

The Uneven Rise of China's Semiconductor Industry



21 January 2021
Equity Research | Asia Pacific

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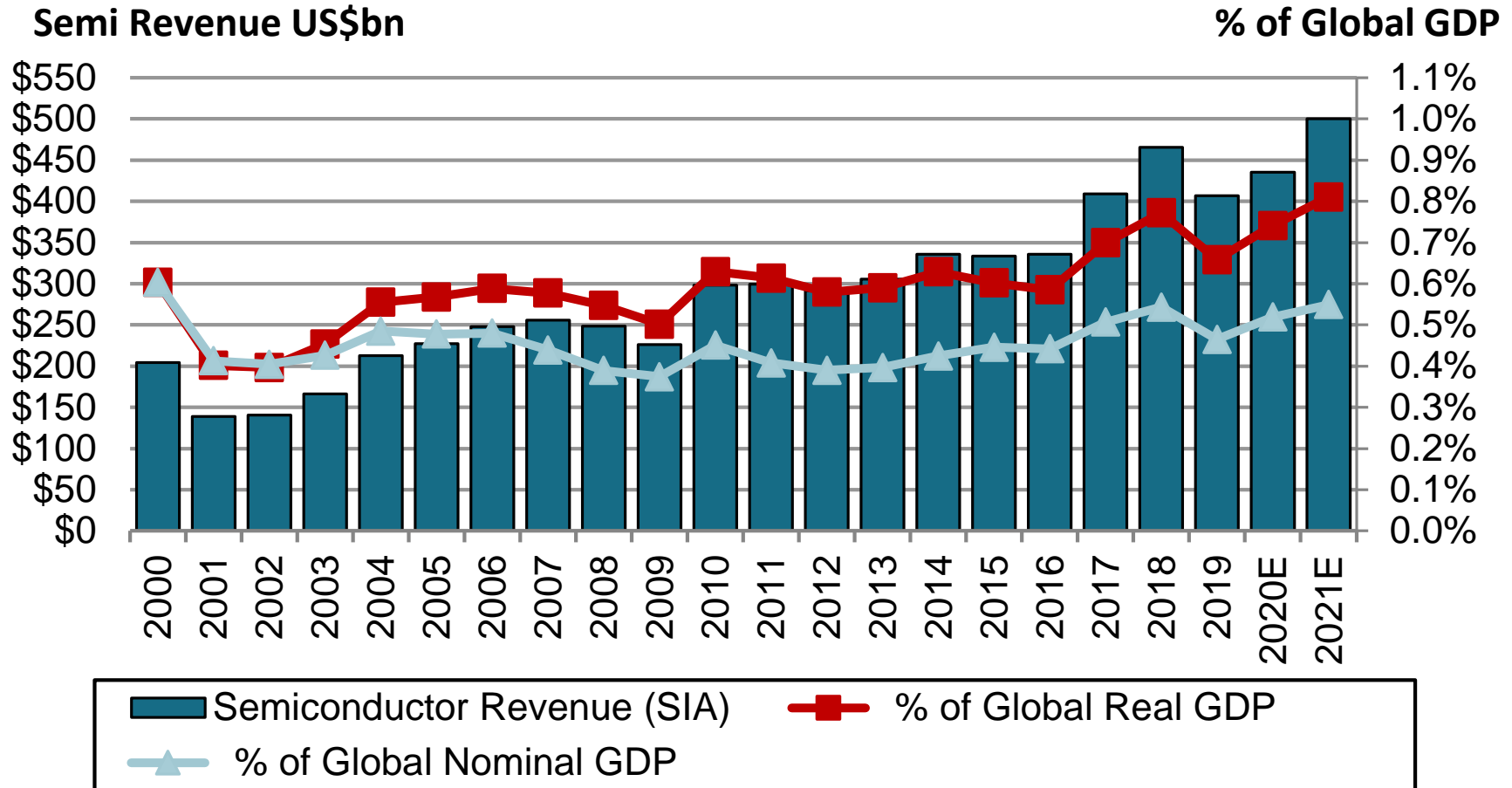
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Examining China's Semiconductor Self-Sufficiency

Present and Future Prospects

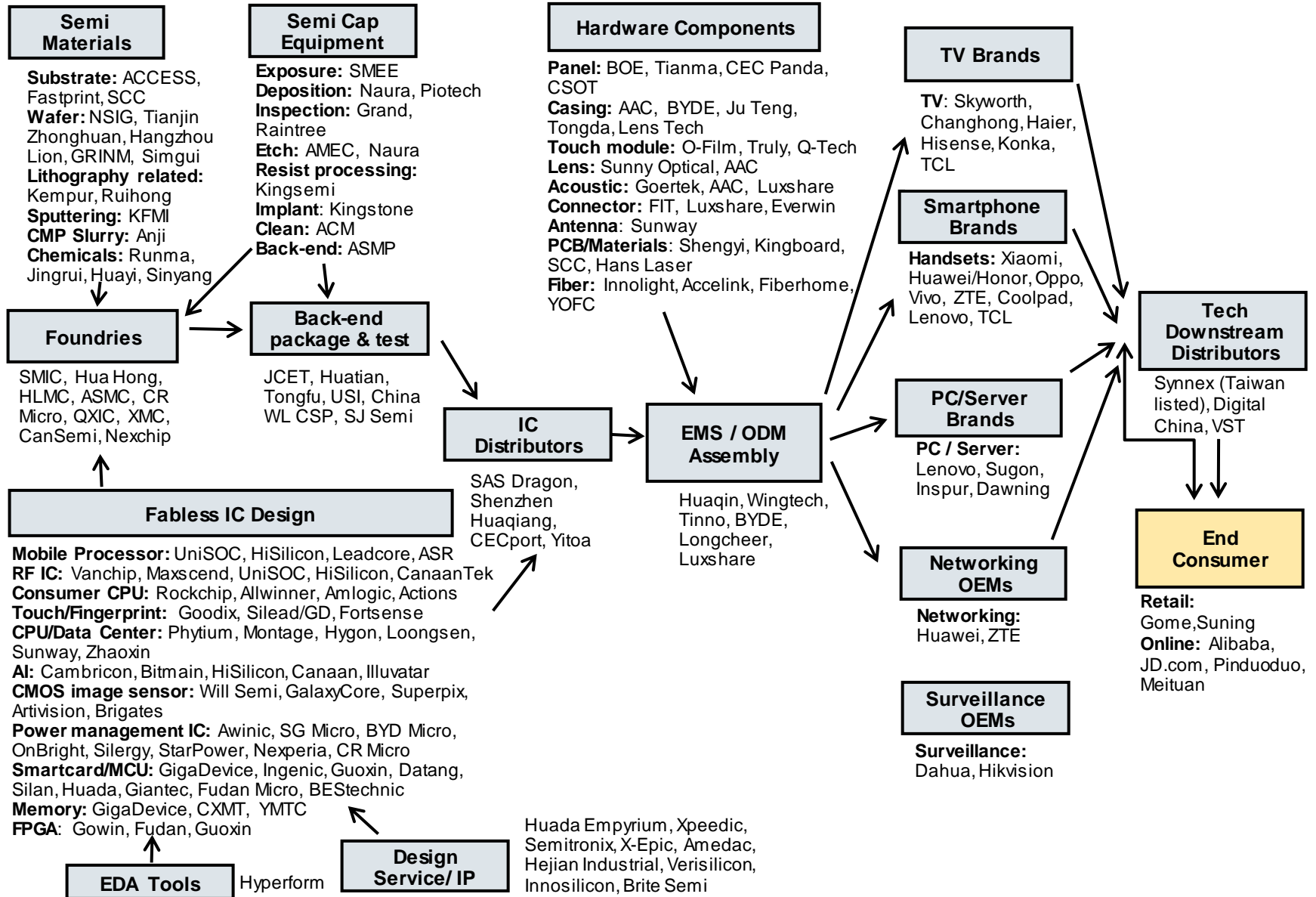
- China building a domestic tech supply chain, although semis have lagged
- Domestic market is 60% of IC consumption and 25% of end demand, but has only 5% semiconductor share
- Policy support through the IC fund, grants, tax breaks, Sci-Tech listings
- High valuations a cheap source of funding for domestic suppliers
- China suppliers having varying traction taking share: gaining in some IC categories and back-end, mixed in foundry and lagging in equipment/materials
- Domestic investment poised to continue in-spite of US resistance
- Stocks: CS picks across sectors to benefit from China's ecosystem rise

Semis growing as % of GDP, approaching \$500bn



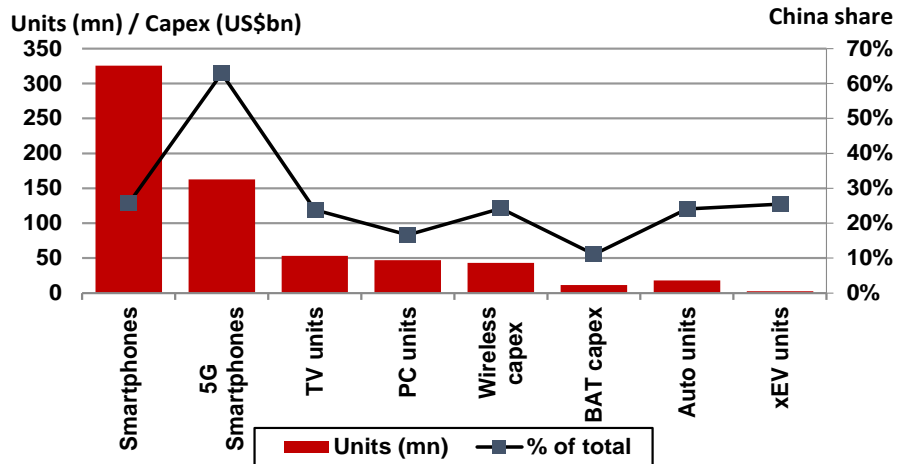
Source: SIA, Company data, Credit Suisse

China building out its tech and semi ecosystem

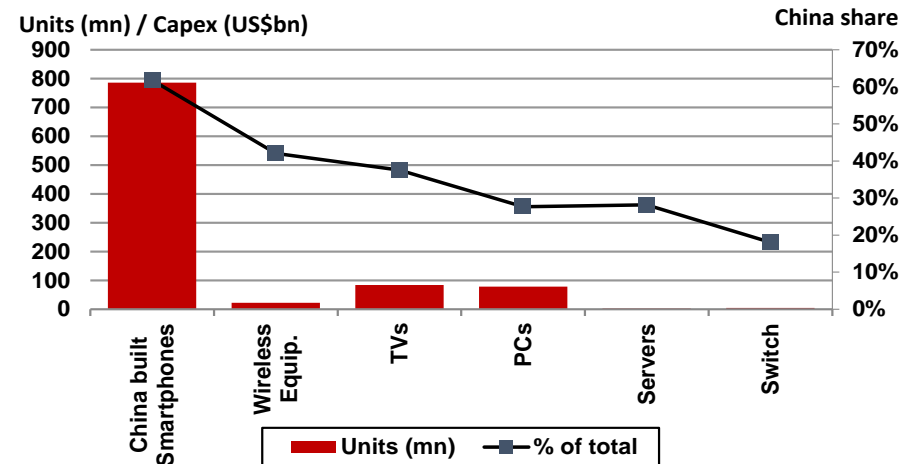


China ~25% of tech demand, 30-40% hardware share

China as a market about 25% of tech product demand



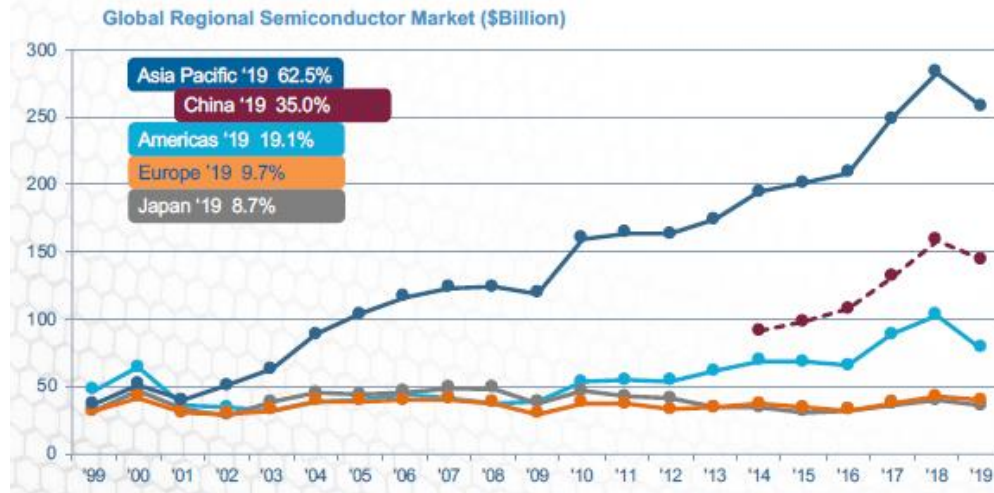
China domestic suppliers gaining higher global share



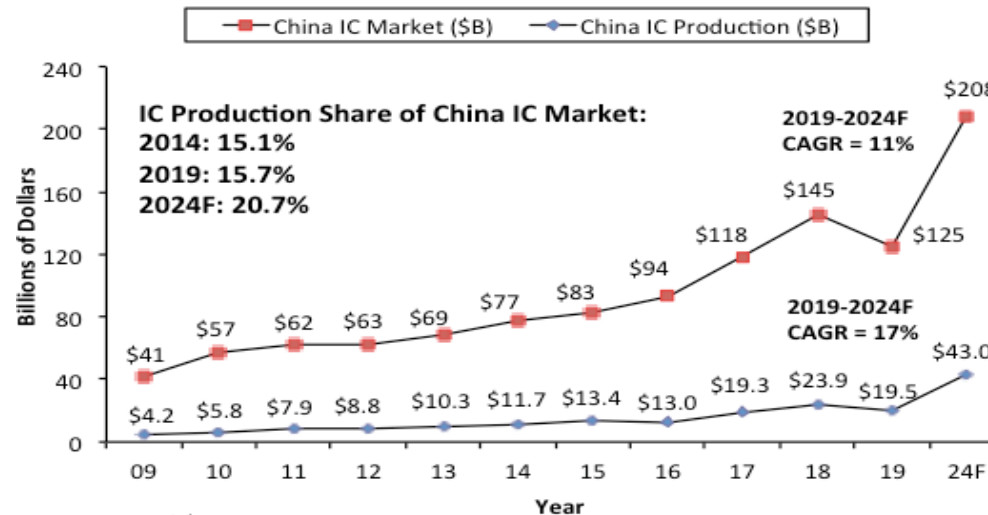
Source: IDC, Omdia, Company Data, Credit Suisse research

China targeting ICs to close its gap to consumption

China semiconductor sales at US\$150bn as of 2019, but includes shipments re-exported as final products to other geographies



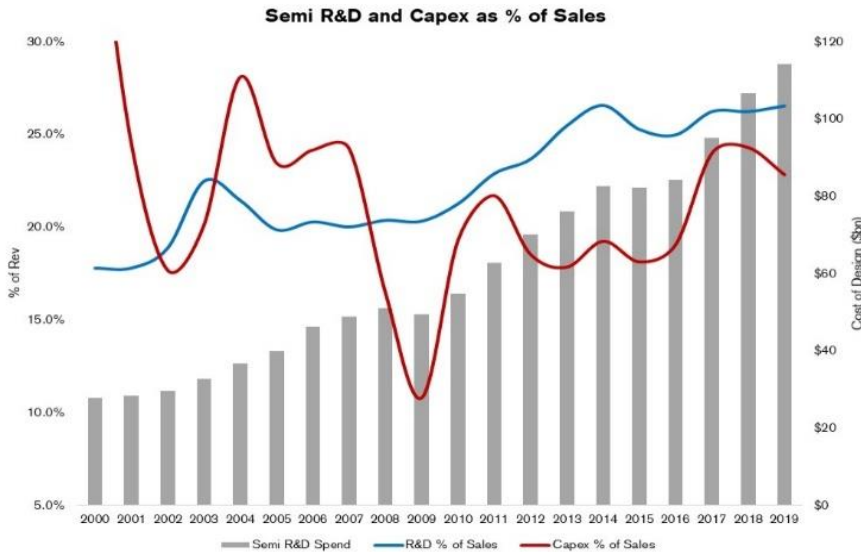
China IC manufacturing still far lagging consumption



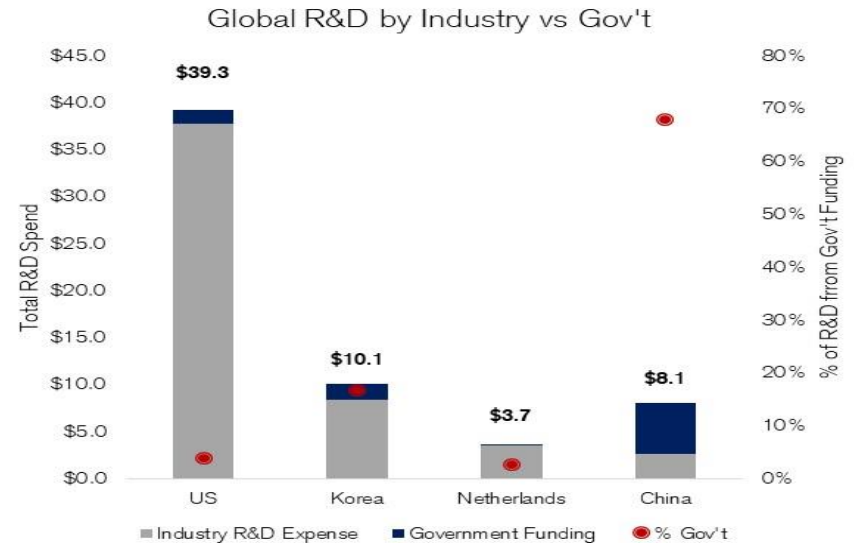
Source: IC Insights

Semiconductors R&D and Capex intensity a barrier

Semis as R&D intensive as it is capex-intensive



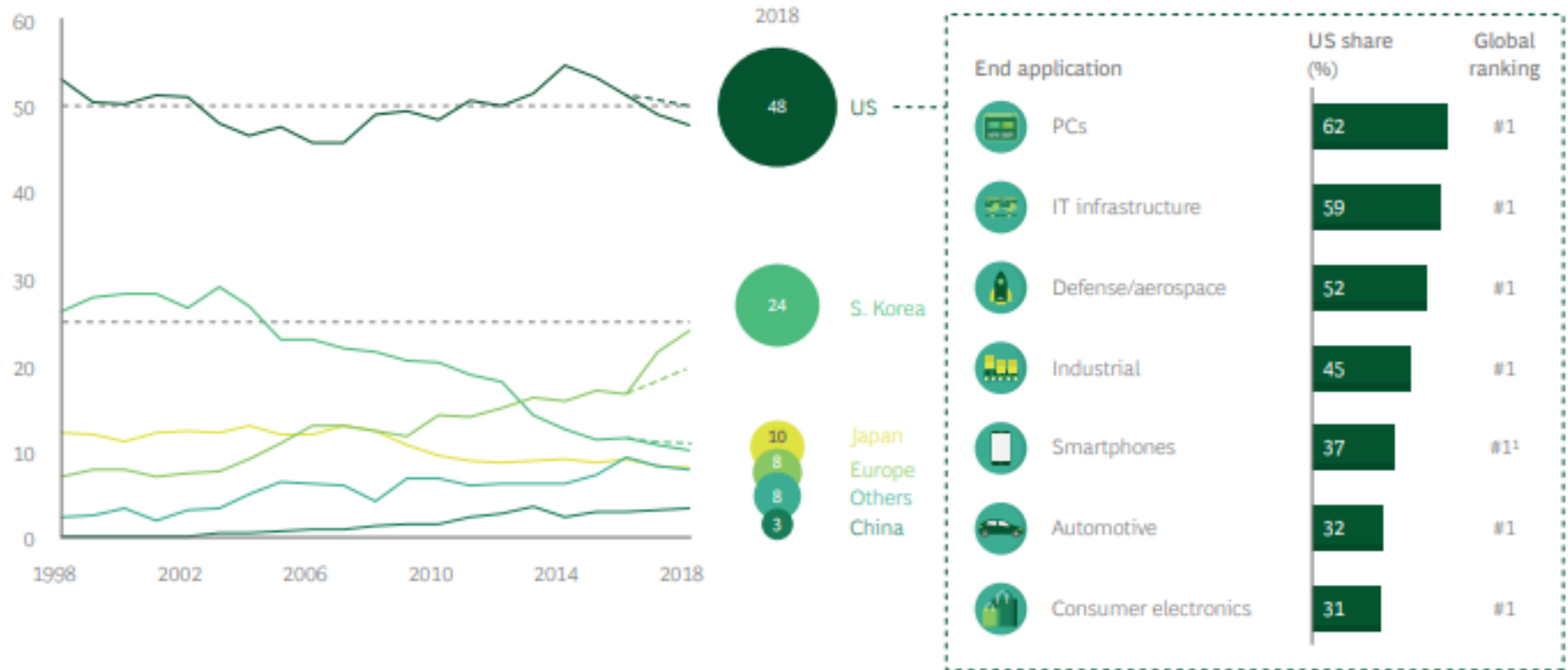
China semi R&D has lagged even with Gov't support



