1,194	1,357	1,610	1,867
% Revenue	14%	13%	13%	10%	9%	9%	10%	9%	10%	11%	11%	11%	11%	11%	12%	14%	15%
(-)CapEx	551	547	472	553	780	908	744	900	1,068	1,218	1,288	1,363	1,478	1,592	1,696	1,788	1,867
% Revenue	13%	13%	12%	11%	13%	13%	12%	13%	14%	15%	15%	15%	15%	15%	15%	15%	15%
Unlevered FCF	397	227	248	368	478	512	202	175	402	393	483	581	749	867	961	976	958
% Chg		-43%	9%	49%	30%	7%	-61%	-13%	130%	1%	1%	1%	1%	1%	1%	1%	1%
Discount Factor							0.25	1.25	2.25	3.25	4.25	5.25	6.25	7.25	8.25	9.25	10.25
PV OF UFCF							197	156	325	288	322	353	413	435	438	404	361

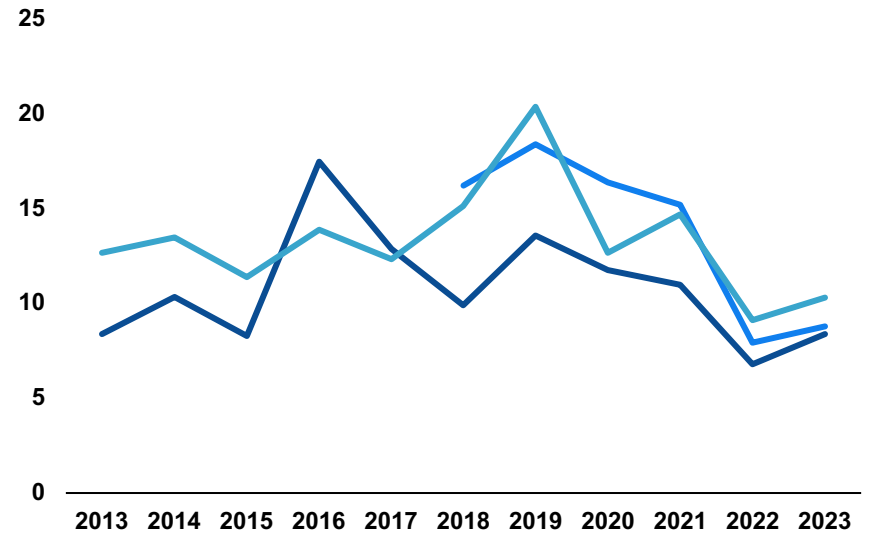
Multiple Analysis



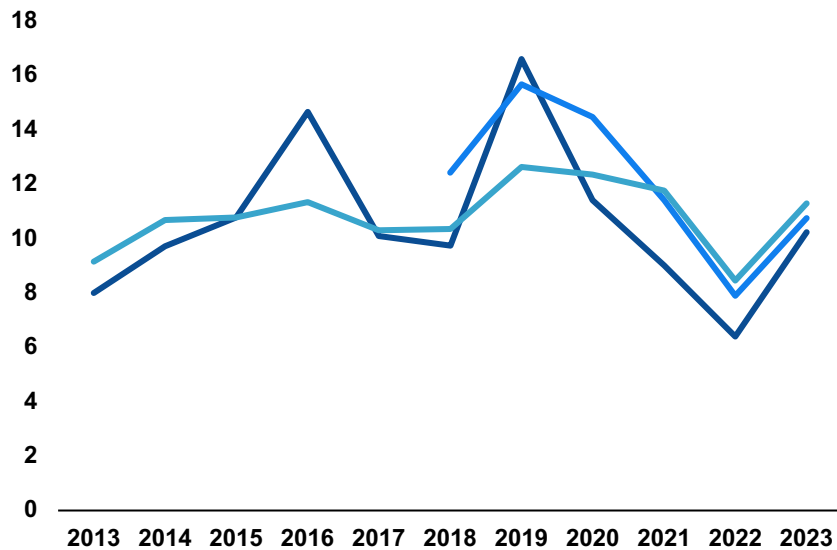
EV / Revenue



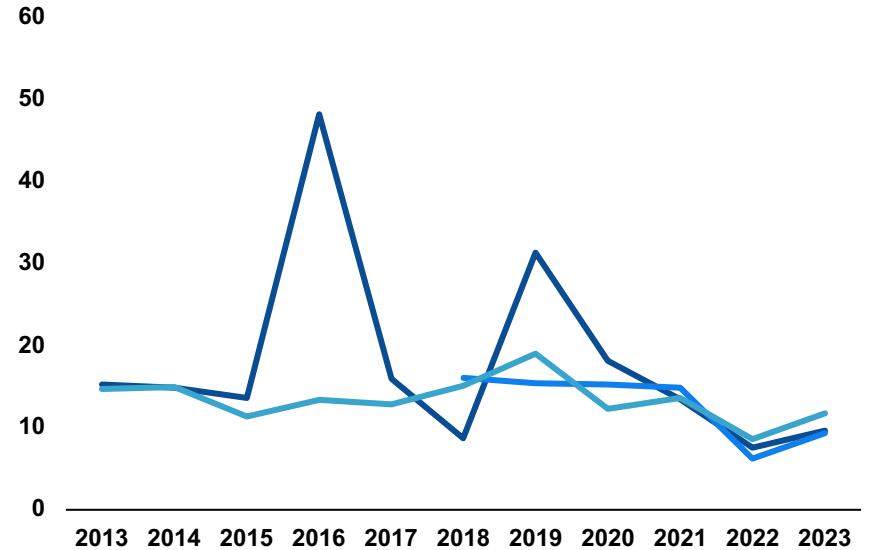
EV / EBIT



EV / EBIT



P / E



(1)

Sensitivity Analysis



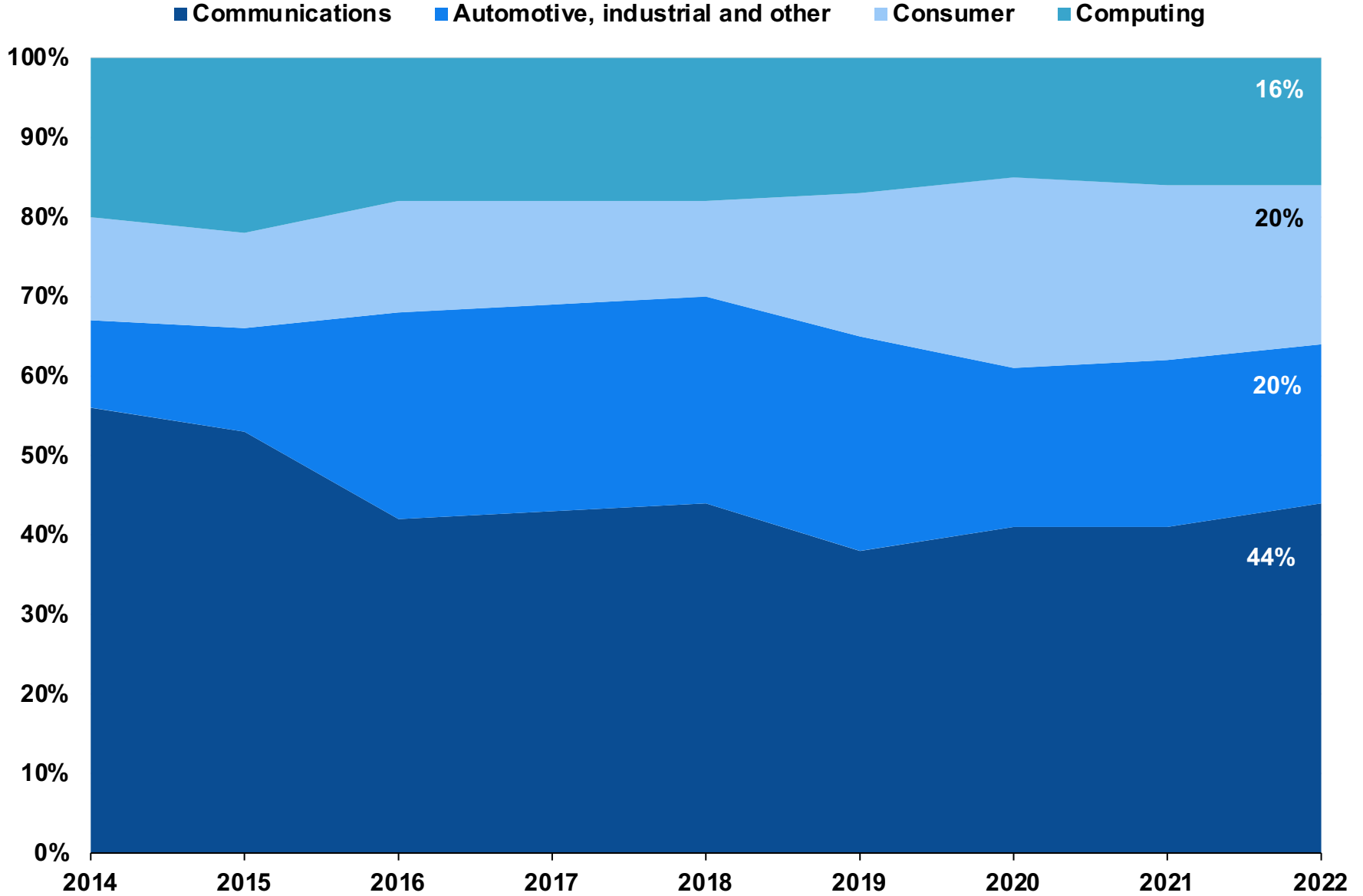
Terminal Multiple Sensitivity Analysis

	8.0x	9.0x	10.0x	11.0x	12.0x
9.0%	-5.37%	6.98%	19.32%	31.67%	44.02%
9.5%	-6.83%	5.33%	17.50%	29.66%	41.83%
10.0%	-8.26%	3.73%	15.71%	27.70%	39.68%
10.5%	-9.66%	2.15%	13.96%	25.77%	37.58%
11.0%	-11.04%	0.60%	12.24%	23.88%	35.51%