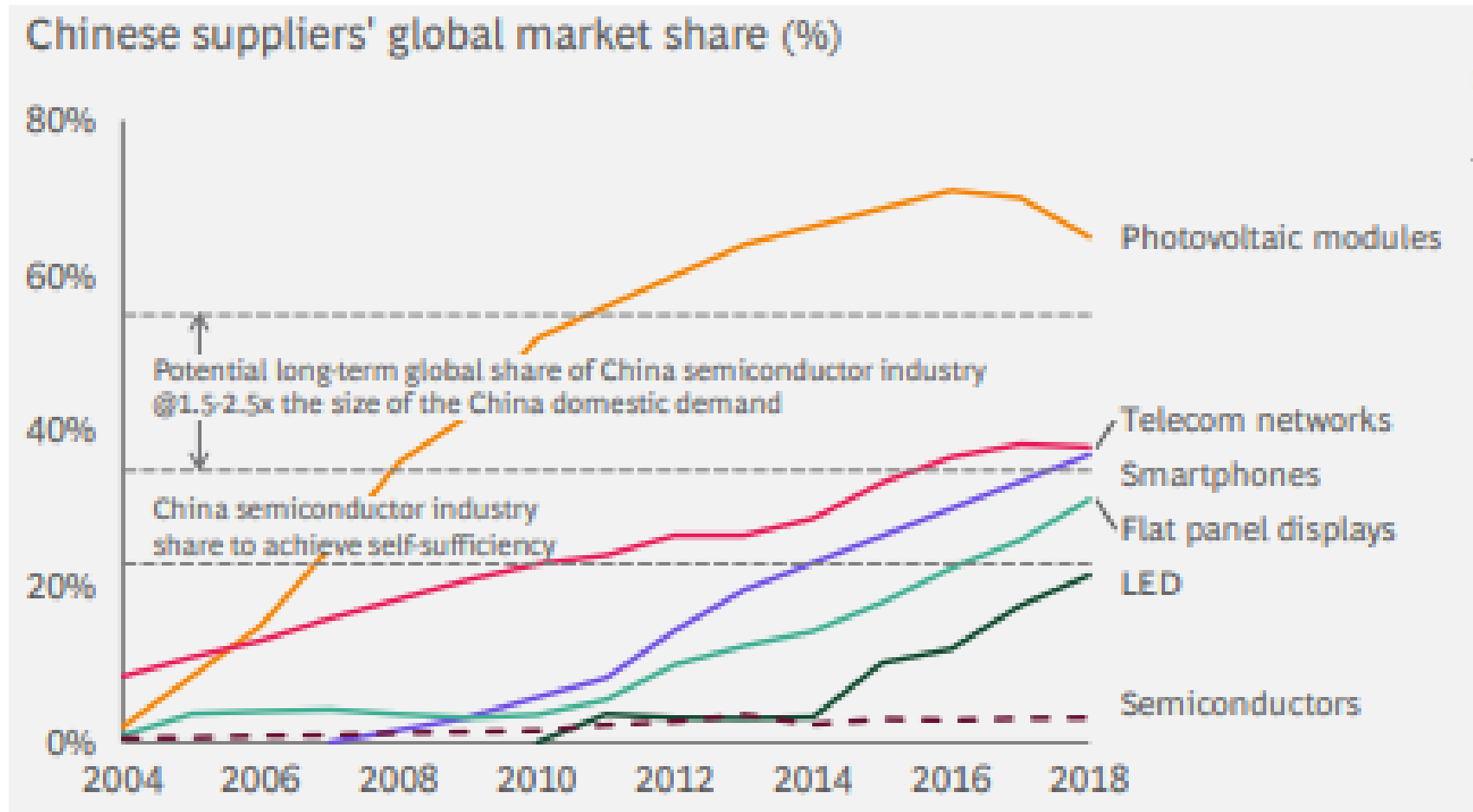
Degrees of barriers for overseas companies to Chinese semiconductor efforts

MOST INSULATED								LEAST INSULATED
	EDA	Front End Equipment	High-end Analog	DRAM	Logic/SoC	Back End & Test	Microcontrollers	NAND
Chinese Companies	Hyperform	SMEE, Naura, Piotech, Grand Raintree, AMEC, Kingsemi, Kingstone, ACM	Awinic, SG Micro, BYD Micro, OnBright, StarPower, CR Micro	Ingenic/ISSI, CXMT	Phytium, Montage, Hygon, Loongsen, Sunway, Zhaoxin, HiSilicon, Rockchip, Allwinner, Amlogic, Actions, Vanchip, Maxscend, UniSOC, CanaanTek, ASR	JCET, Huatian, Tongfu, USI, China WL CSP SJ Semi	CEC Huada Semi, Unigroup, Will Semi, GigaDevice, Fudan Micro Silan, Giantec, NationZ	YMTC
ROW Companies	Cadence, Synopsis, Mentor Graphics	AMAT, ASML, LRCX, Tokyo Electron, KLAC, SCREEN, Hitachi, Daifuku, ASMI, Murata, Nikon, Canon, Ebara, Tokyo Seimitsu, SEMES, NuFlare, BRKS, Wonik, Veeco, Aixtron, Lasertec, Axcelis, Ulvac, Disco, SMIT, Zeiss, Nova, Rudolph, Camtek	TXN, ADI, IFX, ST, SWKS, NXPI, MXIM, ON, MCHP, Renesas, MediaTek	Samsung, SK Hynix, Rohm, Toshiba, Winbond, MU	INTC, XLNX, Samsung, TXN, QCOM, AVGO, Samsung, MediaTek, Novatek, MRVL, Magnachip, Lattice, Siltronic	AMKR, ASE, OSE, Advantest, Anritsu TER	Renesas, NXPI, MCHP, MU, Samsung, WDC, STM, IFX, TXN, Samsung, INTC, Korea Memory, Toshiba, Macronix, Winbond	
China Marketshare %	~2%	~2%	3-5%	~1-2%	3-5%	~17%	~10-15%	~2-3%

US trying to protect share while China tries to grow



Rest of industry wary of share loss / margin erosion



China providing policy support for its IC industry

Target sector	Change	New	Old	Previous Policy
IC manufacturing	Added	Waive the 1 st 10 year corporate income tax for IC manufacturing companies or projects for 28nm or below if in operations for over 15 years	1st 5 years profit tax exempt & 50% reduction in the next 5 years for ICs <65nm set up after 1/1/18 or ICs <250nm set up before 12/31/17; 1st 2 years of profit tax exempt & 50% reduction in the following 3 years for IC <130nm set up after 1/1/18 or ICs <0.8 micro set up before 12/31/17.	Notice on Corporate Income Tax Policies for IC Manufacturing Companies (2018), Caishui Circular (2018)
IC design and software	Changed	Waive the first five-year corporate income tax after turning profitable, and lower the income tax thereafter to 10% (vs normal rate of 25%)	Waive the 1 st 2 years of corporate income tax after turning profitable, and cutting in half to 12.5% for the next 3 years	Announcement on Corporate Income Tax Policies for IC Design and Software Companies (2019)
IC manufacturing, packaging, materials	Added	Waive import tariffs for raw materials, consumables and semi equipment <65nm, specialty logic < 250nm, and compound semi & advanced OSAT <500nm	Waive Import tariffs for certain raw materials, consumables and some equipment for ICs <500nm (some apply to ICs <250nm or investment > Rmb8 bn).	Adjustment to the list of import tariff waiver for raw materials & consumable parts of IC companies (2015)
IC Industry	Expanded	2 nd National IC fund in 2019 (US\$29bn)	1st National IC fund in 2014 (US\$20bn) + US\$150bn of municipal/private funding	MIIT and China's Ministry of Finance Support
All IC companies	Added	Encourage and support IC companies to IPO in Sci-Tech Board or Growth Enterprises Market, with an accelerated IPO review process	List in Hong Kong, US as an A-Share	A Basket of Measures to Further Boost the Software and IC Industry (2011)

China's IC fund owns US\$21.4bn listed stocks

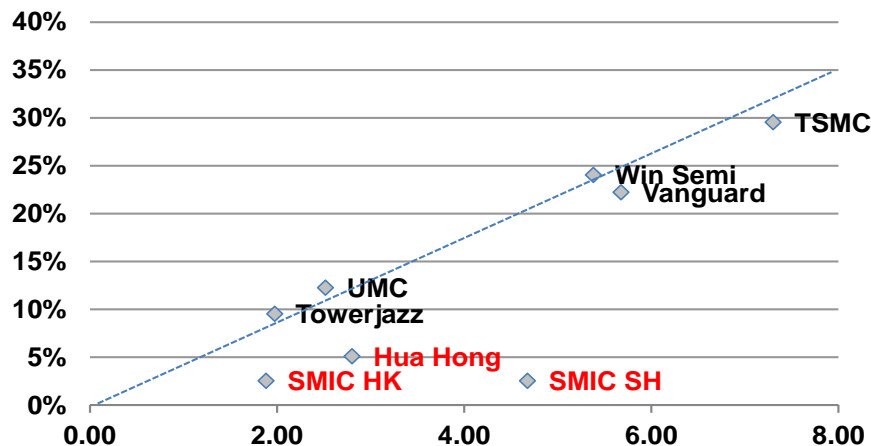
Listed companies	Priced 1/13/21	Company Description	Holding (shares, mn)				Holding % (ownership %)				IC Fund Holding (\$)	Total Market cap	2020E Sales	Price/ Sales
	Ticker		03/31/20	06/30/20	09/30/20	12/04/20	03/31/20	06/30/20	09/30/20	12/04/20				
NSIG	688126.SS	Bare Wafer	567.0	567.0	567.0	567.0	30.5%	22.9%	22.9%	22.9%	\$2,799	\$12,243	\$302	40.5
AMEC	688012.SS	Semi equipment	93.3	93.3	93.3	93.3	17.5%	17.5%	17.5%	17.5%	\$2,282	\$13,079	\$361	36.3
SMIC	0981.HK	Foundry	797.1	797.1	797.1	797.1	15.5%	14.0%	10.4%	10.4%	\$2,081	\$20,099	\$4,214	4.8
JCET	600584.SS	Back-end	304.5	304.5	304.5	288.5	19.0%	19.0%	19.0%	18.0%	\$2,073	\$11,516	\$3,873	3.0
Sanan	600703.SS	LED/RF Foundry	460.9	460.9	416.1	379.4	11.3%	11.3%	9.3%	8.5%	\$2,058	\$24,297	\$1,312	18.5
Naura	002371.SZ	Semi Equipment	49.2	49.2	44.3	44.3	9.9%	9.9%	8.9%	8.9%	\$1,531	\$17,168	\$853	20.1
Hua Hong	1347.HK	Foundry	242.4	242.4	242.4	242.4	18.8%	18.7%	18.7%	18.7%	\$1,331	\$7,114	\$951	7.5
Gigadevice	603986.SS	MCU/NOR	30.0	39.2	34.5	34.5	9.3%	8.3%	7.3%	7.3%	\$1,151	\$15,719	\$708	22.2
Tongfu	002156.SZ	Back-end	250.6	239.2	227.7	227.7	21.7%	20.7%	19.7%	17.1%	\$998	\$5,827	\$1,596	3.7
CR Micro	688396.SS	Analog/Foundry	34.2	78.1	78.1	78.1	2.9%	6.4%	6.4%	6.4%	\$832	\$12,942	\$1,046	12.4
Goodix	603160.SS	Sensor & Touch IC	25.6	25.6	21.3	21.1	5.6%	5.6%	4.7%	4.6%	\$517	\$11,216	\$1,098	10.2
BDStar Navigation	002151.SZ	GPS ICs/Modules	58.8	58.8	49.0	49.0	12.0%	12.0%	9.6%	9.6%	\$401	\$4,161	\$544	7.7
Verisilicon	688521.SS	IP & Design Service	34.7	34.7	34.7	34.7	8.0%	8.0%	7.2%	7.2%	\$374	\$5,218	\$252	20.7
WLCSP	603005.SS	Back-end	21.7	27.1	27.1	27.1	9.4%	8.4%	8.4%	8.4%	\$332	\$3,931	\$188	20.9
Sai Microelectronics	300456.SZ	MEMS/GaN Process	88.4	88.4	88.4	88.4	13.8%	13.8%	13.8%	13.8%	\$314	\$2,268	\$123	18.4
Jingjia Micro	300474.SZ	GPUs	27.5	27.5	27.5	27.5	9.1%	9.1%	9.1%	9.1%	\$302	\$3,306	\$120	27.5
Anji Micro	688019.SS	CMP/Resist	6.1	6.1	6.1	6.1	11.6%	11.6%	11.6%	11.6%	\$269	\$2,329	\$61	38.0
Yoke Technology	002409.SZ	Semi/Display Material	26.5	26.5	26.5	26.5	5.7%	5.7%	5.7%	5.7%	\$267	\$4,666	\$419	11.1
Rockchip	603893.SS	Consumer/IoT APs	25.9	25.9	25.9	25.9	6.3%	6.3%	6.3%	6.3%	\$252	\$4,003	\$278	14.4
Ingenic	300223.SZ	MCU, video, memory	0.0	16.8	16.8	16.8	0.0%	3.7%	3.6%	3.6%	\$212	\$5,904	\$73	80.6
Hangzhou Changchuan	300604.SZ	IC Test	31.0	31.0	31.0	31.0	9.9%	9.9%	9.9%	9.9%	\$180	\$1,823	\$120	15.2
Goke Micro	300672.SZ	STB, SSD, IoT SOC	26.3	26.3	26.3	26.3	14.6%	14.6%	14.6%	14.6%	\$177	\$1,212	\$113	10.7
Wanye	600641.SS	Inv. Fund / Ion Implant	56.4	56.4	67.7	67.7	7.0%	7.0%	7.1%	7.1%	\$167	\$2,357	\$182	12.9
Wuxi Taiji Industry	600667.SS	Back-end & Chem fiber	130.0	130.0	108.9	108.9	6.2%	6.2%	5.2%	5.2%	\$160	\$3,087	\$2,588	1.2
Ninestar	002180.SZ	Printer/NFC ICs	32.1	32.1	32.1	32.1	3.0%	3.0%	3.0%	3.0%	\$128	\$4,248	\$3,120	1.4
Wuxi Chipown	688508.SS	Analog and LED ICs	7.5	7.5	7.5	7.5	8.9%	8.9%	6.7%	6.7%	\$93	\$1,400	\$64	21.8
Wingtech	600745.SS	ODM/Nexperia Analog	4.0	3.1	unknown	unknown	0.4%	0.3%	unknown	unknown	\$61	\$22,255	\$9,977	2.2
NavInfo	002405.SZ	Auto map, service, ICs	13.2	13.2	11.0	11.0	0.7%	0.7%	0.6%	0.6%	\$27	\$4,758	\$372	12.8
3peak Incorporated	688536.SH	Analog ICs	0.3	0.3	unknown	unknown	0.4%	0.4%	unknown	unknown	\$21	\$4,893	\$93	52.5
Expressif	688018.SS	Wifi/Bluetooth ICs	1.2	1.2	0.8	0.8	1.5%	1.5%	1.0%	1.0%	\$17	\$1,685	\$128	13.2
Beken	603068.SS	BT/Wifi/Audio ICs	1.4	1.4	1.4	1.4	0.7%	0.7%	0.7%	0.7%	\$15	\$1,968	\$182	10.8
Chipsea	688595.SS	MCU, BT/Wifi ICs	1.2	1.2	1.2	1.2	1.6%	1.6%	1.2%	1.2%	\$11	\$885	\$59	15.1
Allwinner	300458.SZ	Consumer/IoT APs	2.0	2.0	unknown	unknown	0.6%	0.6%	unknown	unknown	\$10	\$1,704	\$250	6.8
MEMSensing	688286.SS	MEMs devices	0.4	0.4	0.4	0.4	1.1%	1.1%	0.8%	0.8%	\$9	\$1,097	\$55	20.0
										8.9%	\$21,449	\$240,378	\$35,676	6.7

China also has 45 high profile private IC companies

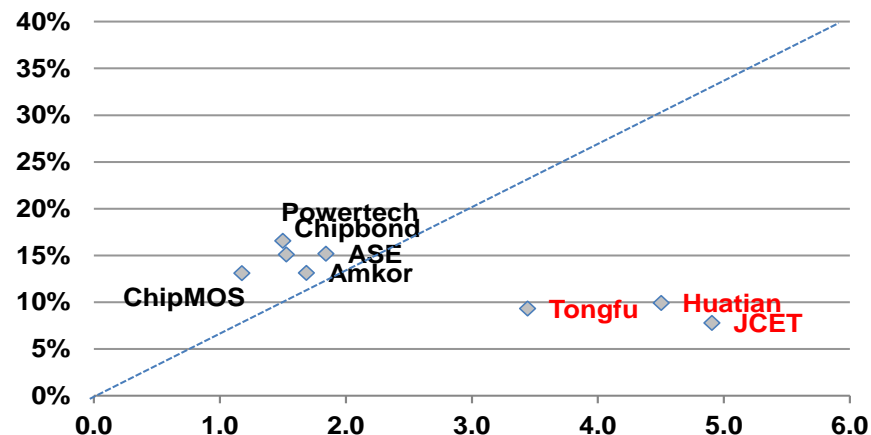
#	Company	Chinese name	Description
1	ACM Research Shanghai (Parent Co listing in US)	盛美股份(上海)	Equipment for wafer fab and back-end
2	Actions Technology	炬芯科技	TWS SoC
3	Analogix	硅谷数模	Display interface IC (DP, HDMI, USB)
4	Anhui North Core Linkage Microsystem	安徽芯动联科微系统	MEMS Gyro Sensor
5	ASR Micro	翱捷科技	Mobile and IoT AP and connectivity
6	AWINIC Tech	艾为电子	Analog, mixed signal and RFIC
7	Betterlife	贝特莱电子	Touch, AMOLED driver, fingerprint IC
8	Blue Rocket Electronics	蓝箭电子	Power discrete and IC
9	Bluetrum	中科蓝讯	TWS, audio SoC
10	Brigates Micro	锐芯微	CMOS image sensors
11	Bright Semiconductor	博蓝特半导体	Substrate
12	BYD Semiconductor (Parent listing in HK)	比亚迪半导体	IGBT, CMOS image sensos
13	C*Core Technology	苏州国芯科技	IP, Custom design, fingerprint IC
14	Cai Qin Technology	灿勤科技	Filter, antenna
15	Chaoyang Micro	朝阳微电子	PMIC, AFE, and AI IoT IC
16	Circuit Fabology Microelectronics Equipment	芯基微电子装备	Direct write lithography and PCB tools
17	CRRC Times Electric's IGBT sub. (Parent listing in HK)	中车电气	IGBT
18	Dosilicon	东芯半导体	NOR, NAND, DRAM
19	ETEK Micro	力芯微	Power and analog IC
20	Everbright Photonics	长光华芯光电技术	Laser chip, VCSEL, Opto devices
21	FerroTec Hangzhou Semiconductor Wafer	杭州中欣晶圆半导体	Silicon wafer
22	Galaxy Microelectronics	银河微电	Diodes, linear IC
23	Galaxycore	格科微	CMOS Sensors and Driver Ics
24	Goertek's MEMS subsidiary	歌尔股份MEMS子公司 (分拆上市)	MEMS microphone and sensors
25	Innotron Memory	睿力集成	DRAM
26	Longsys	江波龙	NAND flash product
27	Loongson	龙芯中科	CPU
28	Macmic science & technology	宏微科技	Power discrete
29	MooreElite	摩尔精英	IC custom design
30	Nexchip (Powerchip's China JV)	晶合集成	Foundry for DDIC, CIS, PMIC and eNVM
31	Oriental Semi	东微半导体	MOSFET, IGBT
32	Phytium	飞腾	ARM CPU for PC and server
33	PowerTech Laser	联动科技	Semi discrete IC tester
34	Puya Semi	普冉半导体	NOR flash and EEPROM IC
35	Sage Micro	华澜微电子	SSD, USB, and memory controller IC
36	Shanghai Fudan (now listing in HK)	上海复旦	Smart card and MCU
37	Shanghai Microelectronics	上海微电子	Equipment for wafer fab and OSAT
38	SICC	山东天岳先进科技	SiC substrate
39	SKY Technology Development	中科仪	Equipment for semi, solar etc
40	Sun.King's IGBT business (Parent listing in HK)	赛晶半导体	IGBT
41	UniSOC	紫光展锐	Smartphone SoCs and RFICs
42	U-Precision Tech	华卓精科	Equipment
43	Vanchip	唯捷创芯	RF Power Amplifiers
44	WeEn Semi	瑞能半导体	Power discrete
45	Zuhzhou CRRC Times Electric	株洲中车时代	IGBT

High China valuations provide access to capital

China foundries at similar multiples despite lower ROE

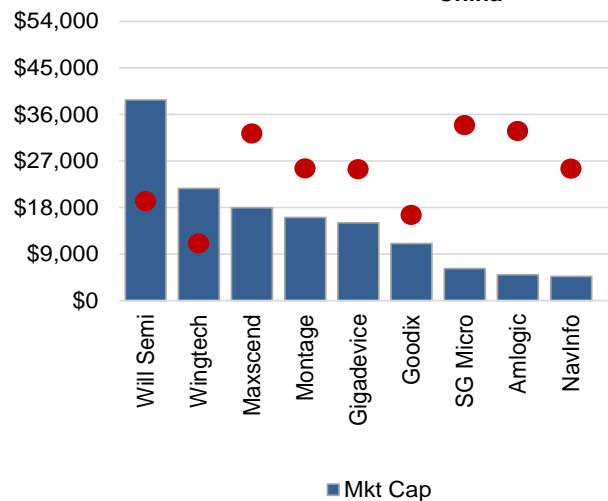


China back-end at a large premium despite lower ROEs



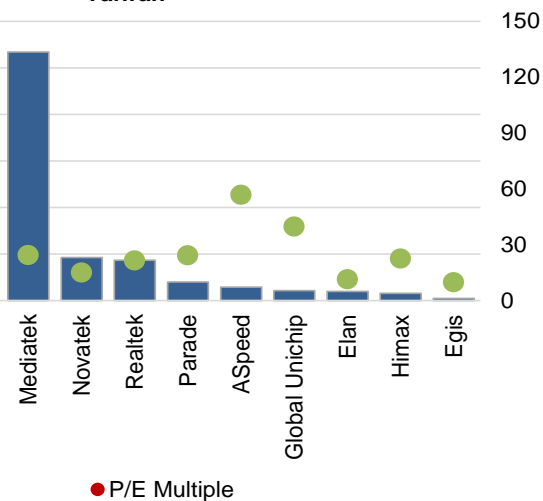
China fabless at a substantial premium P/E to Taiwan (60-90x vs. 20-25x)

Market cap (US\$mn)

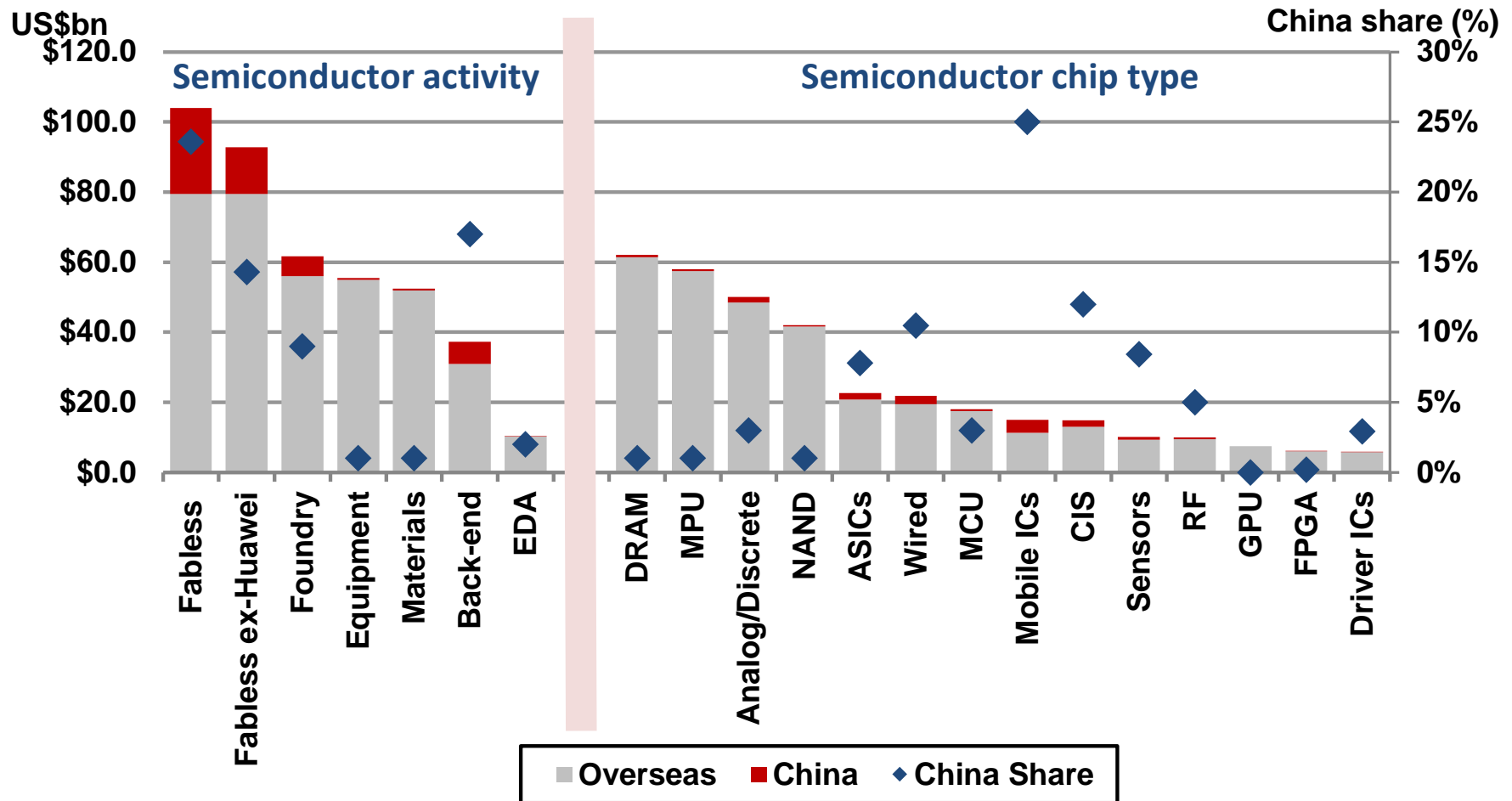


Taiwan

P/E multiple (x)



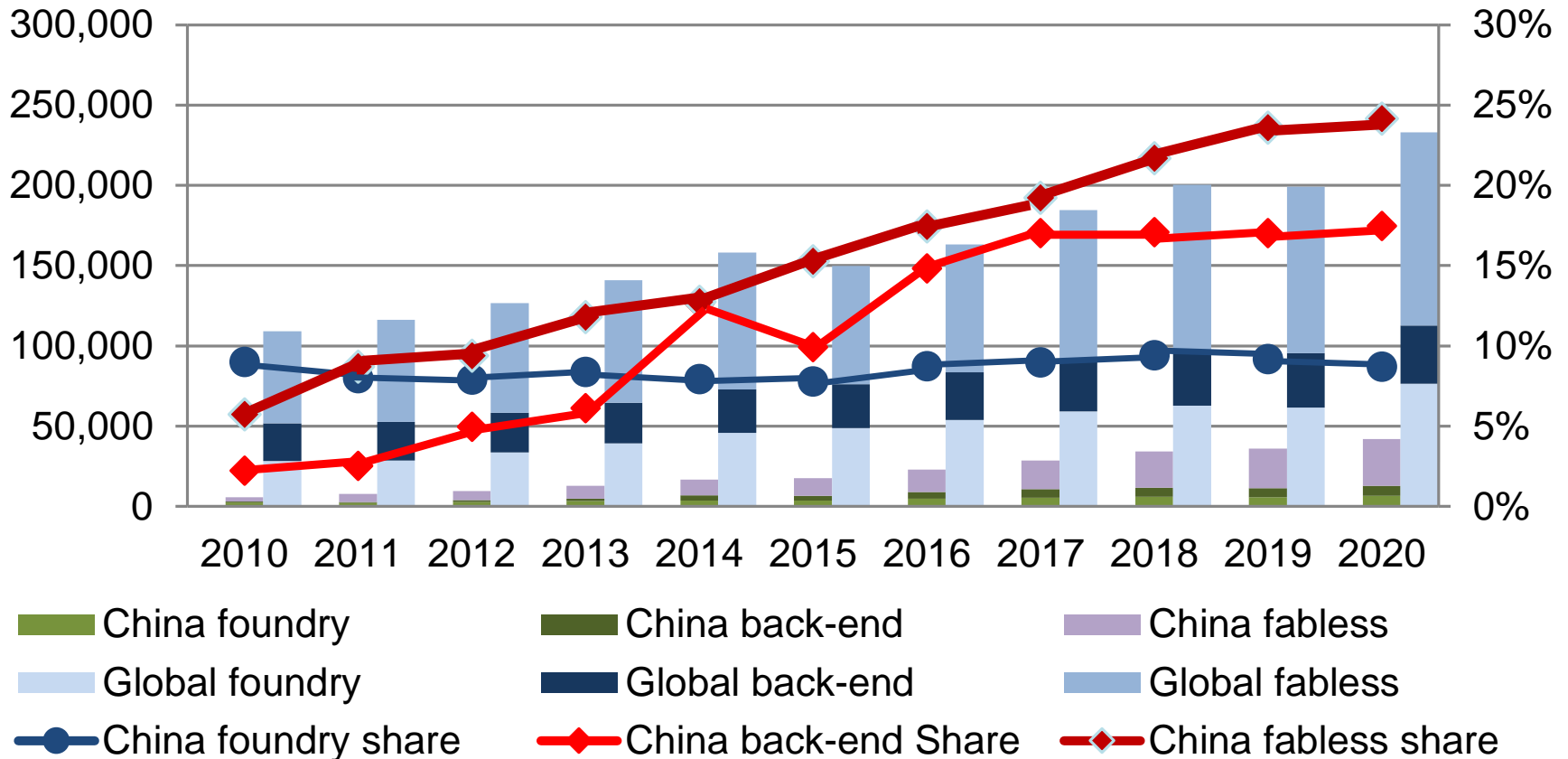
China's IC progress is uneven across the sectors



China has been gaining in manufacturing & design

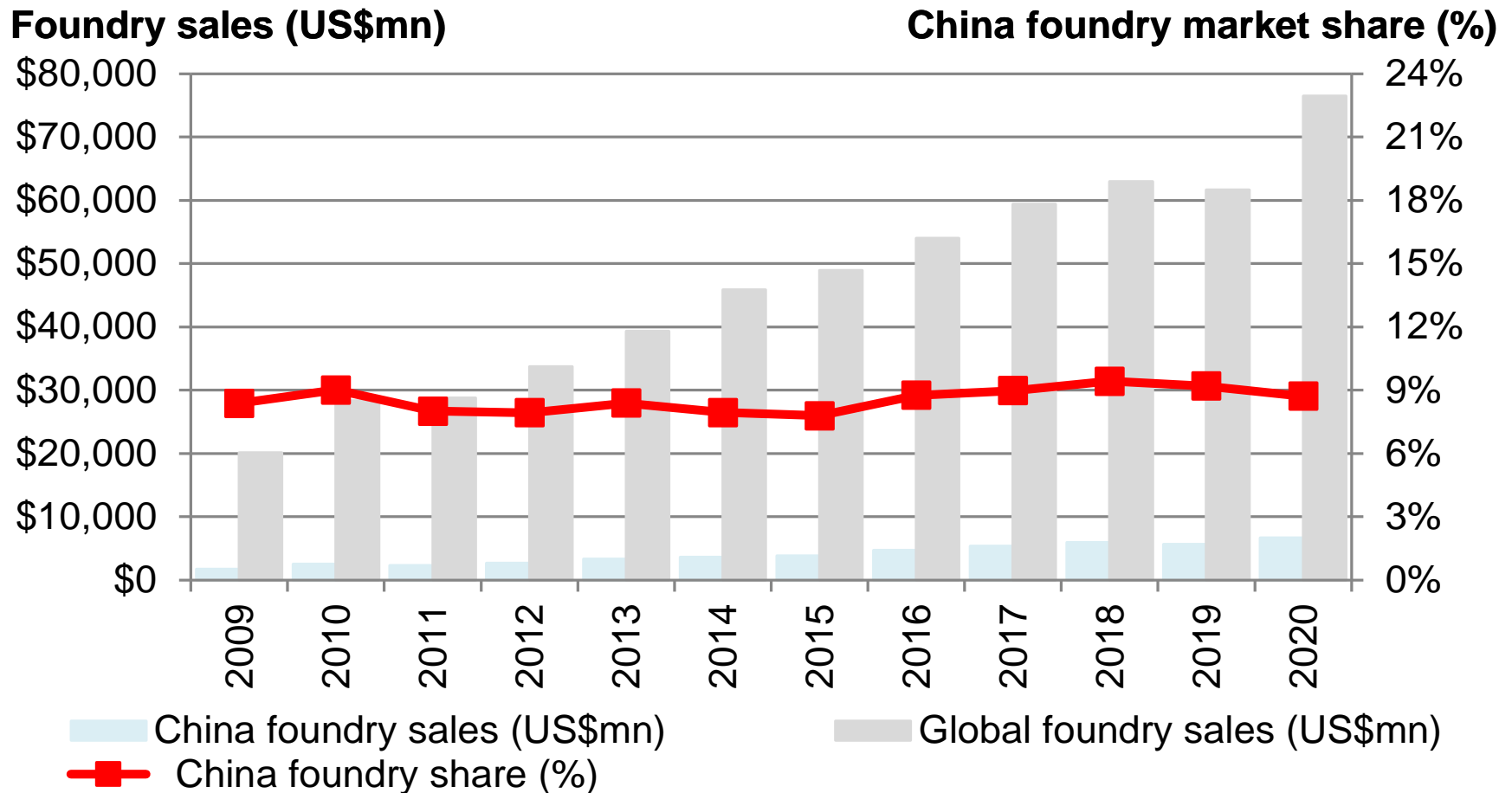
Semiconductor sales (US\$m)

China market share (%)



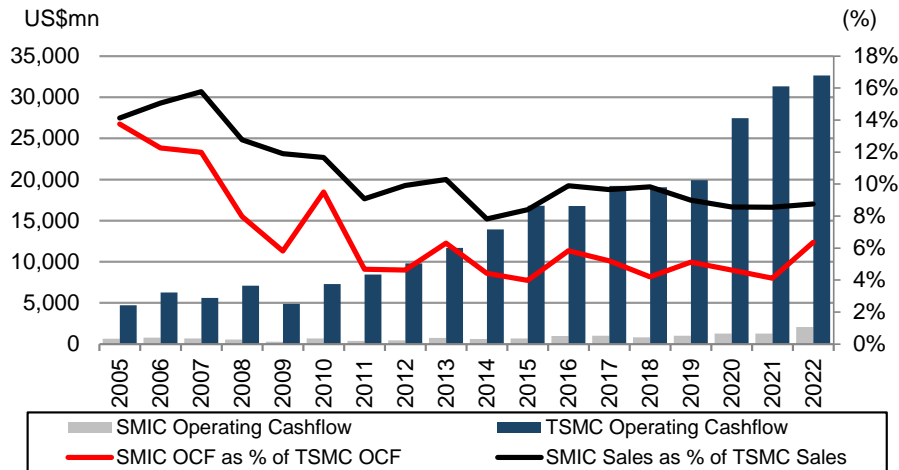
Source: Company Data, Gartner, Credit Suisse research

China foundry share stagnant



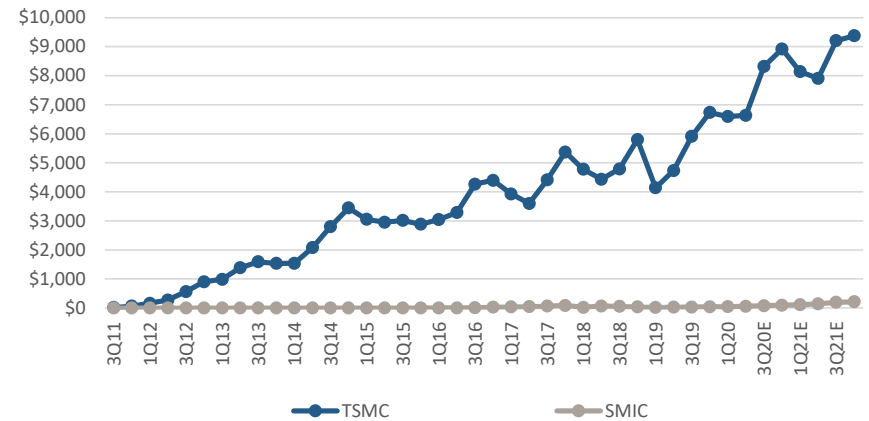
TSMC retains a wide gap over China's leader SMIC

SMIC <10% of TSMC's sales and cash flow



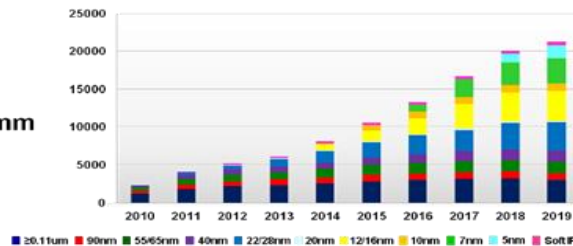
TSMC 28nm and below outpaces SMIC

28nm and below revenue



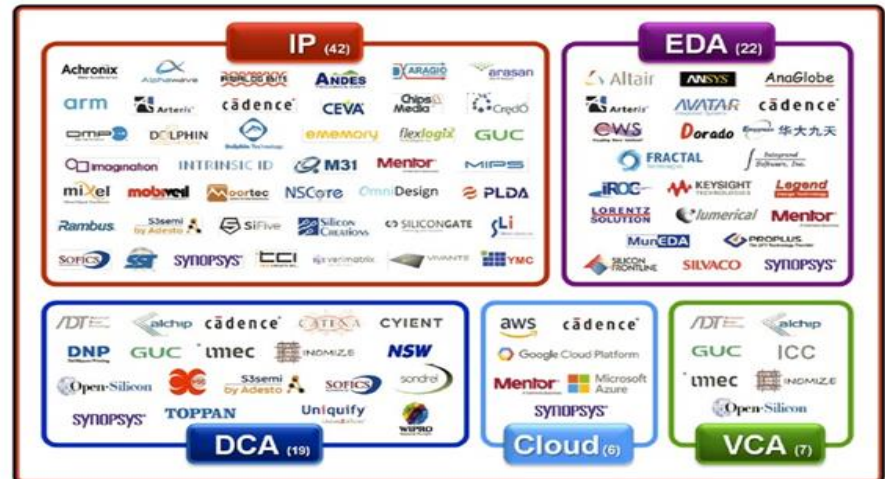
TSMC qualifying a large IP pool on its process

- 21,000 IP titles
- All major IP types
- From 0.35um to 5nm



MTP/OTP					
Standard Cell / IO	PVT Sensor	AV CODEC	MIPI	SATA	Electrical Fuse
ADC/DAC	Security	SD/MMC	PCIe/PCiX	Embedded DRAM	
SRAM	Inter-Connectivity	HDMI	DDR/LPDDR	Embedded MRAM	
PLL	Oscillator	DSP	LVDS	USB	Embedded RRAM
	Voltage Regulator	CPU / GPU Core	XAUI	IIC/IIS	Embedded Flash
Foundation IP	Analog IP	Soft IP	Interface IP	Embedded Memory	

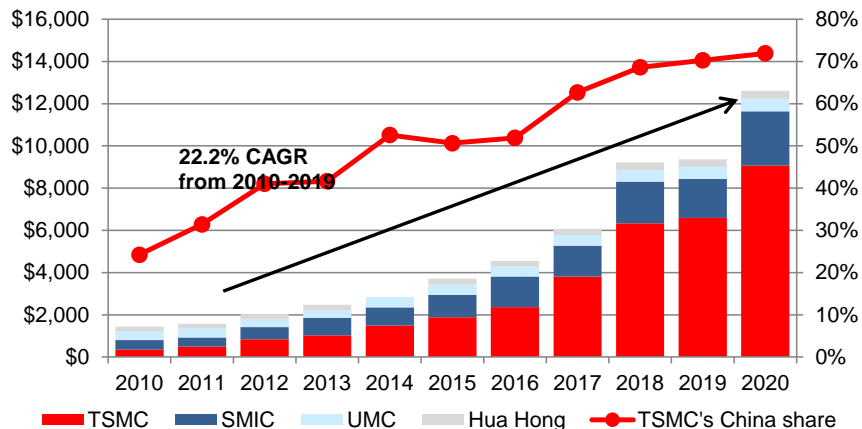
TSMC has built a wide ecosystem of partners



TSMC outpacing SMIC at local China fabless

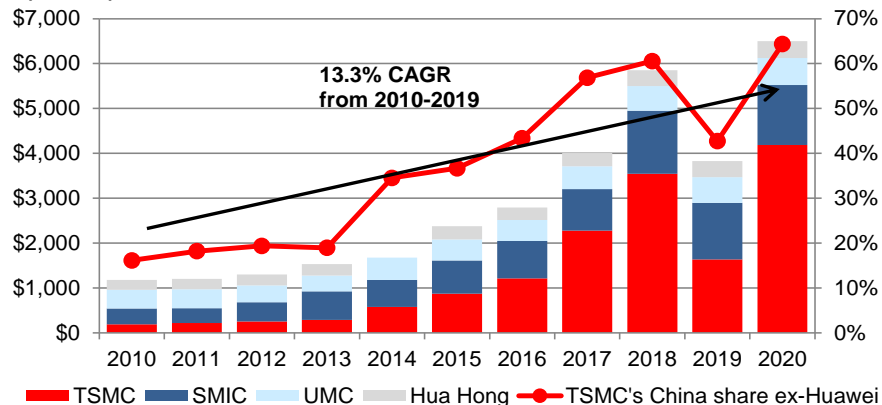
TSMC has gained share of China customers