Long Term Growth Rate Sensitivity Analysis

	1.00%	1.50%	2.00%	2.50%	3.00%
9.0%	45.40%	51.43%	58.31%	66.25%	75.51%
9.5%	35.09%	40.19%	45.96%	52.55%	60.16%
10.0%	25.97%	30.31%	35.19%	40.73%	47.05%
10.5%	17.84%	21.57%	25.73%	30.41%	35.72%
11.0%	10.56%	13.78%	17.35%	21.34%	25.83%

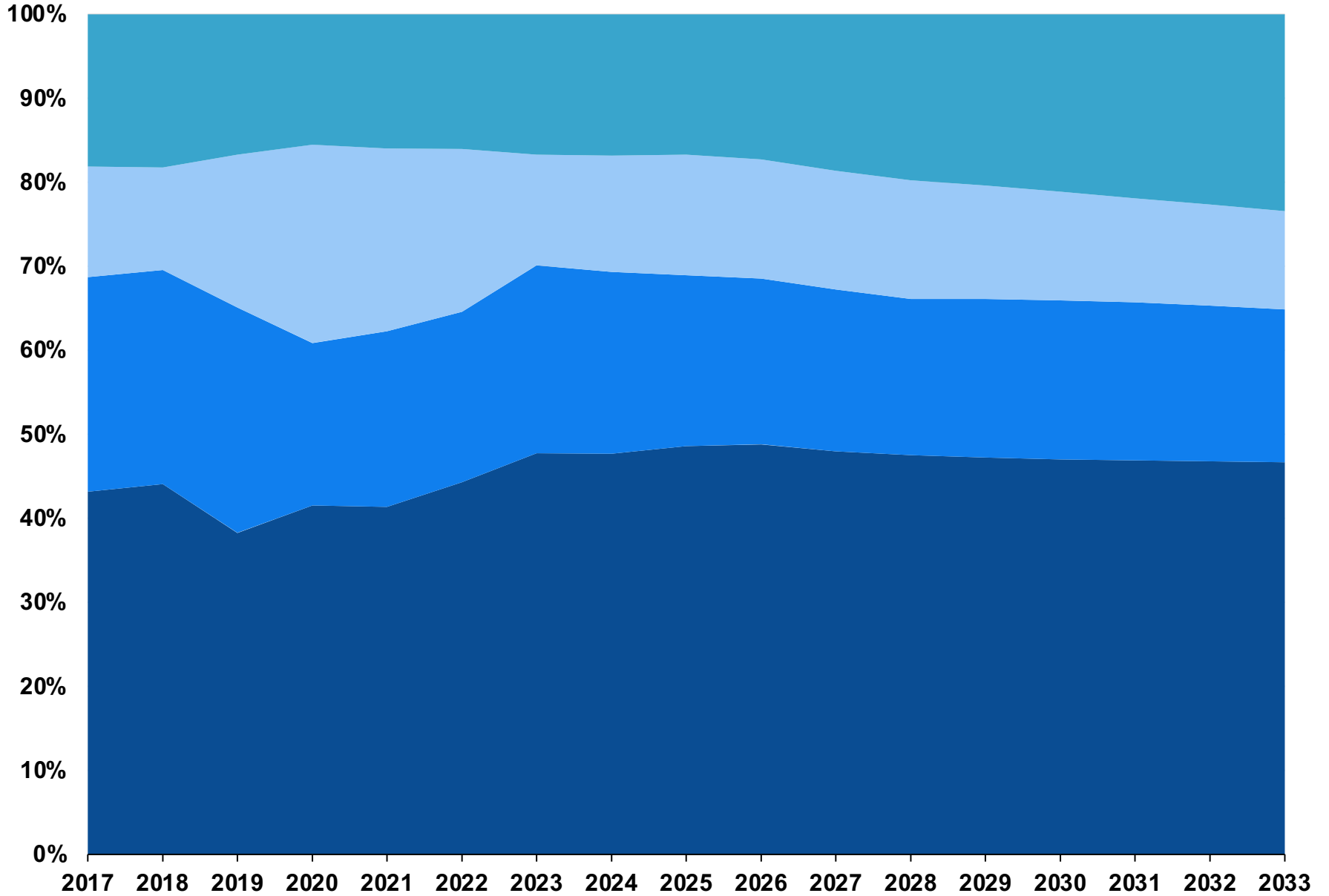
Amkor Revenue Mix



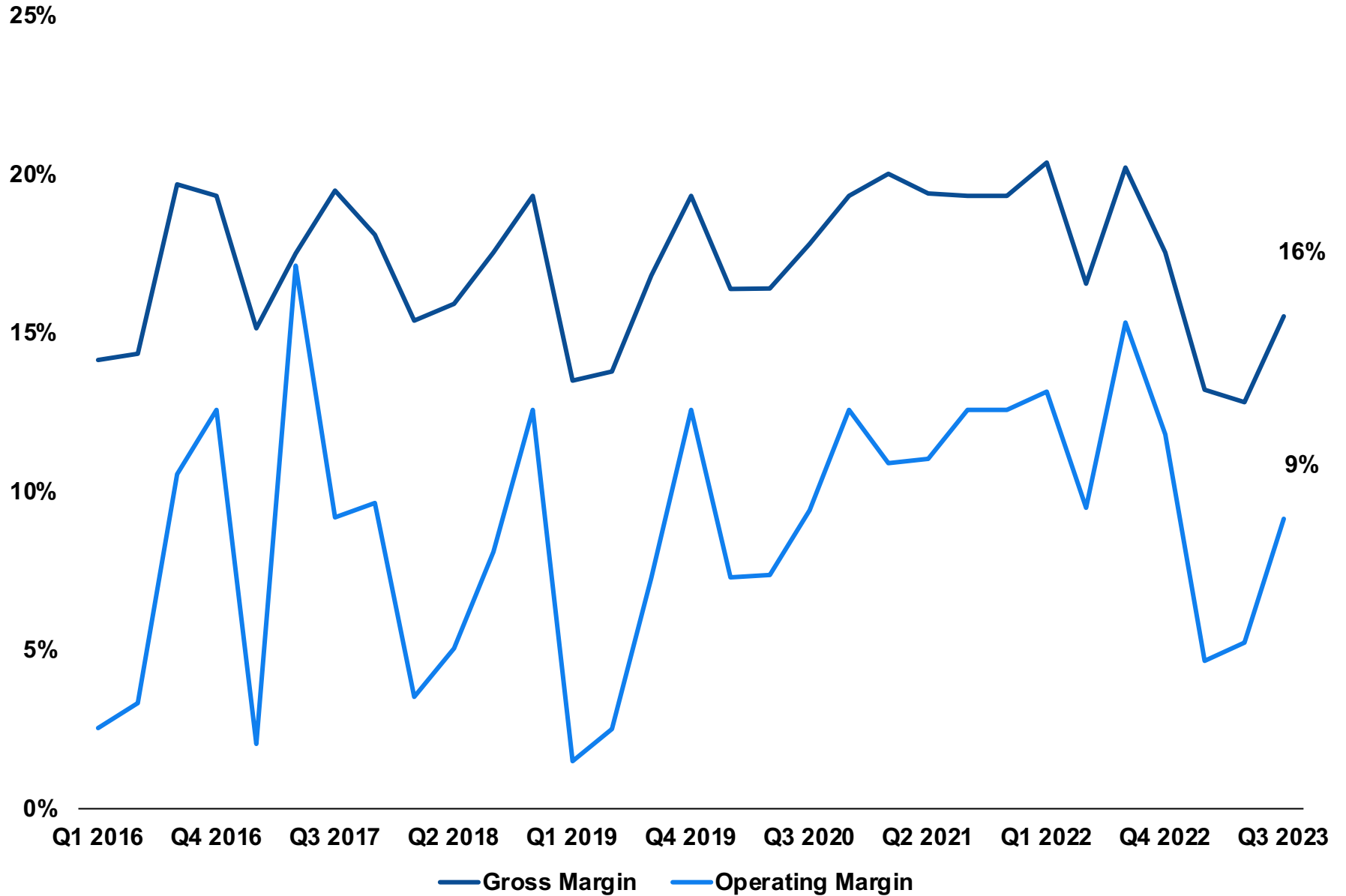
(1) AMKR 10-K



Amkor Revenue Mix (Forecast)