Foundry sales in China (US\$mn)



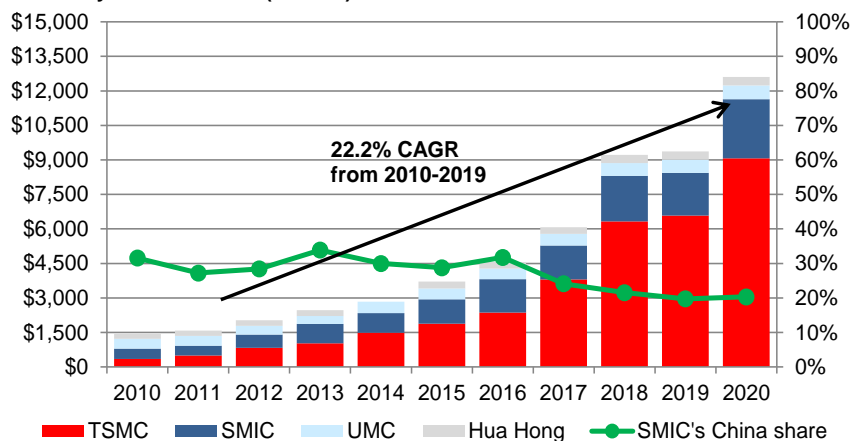
TSMC gains ex-Huawei have slowed

Foundry sales in China ex-Huawei (US\$mn)



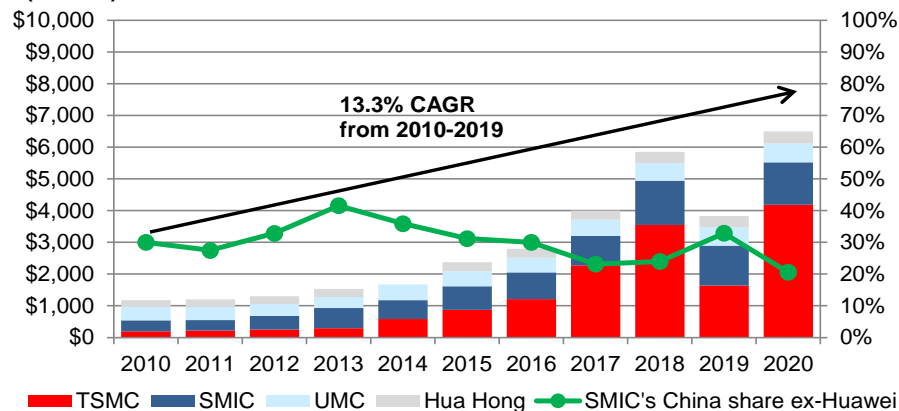
SMIC has lagged TSMC's share gains

Foundry sales in China (US\$mn)



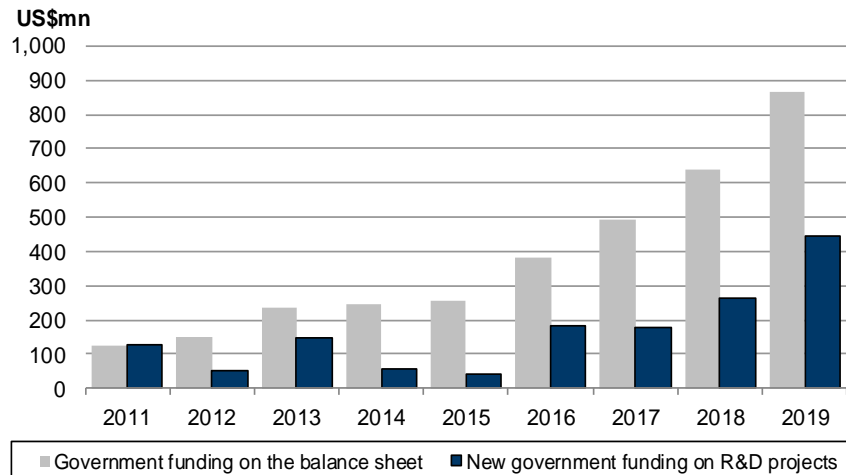
SMIC share ex-Huawei has declined

Foundry sales in China ex-Huawei (US\$mn)

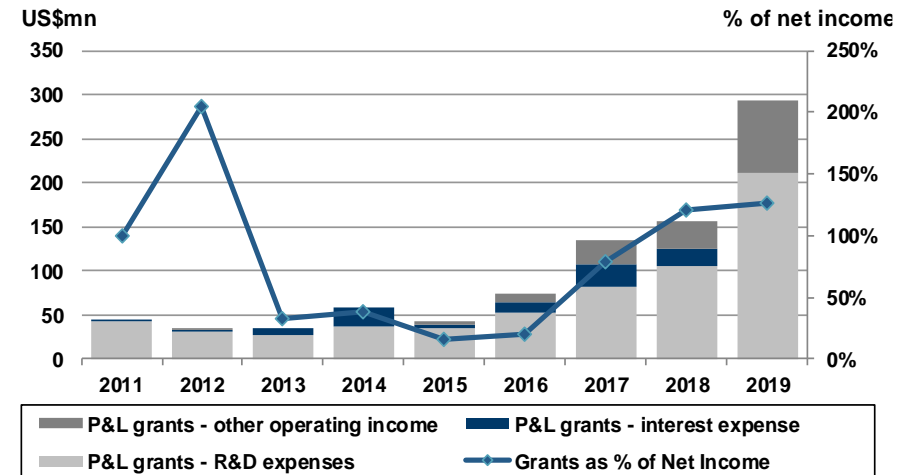


China funding advanced nodes, targeting specialty

SMIC's government funding for R&D ramping up



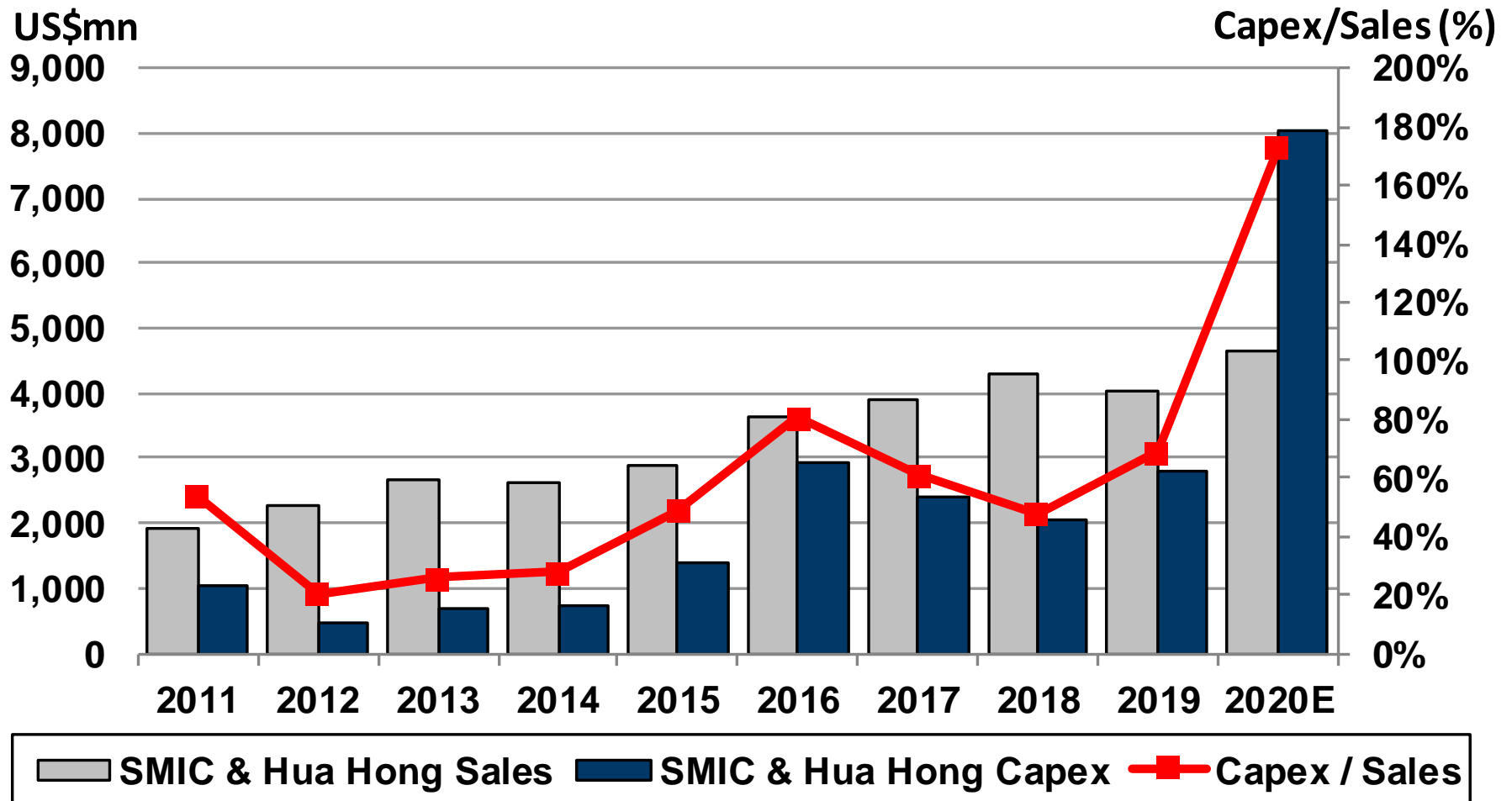
Government grants recognized continues to grow



Foundries also targeting specialty IC applications

Company		Node						Application								Capacity in 2019		
English	Chinese	0.35-0.5µm	0.11-0.25µm	90nm	65/55nm	45nm	14-40nm	Logic	Analog	Power	Display driver IC	CMOS image sensor	Memory	Radio frequency	MEMS	6"	8"	12"
CR Micro	华润微	✓	✓					✓	✓	✓				✓	✓	116	111	
ASMC	上海先进	✓								✓					✓	24	29	
XMC	武汉新芯			✓	✓	✓		✓				✓	✓	✓				135
Huali	上海华力				✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			169
CanSemi	粤芯		✓	✓				✓	✓	✓	✓	✓						36
Nex chip	晶合集成		✓	✓				✓			✓							45

China foundries' capex above their sales in 2020



Source: Company Data, Credit Suisse research

China has 15-20% foundry capacity growth planned

Company	Location	Wafer Size	Node	4Q17	4Q18	4Q19	4Q20	Max Capacity	Status
SMIC	Multiple Sites	8"	350-90nm	101.8	112.6	101.3	110.7	150.0	Mature
SMIC	Beijing	12"	90nm-28nm	46.0	42.0	52.0	52.0	52.0	Fully built
SMIC	Beijing 2A JV	12"	40nm	29.0	33.0	41.0	56.0	70.0	Ramping
SMIC	Beijing New Phase	12"	28nm	0.0	0.0	0.0	0.0	100.0	Announced
SMIC	Shanghai JV	12"	14nm	0.0	0.0	3.0	7.0	70.0	Ramping
SMIC capacity build-out in China:				176.8	187.6	197.3	225.7	442.0	
ASMC/GTA	Shanghai	5/6/8"	500-350nm	16.0	17.0	18.0	19.6	26.7	Mature
ASMC/GTA	Shanghai	12"	65nm BCD	0.0	0.0	0.0	3.0	50.0	Planning
CanSemi	Guangzhou	8"	180-90nm	0.0	0.0	16.0	20.0	24.0	Started 2019
CR Micro	Qongqing	8"	350-180nm	0.0	0.0	0.0	0.0	30.0	Planning
Hua Hong	Shanghai F1-F3	8"	350-90nm	74.7	77.3	79.1	80.4	90.0	Mature
Hua Hong	Wuxi F7	12"	90-65nm	0.0	0.0	10.0	20.0	80.0	Planning
Huali	Shanghai F5	12"	55-40nm	35.0	35.0	35.0	40.0	40.0	Fully built
Huali	Shanghai F6	12"	28-14nm	0.0	0.0	0.0	10.0	40.0	Ramping
Powerchip	Hefei	12"	90-65nm	0.0	6.0	15.0	25.0	40.0	Started 2018
SiEn	Qingdao	8"	350-110nm	0.0	0.0	0.0	0.0	35.6	Planning
SiEn	Qingdao	12"	90-28nm	0.0	0.0	0.0	0.0	40.0	Planning
TSMC	Nanjing	12"	16nm	0.0	10.0	10.0	20.0	80.0	Started 2Q18
UMC	Xiaman: F12X	12"	40-28nm	11.5	17.0	17.0	17.0	25.0	Ramping
XMC	Wuhan	12"	90-45nm	30.0	40.0	50.0	60.0	80.0	Ramping
Other foundries capacity build out in China				167.2	202.3	250.1	315.0	681.2	
Total capacity build out in China				343.9	389.9	447.4	540.7	1123.2	
YoY capacity growth					13%	15%	21%		

Source: Company Data, Credit Suisse research

China capacity build-out extends to memory/analog

Origin Country	Company	Fab Site	Wafer size	Segment	Node (nm)	Installed (WPM)	Next phase	Final Capacity
China	Can Semi	Guangzhou	8"	Foundry	180-90nm	20,000	4,000	24,000
China	CR Micro	Qongqing	8"	IDM	0.35-0.18um	0	30,000	30,000
China	CXMT	Hefei	12"	DRAM	19nm	20,000	30,000	125,000
China	Fujian Jinhua	Fujian	12"	DRAM	25nm	On Hold	0	60,000
China	GTA Semi/ASMC	Shanghai	8"	Foundry	0.35-0.18um	10,000	60,000	60,000
China	GTA Semi/ASMC	Shanghai	12"	Foundry	65nm BCD	3,000	47,000	50,000
China	Hua Hong JV	Wuxi	12"	Foundry	90-55nm	20,000	20,000	80,000
China	Huali Micro	Pudong	12"	Foundry	28-14nm	60,000	20,000	80,000
China	SiEn	Qingdao	8"	Foundry	110nm+	0	0	80,000
China	SiEn	Qingdao	12"	Foundry	55/40nm	0	0	40,000
China	SMIC JV	Beijing	12"	Foundry	40/28nm	56,000	14,000	170,000
China	SMIC JV	Shanghai	12"	Foundry	14nm	7,000	8,000	35,000
China	XMC	Wuhan	12"	Foundry	90-45nm	60,000	20,000	80,000
China	YMTC	Wuhan	12"	3D NAND	3D NAND	20,000	30,000	300,000
Upcoming fabs by domestic companies						236,000	219,000	1,035,000
US	Alpha & Omega	Chongqing	8"	Discretes	130nm+	25,000	0	25,000
US	Alpha & Omega	Chongqing	12"	Discretes	130nm+	10,000	10,000	40,000
Korea	Hynix	Wuxi C3	12"	DRAM	1x nm	140,000	20,000	170,000
US	Intel	Dalian	12"	NAND	3D NAND	85,000	15,000	100,000
Taiwan	Powerchip Nexchip	Hefei	12"	Logic	90nm	25,000	15,000	40,000
Korea	Samsung	Xian	12"	3D NAND	3D NAND	150,000	110,000	260,000
Taiwan	TSMC	Nanjing	12"	Foundry	16nm	20,000	20,000	80,000
Taiwan	UMC JV	Xiamen	12"	Foundry	28nm	17,000	8,000	25,000
Upcoming fabs by overseas companies						472,000	198,000	740,000

China has low share in equipment and materials

China equipment suppliers still very small vs global players

	2019 Size (\$bn)	Incumbent equipment suppliers							Emerging China suppliers		
		ASML	ASM International	Applied Materials	Lam Research	KLA Tencor	Tokyo Electron	Screen	AMEC	Naura	ACM
Deposition	\$12.0		7.9%	43.8%	19.1%		10.4%		1.1%	0.9%	0.1%
Lithography	\$11.7	83.3%		0.3%							
Etch	\$10.8			18.1%	44.7%		28.0%		1.1%	0.8%	
Process Control	\$6.2	4.9%		11.3%		53.6%					
Material Removal/Clean	\$3.7			18.3%	34.0%		24.1%	9.7%	0.7%	0.8%	0.6%
Fab Automation	\$2.9			4.7%							
Photoresist Processing (Track)	\$2.1						91.3%	5.6%			
CMP	\$1.4			66.1%							
RTP	\$1.4			40.4%			20.3%	3.8%		1.7%	
Ion Implant	\$1.2			60.0%							
Wafer Level Packaging	\$2.1						13.7%				
Total Market	\$55.5	18.1%	1.7%	18.7%	13.9%	6.5%	13.6%	3.1%	0.5%	0.5%	0.2%

China silicon wafer suppliers far behind global suppliers

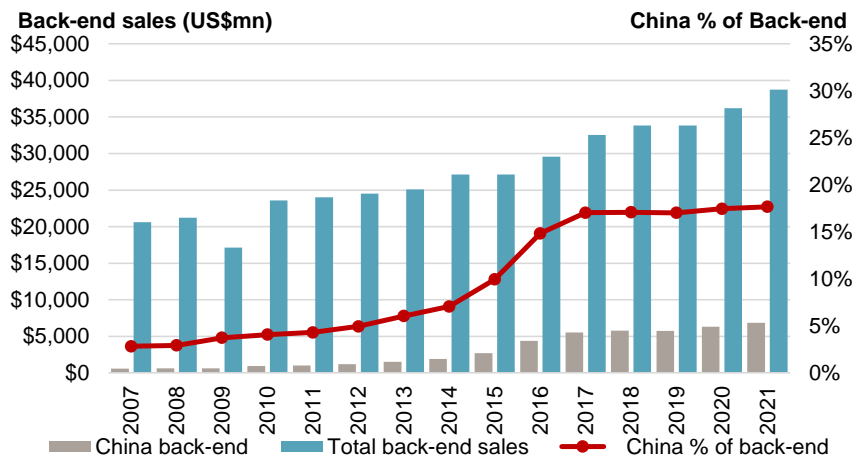
China players	Market share	Global players	Market share	Asian players displace West
NSIG	~1% for 12" 1-2% for 8"	Shin-Etsu	30%	✓
Tianjin Zhonghuan Semiconductor	<3%	SUMCO	27%	✓
Hangzhou Lion Electronics	~2% for 8" <2% for 12"	GlobalWafers	18%	✓
Regional players in China	Market share	Siltronic	15%	
Ferrotec – GlobalWafers JV	5% for 8"	SK Siltron	10%	✓
GRINM Semiconductor Materials	~1% for <8"?			
JV/subsidiary of regional players to IPO in A-share Sci-Tech board	Market share			
FerroTec Hangzhou Semiconductor Wafer	~1% for 12" 2-3% for 8"			
Wafer Works (Shanghai) (IPO terminated)	<1% for 8"			

China wafers aggressive; effective capacity limited

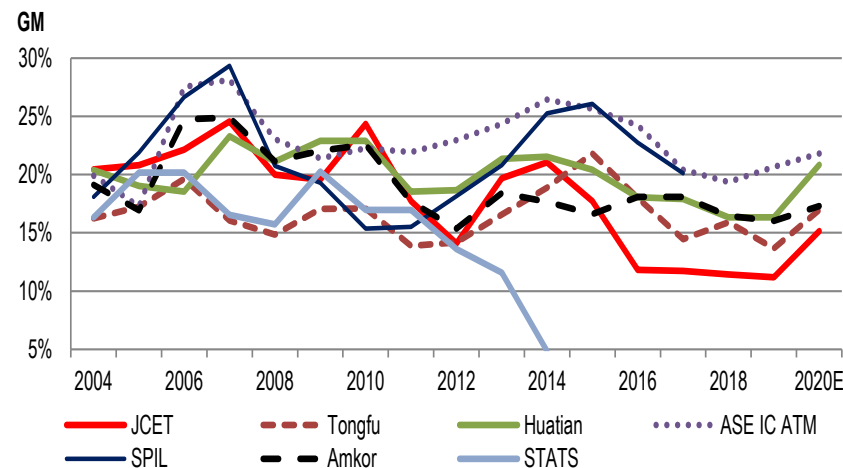
12" raw wafer capacity expansion in China (k WPM)				Planned	Planned progress			Effective
Company	Projects	Location	Investment (RMB bn)	12" capacity	End of 2019	End of 2020	End of 2021	End of 2021
Anhui Yixin	Anhui	Anhui	3	150	0	0	0	0
AST	Shanghai	Shanghai	10	300	0	50	150	15
	Chongqing	Chongqing	5	50	0	0	0	0
	Chengdu	Chengdu	5	500	0	0	0	0
ChangFong	Sichuan	Sichuan	5	400	0	0	0	0
Eswin Silicon Wafer	Xian	Xian	11	500	0	0	0	0
GRINM	Phase 2	Dezhou	6.2	300	0	0	0	0
Sino Crystal Jiaxing	Phase 1	Jiaxing	6	400	0	0	0	0
	Phase 2	Jiaxing	5	600	0	0	0	0
TSI Semiconductor	Guanxi	Guanxi	20	1,200	0	0	0	0
Zing Semi	Phase 1	Shanghai	2.3	150	150	150	150	30
	Phase 2	Shanghai	4.5	450	50	150	250	15
Zhonghuan	Phase 1	Wuxi	10	150	0	20	150	15
	Phase 2	Wuxi	10	350	0	0	50	0
ZJJRH	Quzhou	Quzhou	5	150	0	0	0	0
Ferrotec	HanZhou JV	Hanzhou	6	200	0	30	30	30
	Phase 2	Ningxia	6	200	0	0	0	0
WaferWorks	Zhengzhou	Zhengzhou	5.7	200	0	10	45	45
Total China - domestic				5,650	200	370	750	75
Total China - overseas				600	0	40	75	75
Total China				6,250	200	410	825	150
% of global capacity				89%	3%	6%	12%	2%

China OSATs gaining share following M&A

China's OSATs gained market share through M&A



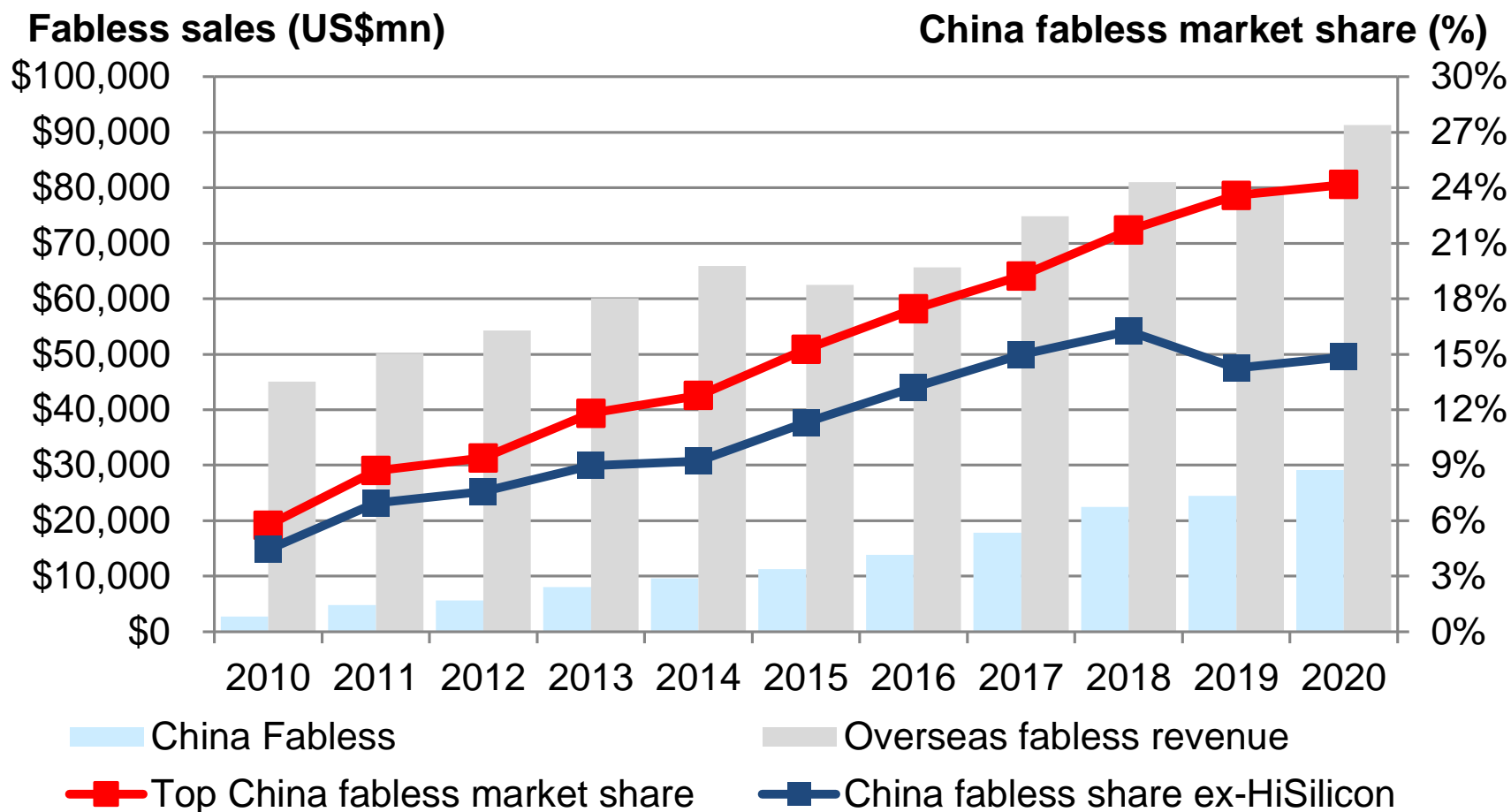
China's lead OSATs now focused on margin improvement



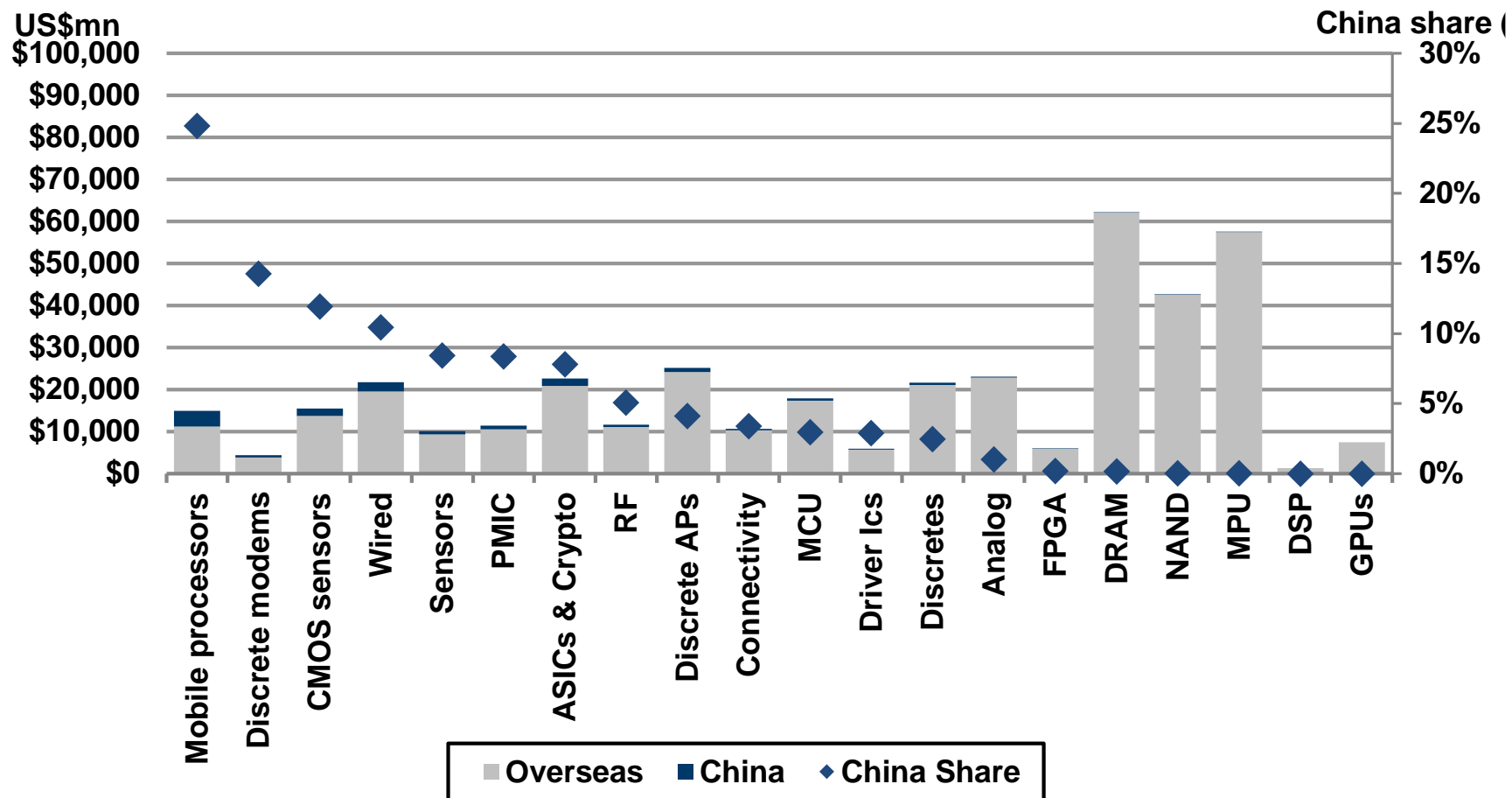
Comparisons of the China companies vs. Taiwan's ASE

	US\$mn	Revenue	GM	OPM	FCF	Top customers & revenue %
		2020E	2020E	2020E	2020E	
3711.TW	ASE	15,756	17%	8%	230	Apple 22% (including USI module revenue), Hi-Silicon 13% (18% pre-ban), QCOM 8%
	ASE ex-USI	8,578	21%	11%	180	Broadcom 7%, Mediatek 7%, AMD 5%, NVIDIA 4%, Infineon 3%, STM 3%, NXP 3%
600584.SS	JCET	3,872	15%	6%	379	Apple, Broadcom, Huawei HiSilicon, Spreadtrum, Bitmain/Cannon, Samsung
002185.SZ	Huatian	1,300	23%	10%	-117	Gigadevice, Maxscend, On Semi, Galaxycore, Huawei
002156.SZ	Tongfu	1,596	16%	5%	-123	AMD, MediaTek, Broadcom, Huawei HiSilicon, STM, TI, NXP

China fabless share rising; milder ex-Hi-Silicon

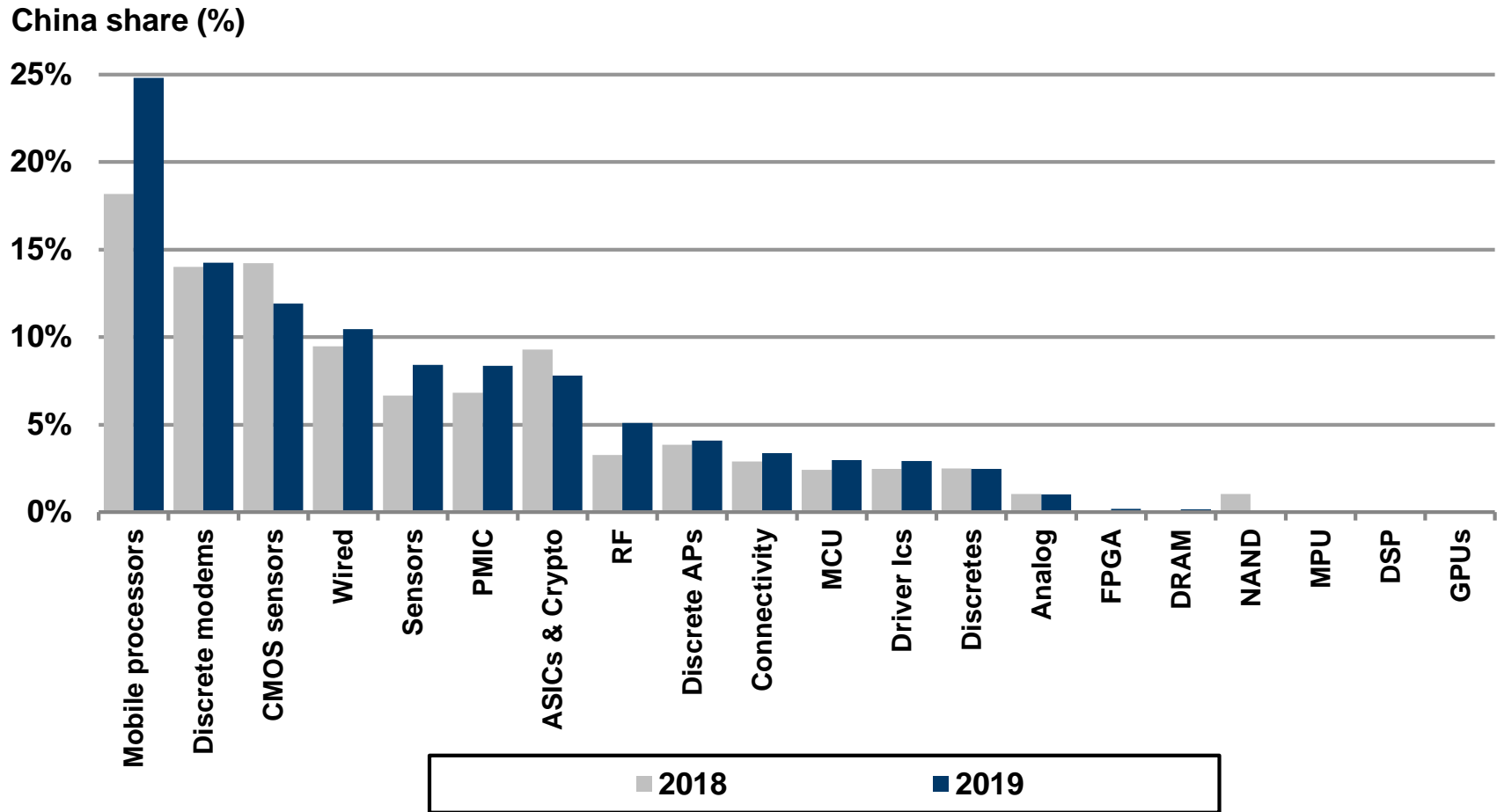


China targeting to share gains in more IC categories



Source: Gartner, Company Data, Credit Suisse research

China targeting to share gains in more IC categories



Source: Gartner, Company Data, Credit Suisse research

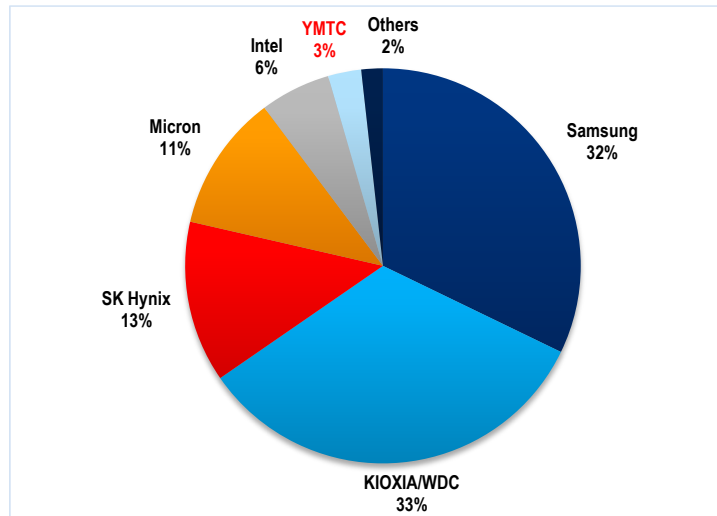
China's 2019 market share growing from a low base

Market	18 (US\$)	19 (US\$)	Overseas players	2018	2019	Chinese players	2018	2019
DRAM	99,872	62,170	Samsung Electronics	42.8%	43.3%	YMTC	<1%	<1%
			SK hynix	29.5%	28.1%	CXMT	<1%	<1%
			Micron Technology	22.9%	23.5%	Fujian Jinhua	<1%	<1%
			Nanya Technology	2.8%	2.7%			
			Overseas subtotal:	98.0%	97.5%	Chinese subtotal:	<1%	<1%
NAND	57,951	42,628	Samsung Electronics	37.8%	36.8%	YMTC	<1%	<1%
			Kioxia	14.6%	18.2%	GigaDevice	<1%	<1%
			Western Digital	15.5%	14.4%	ISSI / Ingenic	<1%	<1%
			Micron Technology	11.1%	12.7%			
			SK hynix	11.0%	9.7%			
			Intel	4.1%	7.2%			
			Toshiba	4.9%	0.0%			
			Overseas subtotal:	98.9%	99.0%	Chinese subtotal:	<1%	<1%
MPUs	54,151	57,481	Intel	91.4%	90.0%	HiSilicon	<1%	<1%
			AMD	5.2%	7.0%	Cambricon	<1%	<1%
			NXP	0.8%	0.8%	Alibaba	<1%	<1%
			Marvell	0.4%	0.7%	Montage	<1%	<1%
			Texas Instruments	0.5%	0.4%	Eeasy Tech	<1%	<1%
			Overseas subtotal:	98.4%	98.9%	Chinese subtotal:	<1%	<1%
MCUs	19,211	17,867	Renesas Electronics	18.0%	18.7%	CEC Huada	1%	1%
			NXP	17.3%	17.3%	Gigadevice	<1%	<1%
			Microchip Technology	14.0%	13.8%	Unigroup Guoxin	<1%	1%
			STMicroelectronics	12.0%	11.8%	SinoWealth	<1%	<1%
			Infineon Technologies	9.0%	9.1%	Silan	<1%	<1%
			Texas Instruments	9.6%	8.7%	Goodix	<1%	<1%
			Overseas subtotal:	80.0%	79.3%	Chinese subtotal:	<2%	<3%
DSP	1,453	1,279	Texas Instruments	43.8%	39.6%			
			NXP	23.6%	25.3%			
			Analog Devices	22.2%	22.4%			
			Overseas subtotal:	89.6%	87.4%	Chinese subtotal:	<1%	<1%
FPGA	5,683	5,975	Xilinx	51.1%	54.1%	Unigroup Guoxin	<1%	<1%
			Intel	35.8%	32.1%	Fudan Micro	<1%	<1%
			Microchip Technology	5.2%	6.3%	Huada	<1%	<1%
			Lattice Semiconductor	5.0%	4.9%	Gowin	<1%	<1%
			Overseas subtotal:	97.1%	97.4%	Chinese subtotal:	<1%	<1%
Driver IC	6,060	5,878	Samsung Electronics	26.6%	24.2%	Huada	<1%	<1%
			Novatek	16.4%	17.4%	SinoWealth	<1%	<1%
			Silicon Works	10.0%	10.3%	Solomon Systech	<1%	<1%
			Himax Technologies	9.7%	9.0%	Chipone	<1%	<1%
			Raydium	5.7%	7.3%			
			Overseas subtotal:	68.5%	68.2%	Chinese subtotal:	<2%	<3%
Analog	24,401	23,014	Texas Instruments	29.2%	29.2%			
			Analog Devices	20.1%	20.1%			
			Maxim Integrated	4.6%	4.2%			
			ON Semiconductor	4.1%	4.0%			
			Renesas Electronics	2.1%	3.1%			
			STMicroelectronics	2.9%	2.9%			
			Overseas subtotal:	63.1%	63.5%	Chinese subtotal:	<1%	<1%
Discretes	22,731	21,608	Infineon	14.8%	14.8%	Nexperia	<1%	<1%
			ON Semiconductor	10.4%	10.2%	Jilin Sino-Micro	1%	1%
			STMicroelectronics	6.0%	6.5%	HiSilicon	<1%	<1%
			Nexperia	5.5%	5.5%	SG Micro	<1%	<1%
			Rohm	5.3%	5.0%	Silan	1%	1%
			Toshiba	5.1%	4.9%	Shanghai Belling	<1%	<1%
			Vishay	5.6%	4.8%	Will Semi	<1%	<1%
			Overseas subtotal:	52.8%	51.8%	Chinese subtotal:	<3%	<2%
			Sony	46.8%	52.0%	Will Semiconductor	12%	9%
			Samsung Electronics	21.0%	19.5%	Galaxycore	3%	3%
CMOS sensors	12,281	14,815	ON Semiconductor	5.7%	4.4%	BYD Micro	<1%	<1%
			SK Hynix	2.4%	3.8%	SmartSens	<1%	<1%
			Overseas subtotal:	76.0%	79.6%	Chinese subtotal:	15%	16%