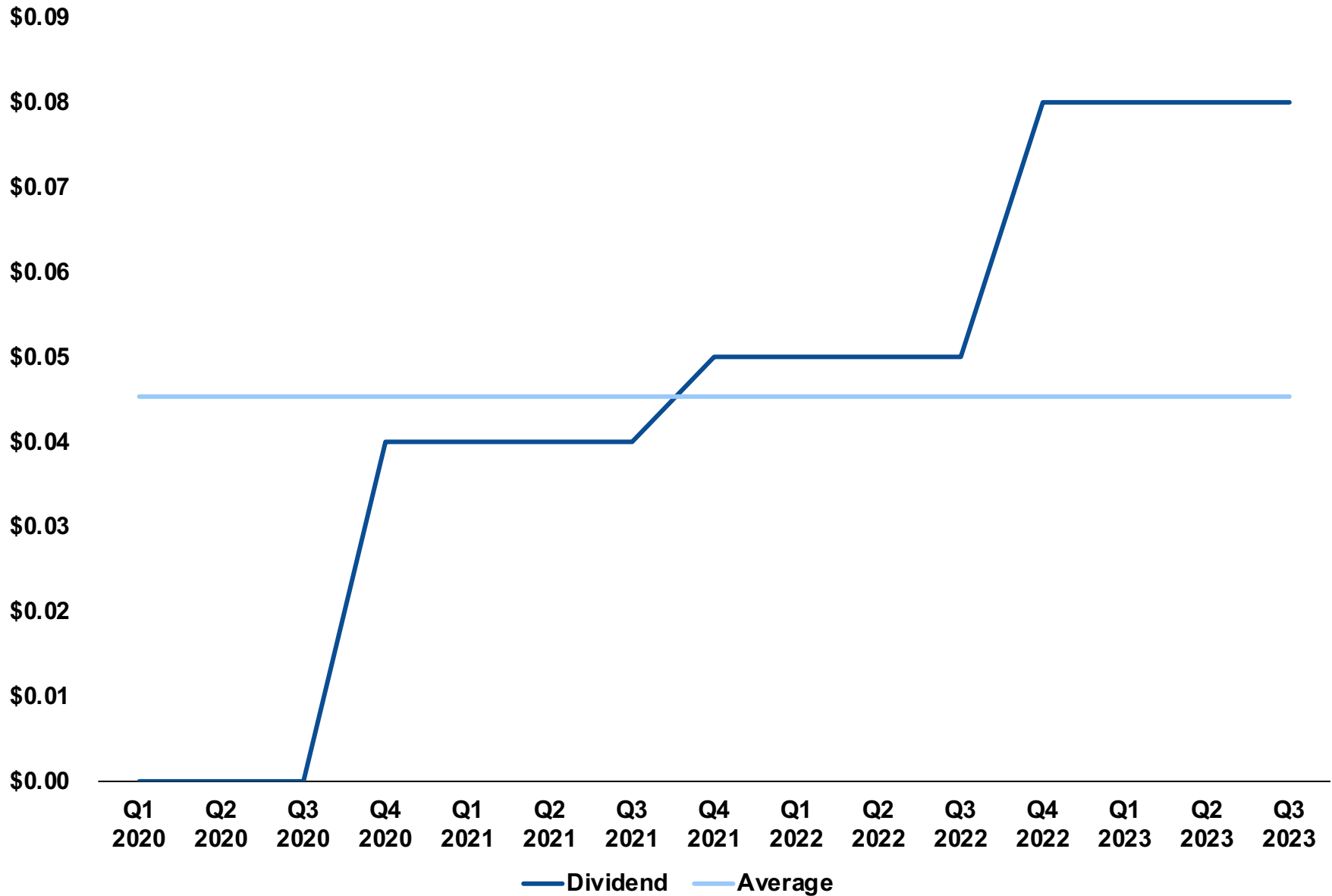
Amkor's Margins Historically



(1) Capital IQ



Dividends Per Share Growth



(1) CapIQ

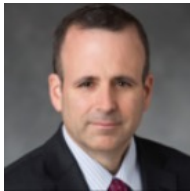
Limited Analyst Coverage



Coverage

Firm	Analyst	Recommendation	Tgt Px	Date
Morgan Stanley	Joseph L Moore "Jo..."	◆ Equalwt/In-Line	27.00	11/08/23
D.A. Davidson	Thomas Diffely "To..."	buy	30.00	10/30/23
Baptista Research	Ishan Majumdar	↑ buy	31.70	10/04/23
Sadif Investment An...	Team Coverage	↑ buy	29.76	07/26/23
ISS-EVA	ISS Eva Equity Rese...	buy		05/23/23

Morgan Stanley Initiation



Joseph Moore
Morgan Stanley Equity Research

- Currently covers 26 companies

Education:

- B.S. from University of California, San Diego
- MBA from Dartmouth College

Career:

- Morgan Stanley (2011-present)
- Goldman Sachs (1994-2011)