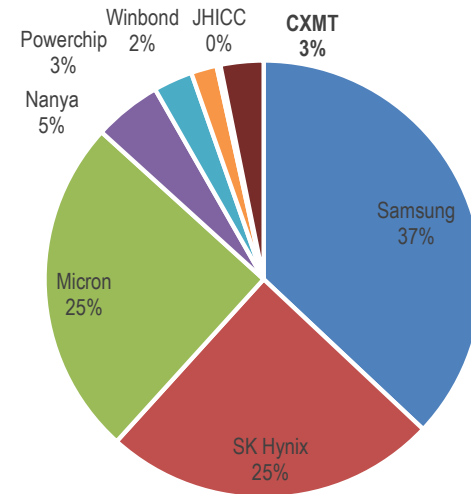
Market	18 (US\$)	19 (US\$)	Overseas players	2018	2019	Chinese players	2018	2019
Sensors	10,489	10,127	Robert Bosch	14.2%	14.1%	Goertek	3%	5%
			Infineon Technologies	8.0%	7.8%	Goodix	4%	3%
			STMicroelectronics	6.0%	5.9%	Silan	<1%	<1%
			TDK	5.0%	5.1%	Shanghai Belling	<1%	<1%
			Knowles	4.5%	4.6%	Yangjie	<1%	<1%
			Overseas subtotal:	37.8%	37.6%	Chinese subtotal:	<8%	<9%
Mobile Processor	14,829	14,928	Qualcomm	54.1%	45.0%	HiSilicon	14%	22%
			Samsung Electronics	13.9%	16.2%	UniSOC	4%	3%
			MediaTek	13.8%	14.0%	Allwinner	<1%	<1%
			Overseas subtotal:	81.8%	75.2%	Chinese subtotal:	<19%	<26%
GPUs	8,262	7,434	Nvidia	81.1%	80.7%	Jingjia Micro	<1%	<1%
			AMD	18.1%	18.3%	Zhaoxin	<1%	<1%
			Overseas subtotal:	99.2%	99.0%	Chinese subtotal:	<1%	<1%
Connectivity	11,362	10,645	Broadcom	22.3%	20.9%	HiSilicon	2%	3%
			Qualcomm	18.5%	17.5%	UniSoC	<1%	<1%
			MediaTek	7.1%	7.4%	Maxscend	<1%	<1%
			NXP	5.4%	6.3%	Goodix	<1%	<1%
			Realtek	3.8%	4.7%	Will Semi	<1%	<1%
			Overseas subtotal:	57.1%	56.9%	Chinese subtotal:	<3%	<4%
			Broadcom	36.3%	35.7%	HiSilicon	7%	8%
Wired	22,122	21,781	Marvell Technology	8.4%	8.0%	Sanechips	1%	2%
			Intel	5.0%	5.1%	Montage	1%	1%
			Realtek Semiconductor	3.0%	4.3%			
			Microchip Technology	3.3%	3.5%			
			Overseas subtotal:	56.0%	56.6%	Chinese subtotal:	<10%	<11%
RF	11,831	11,677	Skyworks Solutions	22.3%	19.0%	HiSilicon	2%	2%
			Qorvo	17.3%	17.7%	Maxscend	1%	2%
			Qualcomm	14.8%	14.8%	Xinyi Semi	<1%	<1%
			Broadcom	11.9%	10.7%	Smarter Micro	<1%	<1%
			Murata Manufacturing	4.4%	6.5%	Lansus	<1%	<1%
			NXP	5.2%	4.7%	UniChip	<1%	<1%
			Overseas subtotal:	75.9%	73.4%	Chinese subtotal:	<4%	<6%
PMIC	11,431	11,432	Texas Instruments	15.3%	14.7%	HiSilicon	3%	4%
			Dialog Semiconductor	9.2%	8.8%	Silergy	3%	3%
			Qualcomm	9.5%	8.2%	SG Micro	<1%	<1%
			STMicroelectronics	7.4%	7.3%	Shanghai Belling	<1%	<1%
			Infineon Technologies	6.5%	6.6%	Silan	<1%	<1%
			Overseas subtotal:	48.0%	45.7%	Chinese subtotal:	<10%	<10%
ASICs	24,801	22,636	Intel	24.8%	25.7%	Bitmain	4%	2%
			STMicroelectronics	4.5%	4.8%	HiSilicon	4%	4%
			Cirrus Logic	3.9%	4.4%	Montage	1%	1%
			HiSilicon Technologies	3.7%	4.0%			
			Infineon Technologies	3.6%	3.9%			
			Broadcom	3.8%	3.8%			
			Overseas subtotal:	44.3%	46.6%	Chinese subtotal:	<15%	<15%
Discrete AP	25,264	25,180	Apple	28.0%	31.7%	HiSilicon	2%	2%
			MediaTek	13.5%	13.8%	Amlogic	1%	1%
			Broadcom	7.6%	7.2%			
			Nvidia	5.3%	5.3%			
			AMD	6.9%	4.2%			
			NXP	3.1%	3.1%			
			Overseas subtotal:	64.4%	65.2%	Chinese subtotal:	<5%	<5%
Discrete modem	4,153	4,425	Intel	39.4%	44.0%	HiSilicon	5%	7%
			Qualcomm	37.1%	32.5%	UniSoC	9%	6%
			MediaTek	6.1%	4.6%			
			Overseas subtotal:	82.6%	81.0%	Chinese subtotal:	<15%	<15%

China memory trying to build effective capacity

Global NAND capacity by supplier



Global DRAM capacity by supplier



YMTC progress in NAND



Capacity at the end of 2020	40K (down from previous 50K)
Capacity at the end of 2021	85K (down from previous 100K)
Production yield as of now	around 70% to move into 128L TLC/QLC production is the primary mission now
Technology as of now	64L TLC products for cards, USB drives and client SSD
Technology in 2021	transitioning to 128L TLC/QLC and preparing to move into 192L production.
TrendForce's View	YMTC accounts for less than 2% of the total NAND Flash bit supply in 2020, and its share will be around 4% in 2021

CXMT progress in DRAM



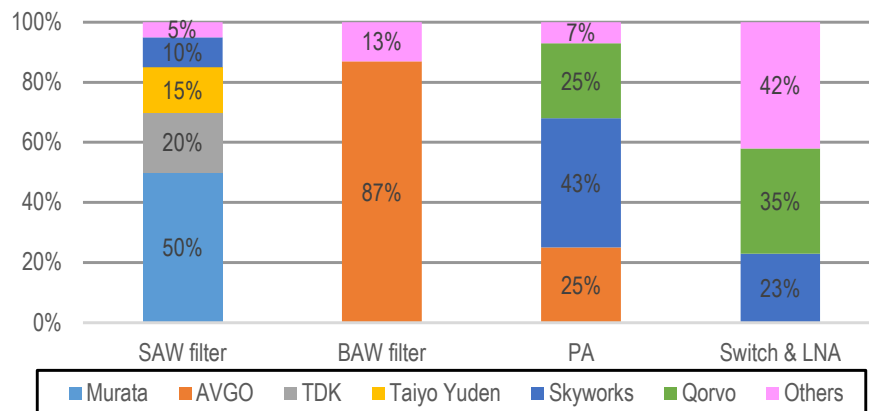
Capacity at the end of 2020	45K (down from previous 55K)
Capacity at the end of 2021	85K (down from previous 100K)
Production yield as of now	around 60-70% to improve its production yield is the primary mission now
Technology as of now	19nm (DDR4 8Gb & LPDDR4 8Gb)
Technology in 2021	transitioning to 17nm and stabilizing its production yield
TrendForce's View	CXMT accounts for less than 0.5% the total DRAM bit supply in 2020, and its share will be around 1% in 2021

China's RF suppliers target the mobile front-end

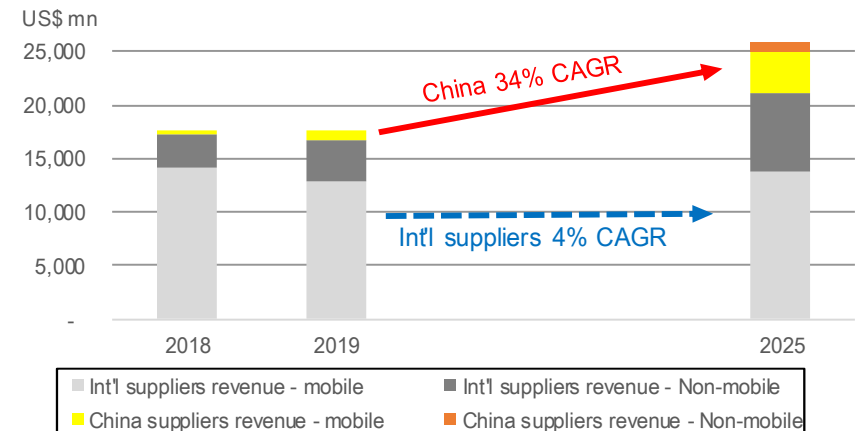
China has a diverse range of RF suppliers targeting the smartphone front-end

	Maxscend	Vanchip (MediaTek)	Huawei HiSilicon	UNISOC	OnMicro (Huntersun)	Will Semi	Etra Semi	RadRock	Kangxi
	卓胜微	唯捷创芯	华为海思	紫光展锐	昂瑞微 (中科汉天下)	韦尔半导体	宜确半导体	锐石创芯	康希通信
Switch	x	x	x	x	x	x	x	x	x
LNA	x		x	x	x	x	x		x
PA	x	x	x	x	x		x	x	x
Filter	x	x	x	x					
Module	x	x	x	x	x			x	x
	Lansus	China UniChip	Smarter Micro	CanaanTek	Microgate	Deqing Huaying	Shoulder	Sunway	Cai Qin
	飞驒科技	中普微	慧智微电子	迦美信芯	麦捷微科技	德清华莹	好达电子	信维通信	灿勤科技
Switch	x	x		x					
LNA				x					
PA	x	x	x						
Filter					x	x	x	x	x
Module	x	x		x					

Global RF front-end share by major component

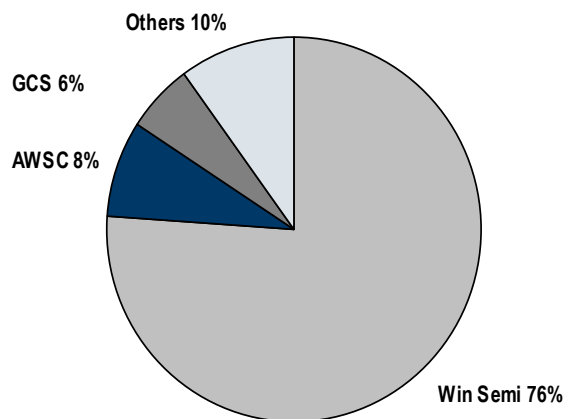


China to grow faster from a low base



Taiwan leads in RF foundry and Display Driver ICs

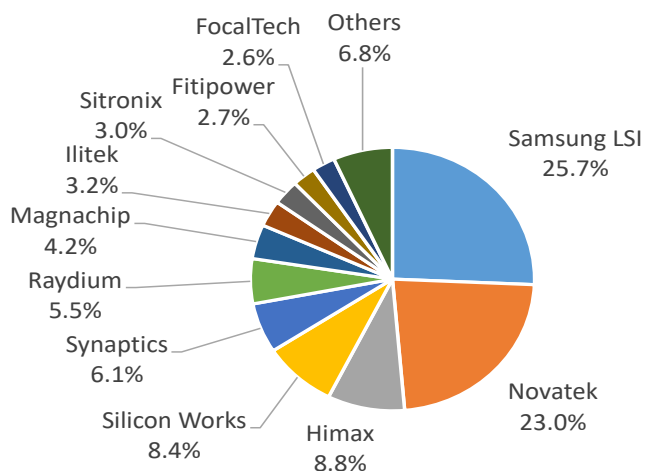
Win semi dominates compound semi foundry



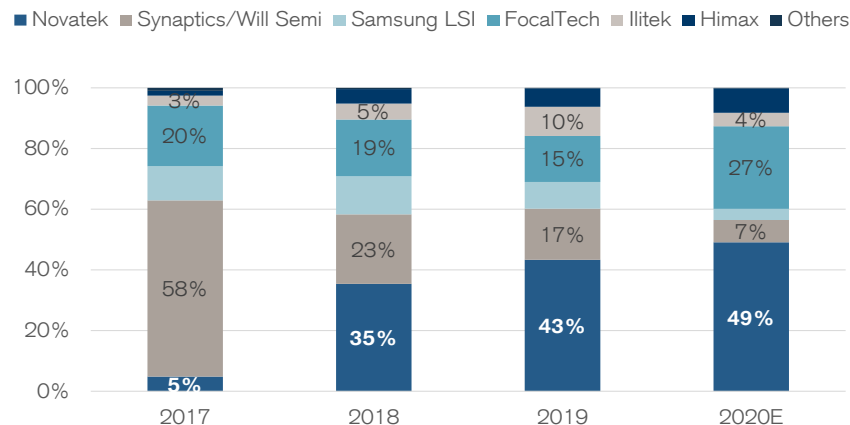
VPEC in epi more diversified than the RF foundries

	Primary epiwafer supplier	Wafer processing
Avago	VPEC	Win Semi
Skyworks	IQE	In-house and AWSC
Qorvo	VPEC	In-house
Qualcomm	Shifting from Win Semi to VPEC	Win Semi, adding AWSC
Murata	Win Semi	Win Semi
Others	Win Semi and VPEC	Win Semi, AWSC, and Sanan

Korea / Taiwan companies dominate display driver ICs

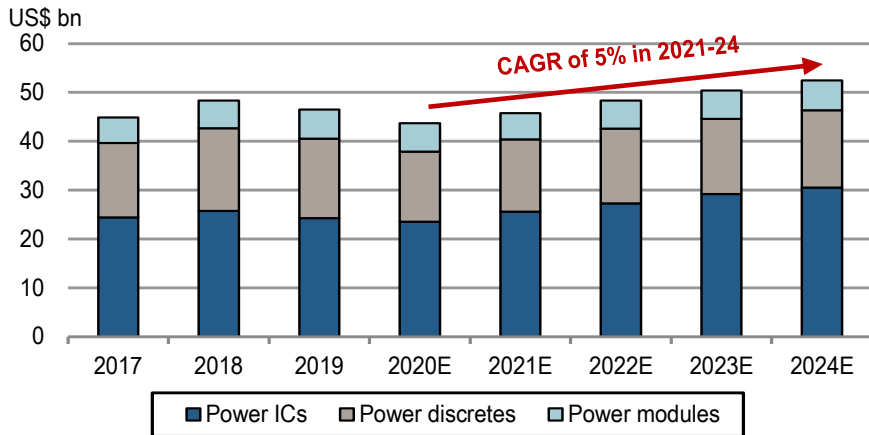


Novatek / FocalTech leading in TDDI

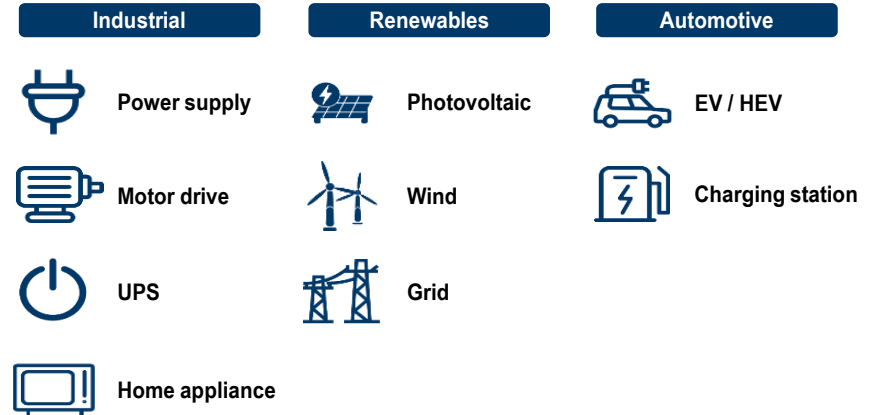


Power ICs led by global players, growing in China

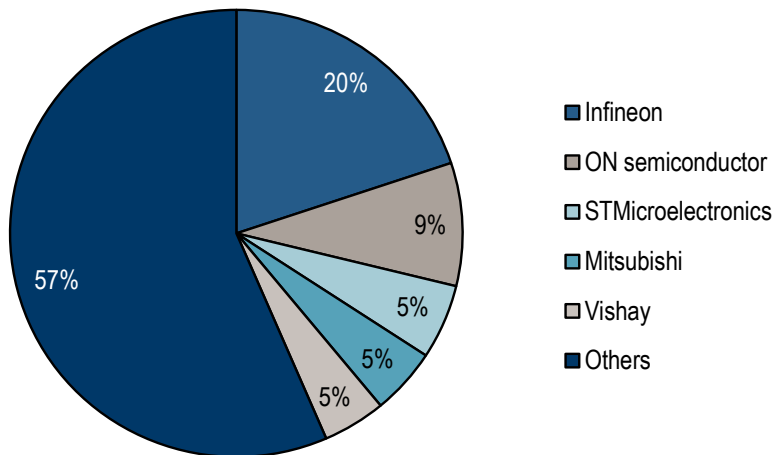
Power Semis at US\$45bn market growing at a 5% CAGR



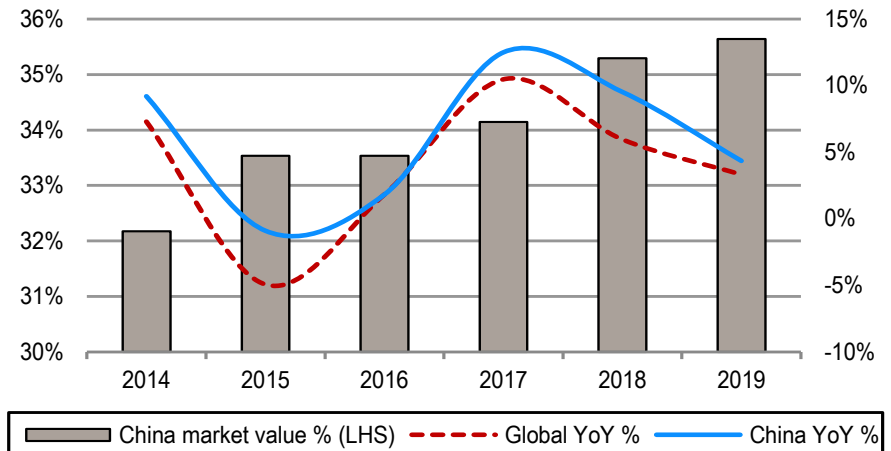
Industrial, renewables and auto driving power semis



Power semis led by global players

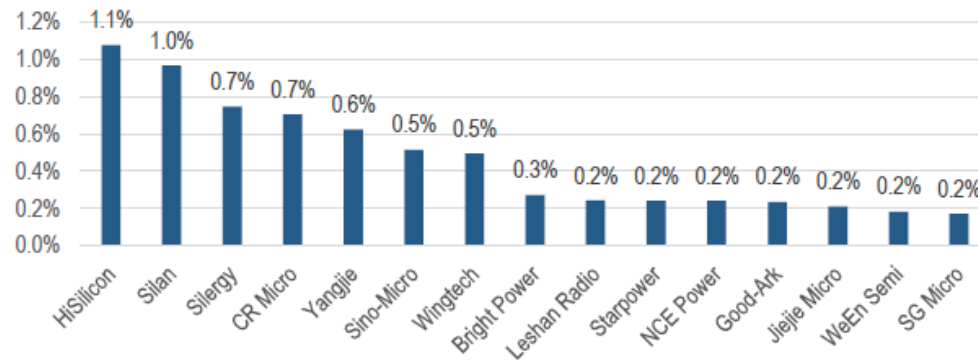


China the largest domestic market for power semis



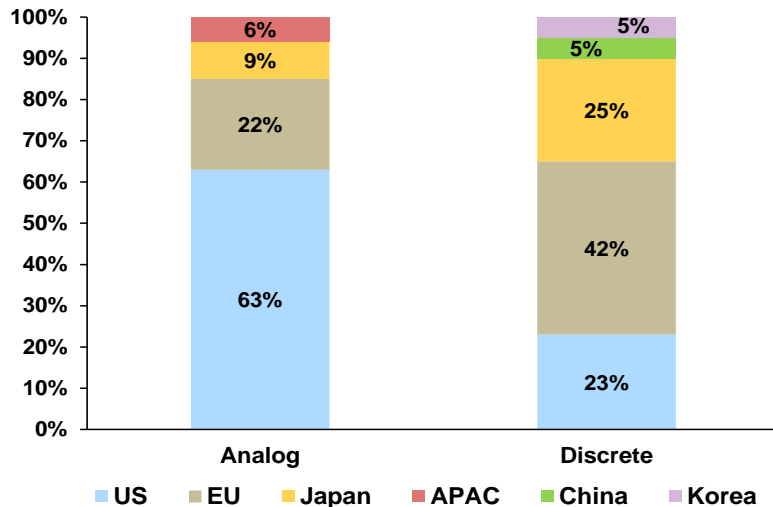
China suppliers targeting share gains in Power ICs

Company		CR Micro	Starpower	BYD	Silan	Sino-Micro	Yangjie	Nexperia - Wingtech	Zhuzhou CRRC Times
Chinese name		华润微	斯达半导	比亚迪	士兰微	华微电子	扬杰科技	安世半导体 - 闻泰	株洲中车时代
Discrete	MOSFET	√		√	√	√	√	√	
	IGBT	√	√	√	√	√	√	√	√
	IPM	√	√		√	√	√	√	
	Diode	√			√	√	√	√	√
Power IC	AC/DC	√		√	√				
	DC/DC	√		√	√				
	PMIC	√		√	√				
	Driver IC	√		√	√	√		√	
	Audio power amplifier	√			√				
Company		NCE Power	Silergy	SG Micro	Bright Power	Jiejie Micro	Chipown	ETEK	Good-Ark
Chinese name		新洁能	矽力杰	圣邦微	晶丰明源	捷捷微电子	芯朋微	力芯微	苏州固锝
Discrete	MOSFET	√			√	√			√
	IGBT	√				√			
	IPM				√				
	Diode								√
Power IC	AC/DC		√	√	√	√	√		
	DC/DC		√	√	√		√	√	
	PMIC		√	√	√	√	√	√	
	Driver IC		√	√	√		√	√	
	Audio power amplifier		√	√				√	