Potential for Domestic Capacity Buildout

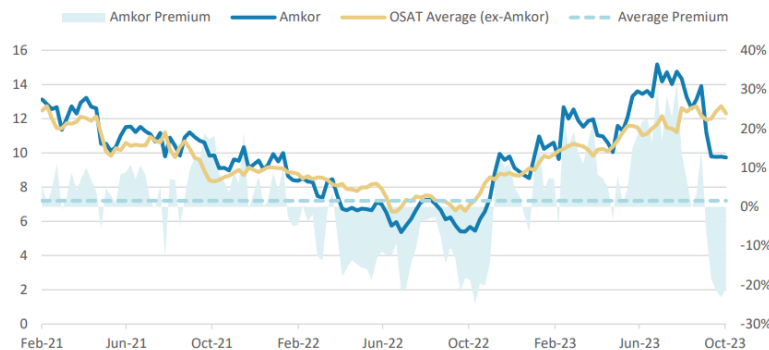
Coverage

“In the U.S., we are progressing our discussions to establish an advanced packaging and test facility. We have **submitted our pre-application for chips funding** and are **actively working with customers and partners on long-term commitments to secure a U.S. manufacturing supply chain**” – *Giel Rutten, Amkor Technology CEO & Director*

Domestic Capacity Would Potentially Give Amkor a Re-rating Opportunity

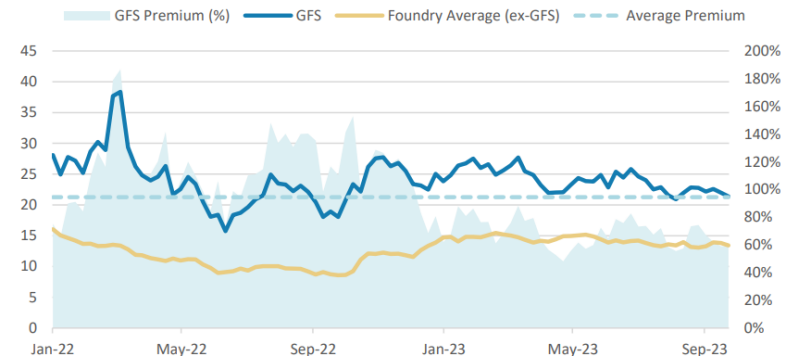
“Were Amkor to reshore capacity, and the **market starts to perceive Amkor as a domestic manufacturing player**, we see a **valuation re-rating opportunity**. On a 1-year forward PE, Amkor has traded at a 1.5% premium to its Taiwanese peers (ASE, King Yuan, Chipbond), compared to GFS which has traded at a 94.5% premium to its Taiwanese peers (TSMC, UMC, Vanguard)” – *Morgan Stanley Equity Research*

Exhibit 21: On PE, Amkor has traded at a 2% average premium over the past 3-years...



Source: FactSet, Morgan Stanley Research

Exhibit 22: Compared to GFS which has traded at a 95% average premium relative to its peers



Source: FactSet, Morgan Stanley Research

Amkor's Connection to 5G-Enabled Smartphone Technology Explained



Baseband

Baseband is the chip in a device that connects to mobile networks to deliver the connected experience. With improvements from 5G capabilities, baseband will need to meet standard requirements of the network to support better connectivity and bandwidth.

Apps Processor

The apps processor (applications processor) is “the brain of the smartphone”. It connects each function of the smartphone, and is comparable to a CPU of a computer. The applications processor contributes to smartphone performance.

Sub-system Modules

Subsystem modules refer to the different components within the smartphone, such as display subsystems or camera subsystems.

RF Front End

RF front end (radio frequency front end) is an encompassing term for the circuitry between a receiver's antenna input up to and including the mixer stage. It includes the components that processes signals from the receiver to the rest of the device.

Sub-6 Ghz & mmWave

Sub-6 Ghz and mmWave tech transmits voice and data through electromagnetic radio frequencies. mmWave refers to higher frequency radio bands (24Ghz to 40Ghz) and Sub-6 Ghz refers to mid and low-frequency bands (under 6Ghz).

Sensors

Examples of different sensors in the smartphone include GPS (global positioning system), fingerprint scanners, Face ID scanners, accelerometers to change phone orientation, and more.

Storage

Storage in smartphones can refer to internal and external storage. Internal storage consists of manufacturer-installed storage space inside the phone for the system software. External storage consists of a “removable storage medium, such as a microSD card”.

Wireless Charging

Wireless charging is enabled through creating a magnetic field around the smartphone to absorb and transfer into energy.



Management and Ownership

Giel Rutton, CEO



Joined Amkor in 2014 and served as Executive Vice President of Advanced Products until 2020 when he accepted the CEO role. More than 30 years of experience in the semiconductor industry.

Megan Faust, CFO



Joined Amkor in 2005 Served six years as Corporate Controller before stepping in as CFO. Prior to joining Amkor, she served as an auditor with KPMG.

James Kim, Executive Director



Appointed as Executive Chairman of the Board of Directors in October 2009. Served as Chief Executive Officer from 1997 until 2009. Founded predecessor, Amkor Electronics, Inc., in 1968.

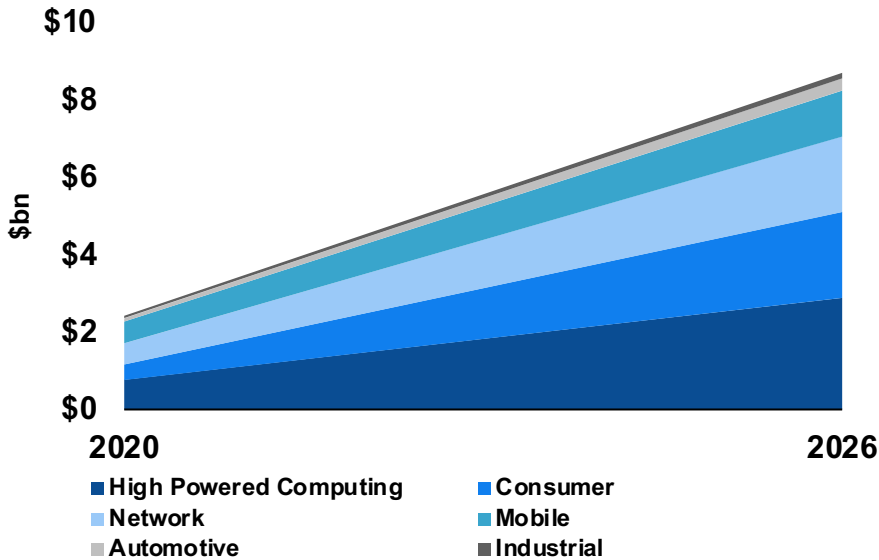
Kim Family Ownership

September 6, 2023, announced James Kim and Susan Y. Kim (Vice Chairman) sold 10 M shares. The shares are currently in the process of being reissued in a secondary underwritten public offering. JP Morgan and Morgan Stanley serve as joint lead book runners. Despite the sale, the Kim family and affiliates maintain majority ownership.

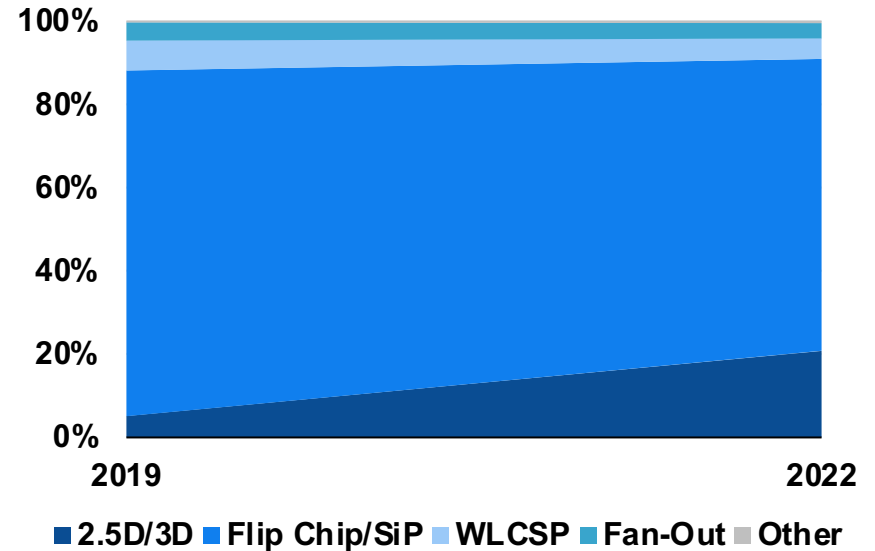


Advanced Packaging Market Info

Advanced Packaging End Market Size



Advanced Packaging by Type

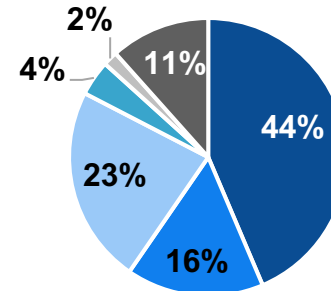


Advanced Packaging Costs



Same CPU with 2 more chips of 32mb L3 Cache and the price goes from \$300 -> \$450