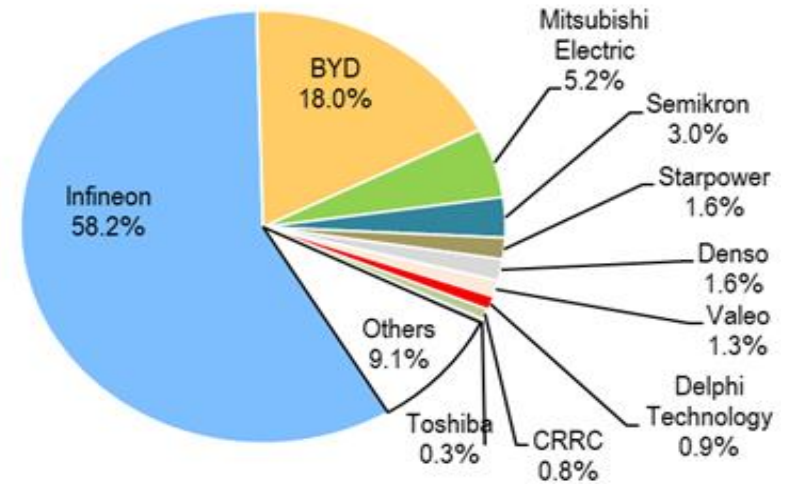


European Power ICs: Opportunity/Threat in China

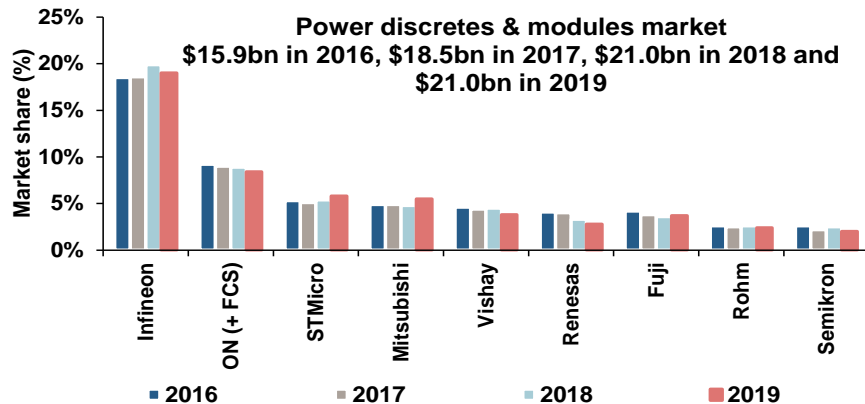
European vendors 22% analog / 42% discrete share



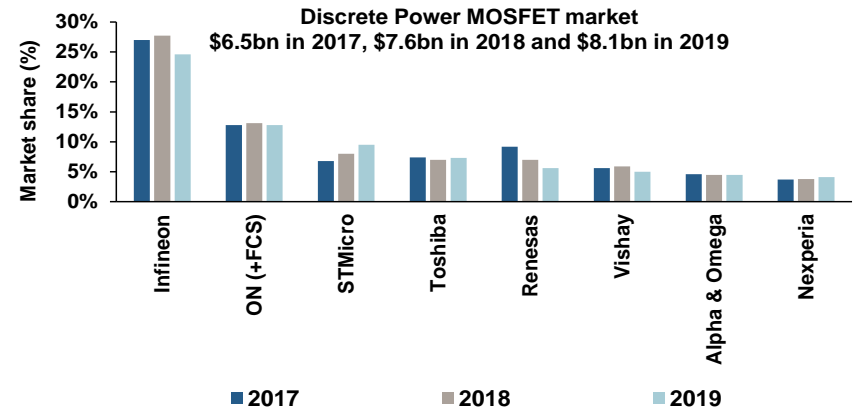
IGBT for China NEV led by Infineon; BYD/Starpower emerge



Infineon #1 and STM #3 in Power Discretes and Modules



Infineon #1 and STM #3 in the Power MOSFET market

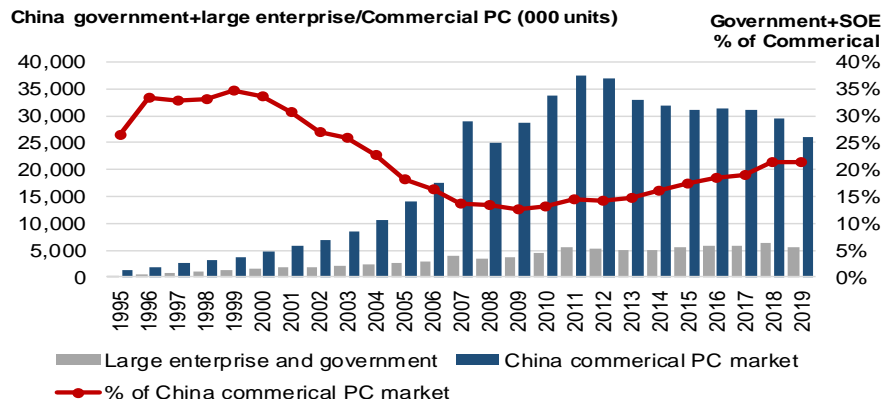


China's CPU suppliers target domestic PCs/Servers

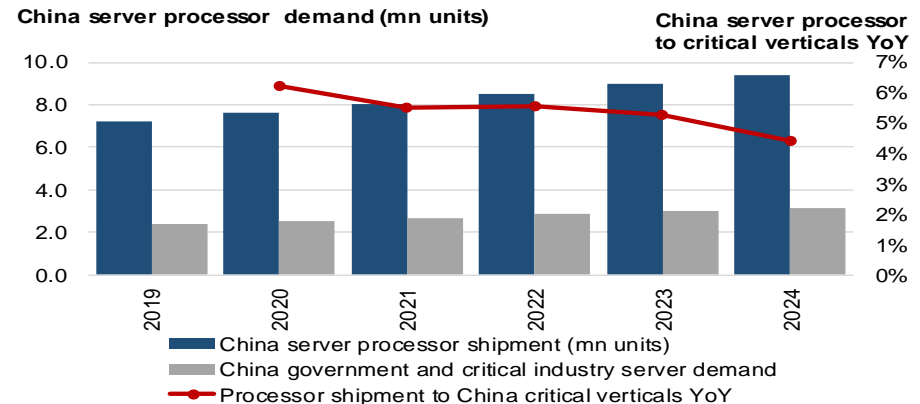
Comparison for the technology development for the major China CPU fabless

China CPU fabless	Phytium 飞腾	Zhaoxin 兆芯	HiSilicon 海思	Hygon 海光	Loongson 龙芯	Sunway 申威
Shareholders	China Great Wall, CEC Group	Shanghai Zhaoxin (VIA + Shanghai government)	Huawei	Sugon, AMD, Hygon	Institute of Computing Technology, Chinese Academy of Sciences	Wuxi Jiangnan Institute of Computing Technology
Architecture	ARM v8	x86	ARM v8	x86	MIPS64	Sunway 64
PC CPU	FT2000/4	KX-6000	Kunpeng 920s	3185	3A4000	SW1621
Tech spec	2.0GHz Quad core 64 bit	2.0GHz Quad core 64 bit	2.0GHz Quad / Octa 64 bit	3.2GHz 8 cores 64 bit	2.0GHz Quad core 64 bit	2.0GHz 16 core 64 bit
Manufacturing node	16nm	16nm	7nm	14nm	28nm	40nm
Server CPU	S2500	KH-30000	Kunpeng 920	7185	3B4000	SW26010
Tech spec	2.2GHz 64 cores 64 bit	3.0GHz Octa cores 64 bit	2.5GHz 64 cores 64 bit	2.0GHz 32 cores 64 bit	2.0GHz Quad core 64 bit	1.45GHz 260 cores 64 bit
Manufacturing node	16nm	16nm	7nm	14nm	28nm	28nm
IC design partner	Alchip, EE2	VIA	NA	AMD	NA	NA
Ecosystem support	Strong	Strong	Strong	Strong	Limited	Limited
Security	High	High	High	High	High	High
China technology control	Medium-High	Low	Medium-High	Low	High	High

China SOEs are 20% of China's commercial PC market



China's SOE server demand 7mn units/year



TSMC leads in AI projects in the advanced nodes

Start-ups	Key focus area	Country	Foundry	Most advanced node	Tech investors
AIMotive	Semiconductor chipset and software for automated driving	Hungary	GlobalFoundries	22nm FD-SOI	Cisco, Samsung
Blaize	Vision processing chips	US	TSMC	28nm HPC	Denso, Samsung
BrainChip	Neuromorphic SoC (Akida) that can be function as an SoC or integrated into ASIC	Australia	TSMC	28nm	Listed
Cambricon	Device and cloud processors for AI	China	TSMC	7nm	Alibaba, TCL
Cerebras	Systems Specialized chip for deep-learning applications	US	TSMC	16nm	NA
Deep Vision	Low-power silicon architecture for computer vision	US	TSMC	28nm HPC	NA
DeepcreatiC	Heterogeneous neuromorphic chips	China	SMIC	40nm	NA
Deephi	Compressed CNN networks and processors	China	TSMC	7nm	Xilinx
DinoPlus	High-performance and ultra-low latency AI chipsets for 5G/edge computing	US	NM	NM	NA
Enflame	Cloud-based deep learning chips for AI training platforms	China	GlobalFoundries	12nm LP	Tencent, SummiView
Esperanto	Massive array of RISC-V cores	US	TSMC	7nm	Western Digital
GrAI Matter Labs	AI chipsets designed for ultra-low latency and low power processing at the edge	France	TSMC	28nm	NA
Graphcore	Graph-oriented processors for deep learning	UK	TSMC	16nm	Dell
Groq	Google spinout working on deep learning chip	US	NM	14nm	NA
Habana Labs	Programmable deep learning accelerators for data center training and inference	Israel	TSMC	7nm	Intel
Hailo	Specialized deep learning microprocessor	Israel	NM	NM	NEC
Horizon Robotics	Chipsets and solutions for smart Home, automotive and public safety	China	TSMC	16nm	SK Hynix
IntelliGo	Hardware and software for image and speech processing	China	NM	NM	Mediatek
Intengine Tech	AI chips for embedded system for edge computing	China	NM	NM	NA
Kneron	NPU that accelerates neural network models making possible applications (e.g. face detection and gesture control) in embedded devices	US	TSMC	16nm	Alibaba, Himax, Qualcomm
Lightmatter	Programmable photonic to accelerate critical operations in deep neural networks	US	NM	NM	Alphabet
Lynxi	Brain-like computing chip for high performance computing	China	NM	28nm	NA
Mythic	Ultra-low power neural networking inference chips based on flash+analog+digital	US	Fujitsu	40nm	Lam Research, Micron, Softbank
Novumind	AI for IoT	US	TSMC	7nm	NA
Preferred Networks	Real time data analytics and chipset solutions with deep learning library	Japan	TSMC	12nm	Hitachi, Fanuc
Reduced Energy Microsystems	Chipset solutions for deep learning and machine vision with low power consumption	US	GlobalFoundries	22nm FD-SOI	NA
SambaNova	Reconfigurable Array platform for matrix arithmetic for AI applications	US	NM	NM	Google, Intel
SenseTime	Chipset solutions for computer vision	China	NM	NM	Softbank, Singtel, Qualcomm, Alibaba
SiMA.ai	Machine Learning SoC platform for high performance and low power consumption	US	NM	NM	Dell
Syntiant	Customized analog neural networks	US	NM	40nm ULP	Amazon, Microsoft, Intel
Tenstorrent	Deep learning processor for faster training and adaptability to future algorithms	Canada	GlobalFoundries	12nm	NA
Thinkforce	AI chips for edge computing	China	NM	NM	NA
Tsinghua Thinker	Low power AI chips for edge computing	China	TSMC	65nm LP	Tsinghua VC
Unisound	Chipsets for AI-based speech and text capability	China	TSMC	28nm	Qihoo
Vathys	Chipset design for deep learning supercomputers	US	NM	NM	NA
Wave Computing	ASIC solutions for deep learning computers	US	TSMC	7nm	Samsung
Xanadu	Quantum photonic processors	Canada	NM	NM	NA

Source: Company data, Credit Suisse

Design service companies targeting CPU and AI

IC design service company	Global Unichip	Alchip	Faraday	VeriSilicon
Ticker	3443.TW	3661.TW	3035.TW	Pending
Revenue (US\$mn)	\$346	\$140	\$172	\$191
GMs	27.5%	35.6%	44.6%	40.2%
OpMs	6.5%	10.0%	7.5%	-4.7%
Headcounts	759	404	882	936
Service	Front/back-end design, IP	Back-end design	Back-end design	IP, back-end design
Technology support	65nm and above: 30% 40nm: 13% 28nm: 37% 16nm: 16% 7nm and below: 4%	55nm and above: 4% 40nm: 6% 28nm: 29% 20/16nm: 33% 12/7nm: 27%	0.25um: 0-5% 0.18-0.11um: 35-40% 90-55nm: 20-25% 40nm: 15% 28nm and below: 20-25%	28nm and below: 85% 28nm and above: 14%
Targeted applications	Computer: 43% Consumer: 34% Communication: 11% Others: 12%	HPC: 59% Network: 14% Niche: 18% Consumer: 9%	Industrial: 30-35% AIoT: 30-35% Communication: 20% PC: 10-15% Others: 0-5%	Consumer: 38% IoT: 24% Data processing: 20% Industrial: 10% PC: 4% Automotive: 4%
Foundry partners	TSMC (100%)	TSMC (~100%), Samsung, SMIC, GlobalFoundries	UMC (70-75%), Samsung (20-25%)	SMIC (30%), Samsung (5-10%), GlobalFoundries (5-10%), Hua Hong, TSMC

Source: Company data, Credit Suisse

Stocks with leverage to China's rising ecosystem

Company	Ticker	Local Price	Mkt Cap	Ent. Value	P/E Multiple (x)		EV/EBITDA (x)		EV/Sales (x)		P/B Multiple (x)		ROE		
		1/19/2021	(US\$m)	(US\$m)	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021	
Foundries															
TSMC	2330.TW	\$627.00	\$580,344	\$519,867	31.4	29.9	17.6	15.4	11.8	10.6	8.8	7.6	28.0	30.0	
SMIC Hong Kong	0981.HK	\$29.60	\$22,742	\$16,579	54.1	79.0	9.7	9.4	3.9	3.8	2.1	2.0	3.8	2.5	
SMIC Shanghai	688981.SS	\$62.46	\$24,243	\$18,640	125.5	183.4	10.9	10.5	4.4	4.3	4.8	4.7	3.8	2.5	
Hua Hong	1347.HK	\$48.50	\$8,119	\$8,305	98.9	65.5	34.8	15.8	8.7	7.0	3.5	3.4	3.5	5.1	
Win Semi	3105.TWO	\$445.00	\$6,736	\$6,130	27.4	29.6	15.8	15.6	7.3	7.1	6.0	5.7	22.0	24.0	
Foundry Median:					54.1	65.5	15.8	15.4	7.3	7.0	4.8	4.7	3.8	5.1	
Foundry Mean:					67.5	77.5	17.8	13.3	7.2	6.5	5.0	4.7	12.2	12.9	
Equipment Companies															
Advantest	6857.T	\$9,140.00	\$17,231	\$15,570	33.8	36.7	27.0	24.5	6.0	6.0	7.8	6.8	23.1	18.6	
Applied Materials	AMAT	\$103.14	\$94,196	\$94,293	24.8	21.4	21.4	17.8	5.5	4.8	9.0	6.5	36.3	30.4	
ASM Int'l	ASMI.AS	\$213.20	\$7,225	\$6,846	36.1	29.0	18.3	16.6	6.3	5.7	5.5	5.2	15.5	18.2	
ASM Pacific	0522.HK	\$117.00	\$6,200	\$5,945	54.0	20.6	29.4	12.7	2.8	2.5	4.2	3.8	7.8	18.3	
ASML	ASML	\$437.60	\$183,572	\$182,360	56.5	47.1	43.4	37.4	13.6	12.2	13.1	12.4	23.2	26.4	
DISCO	6146.T	\$37,600.00	\$13,022	\$12,180	48.9	47.8	29.4	28.0	9.0	8.7	6.0	5.7	12.3	11.9	
KLA	KLAC	\$304.13	\$46,976	\$48,465	29.4	24.4	24.1	17.4	8.3	7.6	17.9	13.1	60.9	53.8	
Lam Research	LRCX	\$547.53	\$78,849	\$77,961	34.5	24.9	27.6	19.1	7.8	6.0	15.8	10.4	45.7	41.9	
SCREEN	7735.T	\$8,860.00	\$3,976	\$4,075	82.5	29.1	20.7	13.1	1.4	1.5	2.4	2.2	2.9	7.6	
Tokyo Electron	8035.T	\$44,130.00	\$65,963	\$213,962	37.7	43.9	24.3	26.5	5.8	6.1	8.5	7.6	22.6	17.4	
Equipment Median:					36.9	29.0	25.7	18.5	6.2	6.0	8.2	6.7	22.9	18.4	
Equipment Mean:					43.8	32.5	26.6	21.3	6.6	6.1	9.0	7.4	25.0	24.4	
Back-end Companies															
Tianshui Huatian	002185.SZ	\$16.05	\$6,778	\$6,520	63.4	38.4	20.0	15.0	5.4	4.2	5.4	4.8	7.9	9.9	
Tongfu Micro	002156.SZ	\$29.38	\$6,018	\$6,500	87.3	55.8	20.4	16.6	3.9	3.2	4.1	3.8	5.9	8.7	
Back-end Median:					75.3	47.1	20.2	15.8	4.6	3.7	4.7	4.3	6.9	9.3	
Back-end Mean:					75.3	47.1	20.2	15.8	4.6	3.7	4.7	4.3	6.9	9.3	
IDM & Fabless															
Mediatek	2454.TW	\$879.00	\$49,890	\$40,978	35.0	25.3	24.3	17.7	3.5	2.9	3.9	3.6	11.2	14.4	
Will Semi	603501.SS	\$314.89	\$42,106	\$42,106	101.9	52.3	73.1	39.9	13.8	10.1	24.0	15.9	23.6	30.5	
Maxscend	300782.SZ	\$660.00	\$18,310	\$18,148	117.9	89.1	104.8	77.2	42.5	31.3	45.7	31.3	39.1	37.5	
Analog Devices	ADI.OQ	\$157.75	\$58,286	\$62,375	32.2	27.4	25.3	21.6	11.1	9.9	4.9	4.9	15.4	16.2	
Texas Instruments	TXN.OQ	\$169.19	\$155,307	\$156,866	32.0	29.3	27.1	24.3	11.2	10.4	17.9	13.9	55.7	47.2	
IDM & Fabless Median:					35.0	29.3	27.1	24.3	11.2	10.1	17.9	13.9	23.6	30.5	
IDM & Fabless Mean:					63.8	44.7	50.9	36.1	16.4	12.9	19.3	13.9	29.0	29.1	
EDA & IC design service															
Alchip	3661.TW	\$847.00	\$1,875	\$1,620	62.6	37.3	23.5	16.4	7.0	4.3	13.3	11.5	21.2	30.7	
Synopsys	SNPS	\$258.92	\$39,623	\$38,515	46.7	41.1	33.5	28.7	10.5	9.6	8.1	7.1	19.2	17.1	
Cadence	CDNS	\$134.64	\$37,555	\$36,803	49.9	46.9	38.2	34.4	13.9	13.0	14.8	11.8	29.6	24.6	
EDA & IC design service Median:					49.9	41.1	33.5	28.7	10.5	9.6	13.3	11.5	21.2	24.6	
EDA & IC design service Mean:					53.1	41.8	31.7	26.5	10.4	9.0	12.0	10.1	23.3	24.2	

Source: Company data, Credit Suisse estimates

Examining China's Semiconductor Self-Sufficiency

Present and Future Prospects

- China building a domestic tech supply chain, although semis have lagged
- Domestic market is 60% of IC consumption and 25% of end demand, but has only 5% semiconductor share
- Policy support through the IC fund, grants, tax breaks, Sci-Tech listings
- High valuations a cheap source of funding for domestic suppliers
- China suppliers having varying traction taking share: gaining in some IC categories and back-end, mixed in foundry and lagging in equipment/materials
- Domestic investment poised to continue in-spite of US resistance
- Stocks: CS picks across sectors to benefit from China's ecosystem rise