OSAT Market Share By Region

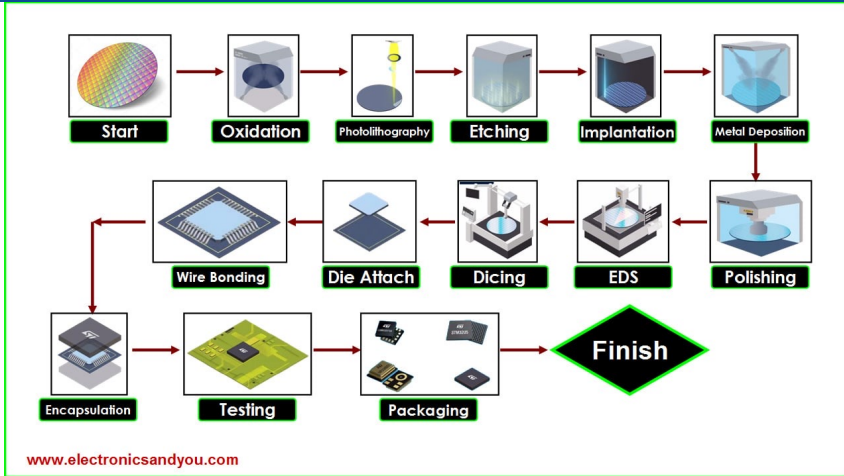


- Taiwan
- US
- China
- South Korea
- Singapore
- Other

Semiconductor Reference Material



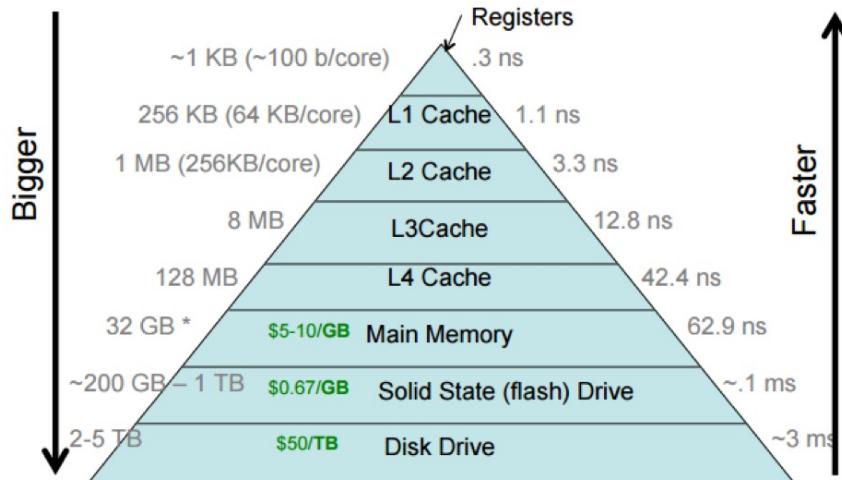
The Semiconductor Process



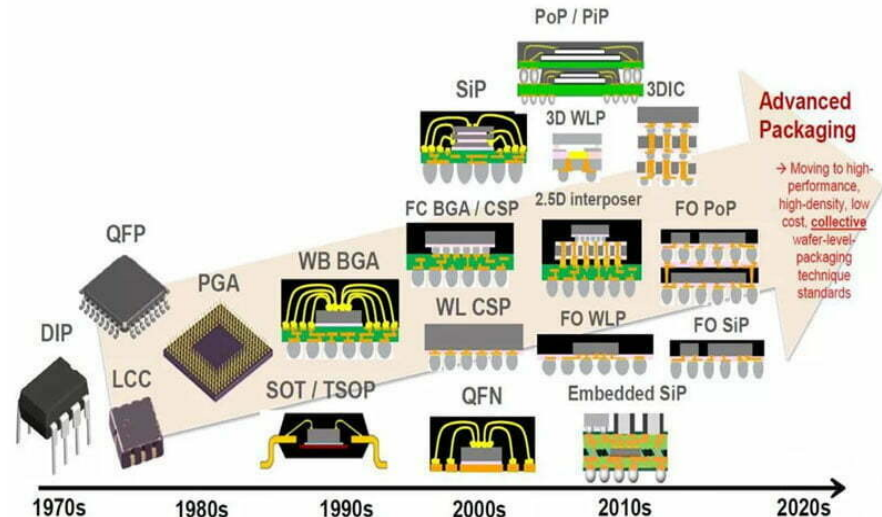
Packaging Use Cases



Memory Hierarchy



Advanced Packaging Tech Over Time





Amkor Institutional Ownership Changes from 6/30/23 to 9/30/23

Top 5 Institutions Increasing Ownership

- 1 **Mirae Asset Global Investments**
Up 464.8%
- 2 **CWM Advisors**
Up 295.0%
- 3 **GHP Investment Advisors**
Up 12.4%
- 4 **STRS Ohio**
Up 9.0%
- 5 **New York State Teachers Retirement System**
Up 0.5%

Top 5 Institutions Decreasing Ownership

- 1 **Denali Advisors**
Down 35.2%
- 2 **Yousif Capital Management**
Down 2.3%
- 3 **BNY Mellon**
Down 1.7%
- 4 **Hanson & Doremus Investment Management**
Down 1.0%
- 5 **State of Alaska, Department of Revenue**
Down 0.2%