Appendix

Foundry market share history

Foundry	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	CAGR 2011-2018
SMIC	\$1,070	\$1,554	\$1,319	\$1,702	\$2,069	\$1,970	\$2,229	\$2,914	\$3,101	\$3,351	\$3,116	\$3,893	11.3%
Hua Hong (plus Grace)	\$357	\$620	\$610	\$572	\$585	\$665	\$651	\$721	\$808	\$929	\$933	\$951	5.5%
CSMC	\$151	\$225	\$230	\$212	\$210	\$341	\$328	\$418	\$456	\$492	\$469	\$539	9.3%
Shanghai Hauli	\$0	\$0	\$0	\$37	\$111	\$305	\$280	\$310	\$587	\$676	\$698	\$800	NM
XMC	\$0	\$0	\$0	\$0	\$180	\$210	\$200	\$250	\$250	\$300	\$280	\$300	NM
ASMC	\$95	\$130	\$124	\$137	\$128	\$132	\$120	\$116	\$124	\$180	\$169	\$180	3.9%
Shanghai Belling	\$14	\$20	\$20	\$13	\$15	\$15	-	-	-	-	-	-	NM
China foundry sales (US\$mn)	\$1,687	\$2,549	\$2,303	\$2,673	\$3,298	\$3,638	\$3,808	\$4,730	\$5,326	\$5,928	\$5,665	\$6,663	11.9%
YoY Growth	-22.2%	51.1%	-9.7%	16.1%	23.4%	10.3%	4.7%	24.2%	12.6%	11.3%	-4.4%	17.6%	
China foundry share (%)	8.4%	9.0%	8.0%	7.9%	8.4%	7.9%	7.8%	8.8%	9.0%	9.4%	9.2%	8.7%	
TSMC	\$8,972	\$13,323	\$14,543	\$17,137	\$20,111	\$25,173	\$26,606	\$29,420	\$32,105	\$34,196	\$34,633	\$45,402	11.5%
GlobalFoundries	\$2,422	\$3,662	\$3,005	\$4,013	\$4,121	\$4,352	\$4,673	\$4,639	\$5,284	\$5,451	\$5,380	\$5,500	7.6%
UMC	\$2,697	\$3,810	\$3,605	\$3,587	\$3,913	\$4,219	\$4,419	\$4,593	\$4,904	\$5,028	\$4,782	\$6,013	3.6%
Samsung Foundry	\$486	\$390	\$770	\$1,295	\$3,200	\$3,339	\$2,621	\$3,700	\$4,475	\$4,721	\$4,340	\$5,859	24.1%
Japanese IDMs	\$972	\$1,095	\$992	\$940	\$954	\$1,111	\$1,261	\$1,291	\$1,289	\$1,318	\$858	\$858	-1.8%
Powerchip Logic	\$140	\$149	\$431	\$614	\$862	\$917	\$985	\$987	\$1,057	\$1,152	\$994	\$994	11.0%
TowerJazz	\$298	\$509	\$613	\$639	\$505	\$828	\$961	\$1,249	\$1,387	\$1,303	\$1,234	\$1,261	9.1%
Vanguard	\$386	\$395	\$509	\$490	\$400	\$546	\$736	\$802	\$819	\$959	\$914	\$1,098	7.6%
Dongbu	\$370	\$512	\$483	\$478	\$464	\$540	\$590	\$667	\$611	\$615	\$694	\$729	4.6%
IBM	\$383	\$500	\$545	\$634	\$495	\$519	\$280	-	-	-	-	-	NM
Magnachip	\$265	\$410	\$338	\$390	\$400	\$400	\$291	\$274	\$320	\$327	\$307	\$292	-1.2%
X-Fab	\$211	\$317	\$278	\$297	\$290	\$310	\$290	\$461	\$582	\$588	\$506	\$467	7.8%
Silterra	\$160	\$180	\$180	\$160	\$172	\$160	\$150	\$130	\$120	\$190	\$120	\$126	-4.9%
Other	\$692	\$504	\$159	\$370	\$165	-\$199	\$1,221	\$1,057	\$1,077	\$1,147	\$1,181	\$1,217	28.4%
Global foundry sales (US\$mn)	\$20,141	\$28,305	\$28,754	\$33,716	\$39,349	\$45,852	\$48,891	\$53,999	\$59,357	\$62,925	\$61,608	\$76,478	10.0%
YoY Growth	-10.8%	40.5%	1.6%	17.3%	16.7%	16.5%	6.6%	10.4%	9.9%	6.0%	-2.1%	24.1%	

Source: Company data, Credit Suisse

Back-end market share history

Sales comparison	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	10-'20 CAGR
JCET	\$343	\$347	\$535	\$582	\$703	\$830	\$1,043	\$1,713	\$2,875	\$3,540	\$3,607	\$3,393	\$3,621	\$3,647	21%
Tianshui Huatian	\$107	\$114	\$172	\$203	\$257	\$399	\$536	\$616	\$824	\$1,039	\$1,081	\$1,172	\$1,228	\$1,453	22%
Tongfu Micro	\$171	\$181	\$255	\$251	\$252	\$288	\$339	\$369	\$689	\$967	\$1,093	\$1,194	\$1,473	\$1,745	19%
China back-end	\$621	\$642	\$962	\$1,035	\$1,213	\$1,517	\$1,918	\$2,698	\$4,388	\$5,545	\$5,781	\$5,760	\$6,323	\$6,845	21%
YoY Growth	6%	3%	50%	8%	17%	25%	26%	41%	63%	26%	4%	0%	10%	8%	
China % of back-end	3%	4%	4%	4%	5%	6%	7%	10%	15%	17%	17%	17%	17%	17%	
JCET ex Stats	\$343	\$347	\$535	\$582	\$703	\$830	\$1,043	\$1,268	\$1,722	\$2,323	\$2,382	\$2,170	\$2,853	\$2,867	
Tianshui Huatian	\$107	\$114	\$172	\$203	\$257	\$399	\$536	\$616	\$824	\$1,039	\$1,081	\$1,172	\$1,228	\$1,453	
Tongfu Micro ex AMD	\$171	\$181	\$255	\$251	\$252	\$288	\$339	\$369	\$427	\$529	\$602	\$567	\$677	\$782	
China organic back-end	\$621	\$642	\$962	\$1,035	\$1,213	\$1,517	\$1,918	\$2,253	\$2,973	\$3,891	\$4,065	\$3,910	\$4,758	\$5,102	17%
YoY Growth	6%	3%	50%	8%	17%	25%	26%	17%	32%	31%	4%	-4%	22%	7%	
ASE	\$3,007	\$2,608	\$3,992	\$4,345	\$4,401	\$4,829	\$5,273	\$4,873	\$4,982	\$8,035	\$8,230	\$8,133	\$9,258	\$9,506	9%
YoY Growth	-2%	-13%	53%	9%	1%	10%	9%	-8%	2%	61%	2%	-1%	14%	3%	
% of back-end	14%	15%	17%	18%	18%	19%	19%	18%	17%	25%	24%	24%	25%	24%	
Amkor	\$2,659	\$2,179	\$2,939	\$2,776	\$2,760	\$2,956	\$3,129	\$2,885	\$3,894	\$4,186	\$4,316	\$4,053	\$4,993	\$5,222	5%
YoY Growth	-3%	-18%	35%	-6%	-1%	7%	6%	-8%	35%	8%	3%	-6%	23%	5%	
% of back-end	13%	13%	12%	12%	11%	12%	12%	11%	13%	13%	13%	12%	13%	13%	
SPIL	\$1,925	\$1,729	\$2,026	\$2,084	\$2,188	\$2,336	\$2,743	\$2,613	\$2,640	N/A	N/A	N/A	N/A	N/A	P/A
Powertech	\$886	\$908	\$1,202	\$1,342	\$1,407	\$1,267	\$1,321	\$1,339	\$1,500	\$1,960	\$2,258	\$2,182	\$2,468	\$2,728	7%
TSMC	\$218	\$249	\$340	\$442	\$477	\$450	\$733	\$873	\$1,115	\$1,408	\$1,838	\$2,022	\$2,237	\$2,440	21%
UTAC	\$711	\$601	\$925	\$981	\$978	\$748	\$734	\$878	\$875	\$874	\$888	\$901	\$914	\$928	0%
ChipMOS	\$466	\$362	\$527	\$555	\$612	\$589	\$699	\$677	\$622	\$604	\$610	\$642	\$681	\$751	3%
Chipbond	\$150	\$163	\$385	\$403	\$478	\$481	\$562	\$574	\$584	\$621	\$618	\$636	\$653	\$737	5%
KYEC	\$465	\$382	\$561	\$516	\$496	\$495	\$537	\$540	\$623	\$647	\$691	\$846	\$982	\$1,031	6%
J-Devices	\$498	\$523	\$549	\$576	\$532	\$825	\$923	\$822	N/A	N/A	N/A	N/A	N/A	N/A	P/A
Carsem	\$370	\$275	\$394	\$360	\$356	\$350	\$336	\$360	\$378	\$384	\$389	\$395	\$401	\$407	0%
Walton	\$258	\$256	\$286	\$279	\$280	\$299	\$330	\$249	\$272	\$310	\$317	\$324	\$332	\$332	1%
Unisem	\$373	\$300	\$433	\$380	\$354	\$315	\$319	\$323	\$340	\$345	\$350	\$355	\$360	\$366	-2%
Orient Semi	\$327	\$265	\$357	\$369	\$360	\$322	\$456	\$507	\$490	\$457	\$504	\$516	\$528	\$535	4%
AOI Electronics	\$248	\$211	\$234	\$304	\$331	\$343	\$363	\$392	\$336	\$414	\$412	\$381	\$389	\$395	5%
Formosa Advanced	\$292	\$257	\$376	\$404	\$360	\$302	\$304	\$276	\$264	\$259	\$265	\$271	\$278	\$282	-3%
Major Players (ex-China)	\$12,851	\$11,267	\$15,528	\$16,116	\$16,372	\$16,907	\$18,762	\$18,181	\$18,916	\$20,505	\$21,687	\$21,658	\$24,474	\$25,661	5%
YoY Growth	0%	-12%	38%	4%	2%	3%	11%	-3%	4%	8%	6%	0%	13%	5%	
% of back-end	61%	66%	66%	67%	67%	67%	69%	67%	64%	63%	64%	64%	65%	65%	
Other suppliers	\$7,736	\$5,241	\$7,104	\$6,873	\$6,942	\$6,659	\$6,450	\$6,251	\$6,268	\$6,479	\$6,363	\$6,413	\$6,923	\$7,101	0%
YoY Growth	9%	-32%	36%	-3%	1%	-4%	-3%	-3%	0%	3%	-2%	1%	8%	3%	
Total back-end sales	\$21,209	\$17,150	\$23,593	\$24,024	\$24,526	\$25,082	\$27,130	\$27,130	\$29,572	\$32,529	\$33,830	\$33,830	\$37,721	\$39,607	5%
YoY Growth	3%	-19%	38%	2%	2%	2%	8%	0%	9%	10%	4%	0%	12%	5%	

Source: Company data, Credit Suisse

China fabless market share history

China IC Design Companies	2013 revenue	2014 revenue	2015 revenue	2016 revenue	2017 revenue	2018 revenue	2019 revenue	2020 revenue	CAGR 2010-20	Major products
Shenzhen HiSilicon Technologies	\$2,120	\$2,950	\$3,299	\$3,881	\$4,640	\$6,742	\$11,287	\$13,175	35%	Networking/Set-tops
Will Semi	\$1,596	\$1,595	\$1,489	\$1,530	\$1,732	\$1,917	\$2,061	\$3,017	18%	Image Sensors
Bitmain	\$0	\$0	\$137	\$278	\$2,518	\$4,268	\$1,280	\$1,921	NM	Cryptocurrency mining machine
Spreadtrum Communications	\$1,050	\$1,110	\$1,640	\$1,866	\$1,587	\$1,104	\$1,233	\$1,418	15%	Mobile processors
Goodix	\$102	\$127	\$167	\$448	\$545	\$563	\$937	\$1,040	NM	Fingerprint ICs
CEC Huada Electronic Design	\$169	\$183	\$504	\$507	\$514	\$869	\$782	\$860	28%	Smart card ICs
ZTE Microelectronics	\$45	\$470	\$520	\$829	\$907	\$883	\$725	\$775	NM	Networking / Wireless
GigaDevice Semiconductor	\$96	\$93	\$110	\$224	\$301	\$340	\$464	\$676	NM	NOR Flash Memory
Hangzhou Silan Microelectronics	\$263	\$263	\$305	\$357	\$407	\$457	\$450	\$533	NM	Communications ASICs
Tongfang Guoxin	\$142	\$180	\$197	\$213	\$272	\$370	\$496	\$458	NM	Smart card / ASIC
Maxscend	NA	\$7	\$18	\$58	\$88	\$85	\$219	\$413	NM	Acquired Omnivision
Tatwah Smartech Co Ltd	\$90	\$127	\$219	\$526	\$514	\$436	\$330	\$393	NM	RFID chips
Yangzhou Yangjie Electronic Technology Co Ltd	\$0	\$104	\$132	\$179	\$218	\$280	\$290	\$355	NM	Discretes
BYD Microelectronics	\$105	\$275	\$345	\$424	\$403	\$383	\$364	\$346	NM	Image Sensor / fingerprint
NavInfo	\$141	\$170	\$237	\$238	\$321	\$322	\$334	\$300	19%	Smart card ICs
Amlogic	\$80	\$100	\$115	\$132	\$152	\$197	\$175	\$295	23%	Consumer / Tablet SoC
Wuhan Tianyu Information Industry Co Ltd	\$206	\$218	\$234	\$245	\$286	\$362	\$320	\$283	22%	Smart cards
Shenzhen Microgate Technology Co Ltd	\$26	\$36	\$107	\$261	\$214	\$253	\$262	\$273	NM	Surveillance
Montage	\$100	\$150	\$200	\$220	\$225	\$254	\$251	\$273	NM	Memory interface design
Leadcore Technology	\$152	\$115	\$218	\$228	\$235	\$242	\$250	\$257	8%	Mobile processors
Jilin Sino-Microelectronics Co Ltd	\$202	\$199	\$205	\$210	\$243	\$258	\$239	\$251	4%	Power/Analog
Suzhou Good-Ark Electronics Co Ltd	\$132	\$149	\$128	\$178	\$275	\$285	\$286	\$226	6%	Discretes
Fuzhou Rockchip Electronics	\$216	\$152	\$152	\$191	\$179	\$182	\$203	\$211	14%	Tablet/audio processors
Allwinner Technology	\$246	\$185	\$181	\$187	\$179	\$206	\$212	\$187	NM	Tablet/audio processors
SG Micro Corp	\$0	\$0	\$12	\$0	\$79	\$87	\$114	\$145	NM	Power Semis/Foundry
Sino Wealth Electronic Ltd	\$55	\$60	\$65	\$78	\$102	\$115	\$121	\$142	NM	MCUs
Shanghai Belling Co Ltd	\$95	\$76	\$77	\$77	\$83	\$119	\$127	\$137	5%	Consumer ICs
Jiangsu Jiejie Microelectronics Co Ltd	\$0	\$0	\$0	\$0	\$64	\$81	\$97	\$127	NM	Discretes
Canaan Inc	\$0	\$0	\$7	\$48	\$195	\$416	\$203	\$120	NM	AI / bitcoin
Ingenic Semiconductor Co Ltd	\$15	\$9	\$11	\$17	\$27	\$39	\$49	\$110	23%	Smart cards
Datang Microelectronics Technology	\$151	\$131	\$146	\$135	\$150	\$151	\$82	\$94	2%	Smart card ICs
Espressif Systems Shanghai Co Ltd	\$0	\$0	\$0	\$0	\$0	\$37	\$62	\$92	NM	Connectivity
Shanghai Fullhan Microelectronics Co Ltd	\$0	\$0	\$0	\$0	\$67	\$62	\$75	\$88	NM	MCUs
Giantec Semiconductor Corp	\$0	\$0	\$0	\$0	\$0	\$13	\$39	\$68	NM	Contactless
Nationz Technologies Inc	\$70	\$69	\$89	\$106	\$103	\$92	\$57	\$53	-6%	Industrial ICs
RDA Microelectronics	\$380	\$339	In SPRD	In SPRD	In SPRD	In SPRD	In SPRD	In SPRD	NM	Connectivity and RF
China Fabless	\$8,046	\$9,642	\$11,266	\$13,868	\$17,826	\$22,468	\$24,476	\$29,111	27%	
YoY Growth	43%	20%	17%	23%	29%	26%	9%	19%		
Top China fabless market share	11.8%	12.8%	15.3%	17.4%	19.2%	21.7%	23.6%	24.2%		
China Fabless ex-HiSilicon	\$5,926	\$6,692	\$7,968	\$9,988	\$13,186	\$15,725	\$13,189	\$15,936	22%	
YoY Growth	33%	13%	19%	25%	32%	19%	-16%	21%		
China fabless share ex-HiSilicon	9.0%	9.2%	11.3%	13.2%	15.0%	16.3%	14.3%	14.9%		

Source: Company data, Credit Suisse

Overseas fabless market share history

Overseas IC Design Companies	2013 revenue	2014 revenue	2015 revenue	2016 revenue	2017 revenue	2018 revenue	2019 revenue	2020 revenue	CAGR 2010-20	Major products
Broadcom	\$8,305	\$8,388	\$8,472	\$13,292	\$17,665	\$20,029	\$17,297	\$18,321	10%	Networking/Broadband
QCOM QCT	\$17,211	\$19,291	\$16,008	\$15,415	\$17,029	\$16,581	\$16,208	\$18,227	10%	Mobile Processors
NVIDIA	\$4,118	\$4,646	\$4,982	\$6,750	\$9,474	\$11,546	\$10,986	\$15,364	15%	Graphics
Mediatek	\$4,586	\$7,030	\$6,718	\$8,549	\$7,832	\$7,902	\$7,972	\$10,643	11%	Mobile/Digital Home
AMD	\$5,481	\$5,668	\$4,111	\$4,272	\$5,253	\$6,475	\$6,731	\$8,898	3%	Processors/Graphics
Xilinx	\$2,256	\$2,485	\$2,447	\$2,334	\$2,485	\$2,661	\$3,215	\$3,367	6%	Programmable Logic
Marvell	\$3,169	\$3,404	\$3,707	\$2,726	\$2,393	\$2,416	\$2,866	\$2,699	0%	Networking/Connectivity
Realtek	\$950	\$1,032	\$1,000	\$1,207	\$1,371	\$1,521	\$1,967	\$2,600	14%	Networking/IoT
Novatek	\$1,397	\$1,784	\$1,602	\$1,416	\$1,548	\$1,820	\$2,084	\$2,598	8%	Driver ICs/Display
Phison	\$1,083	\$1,012	\$1,129	\$1,391	\$1,271	\$1,296	\$1,361	\$1,429	4%	Memory Controllers
Synaptics	\$948	\$948	\$1,703	\$1,667	\$1,718	\$1,630	\$1,472	\$1,334	8%	Touch
Dialog	\$901	\$1,159	\$1,356	\$1,198	\$1,353	\$1,444	\$1,444	\$1,318	16%	Power management
Silicon Lab	\$580	\$621	\$645	\$698	\$769	\$868	\$838	\$850	6%	MCUs/Networking
Himax	\$771	\$841	\$692	\$803	\$685	\$724	\$672	\$812	2%	Display Drivers
Silicon Motion	\$225	\$289	\$361	\$556	\$523	\$530	\$449	\$517	15%	Memory controllers
ELAN	\$258	\$232	\$197	\$205	\$223	\$268	\$323	\$480	10%	MCUs/Touch
Lattice	\$333	\$366	\$411	\$427	\$386	\$399	\$404	\$400	3%	FPGAs
FocalTech	\$315	\$0	\$229	\$179	\$158	\$136	\$312	\$398	8%	Display Drivers
Global Mixed-Mode	\$131	\$121	\$105	\$117	\$120	\$142	\$193	\$230	4%	Analog
Asmedia	\$40	\$47	\$47	\$65	\$91	\$118	\$128	\$218	27%	Logic I/O
EGIS	\$3	\$1	\$16	\$53	\$144	\$188	\$197	\$207	NM	Fingerprint
Holtek	\$121	\$111	\$110	\$118	\$126	\$138	\$156	\$172	3%	MCUs
PixArt Imagine	\$132	\$76	\$63	\$68	\$106	\$139	\$146	\$153	2%	MCUs/Bluetooth
Sunplus	\$105	\$79	\$81	\$61	\$42	\$39	\$41	\$43	-14%	MCUs
Pixelworks	\$48	\$61	\$60	\$53	\$81	\$77	\$69	\$42	-5%	Consumer
Altera	\$1,733	\$1,932	\$1,971	\$2,010	\$2,050	\$1,948	\$1,753	In Intel	NM	Programmable Logic
Avago	\$2,520	\$4,269	\$4,300	In BRCM	In BRCM	In BRCM	In BRCM	In BRCM	NM	RF/Storage/Networking
LSI (Acquired by Avago)	\$2,370	In Avago	In Avago	In BRCM	In BRCM	In BRCM	In BRCM	In BRCM	NM	Storage/Networking
Top overseas fabless	\$60,089	\$65,892	\$62,523	\$65,630	\$74,894	\$81,035	\$79,283	\$91,320	7%	
YoY Growth	11%	10%	-5%	5%	14%	8%	-2%	15%		
Top overseas fabless market share	88.2%	87.2%	84.7%	82.6%	80.8%	78.3%	76.4%	75.8%		
China top fabless	\$8,046	\$9,642	\$11,266	\$13,868	\$17,826	\$22,468	\$24,476	\$29,111	27%	
Overseas fabless revenue	\$60,089	\$65,892	\$62,523	\$65,630	\$74,894	\$81,035	\$79,283	\$91,320	7%	
Fabless Revenue	\$68,135	\$75,535	\$73,789	\$79,498	\$92,720	\$103,502	\$103,760	\$120,431	10%	
YoY Growth	14%	11%	-2%	8%	17%	12%	0%	16%		
Semiconductor Revenue	\$305,584	\$335,744	\$333,568	\$336,027	\$408,999	\$465,529	\$406,957	\$435,444	4%	
YoY Growth	5%	10%	-1%	1%	22%	14%	-13%	7%		

Source: Company data, Credit Suisse

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ASE Industrial Holdings (3711.TW, NT\$104.5)
ASM International (ASMI.AS, €216.2)
ASM Pacific Technology Ltd (0522.HK, HK\$117.0)
ASML Holding N.V. (ASML.AS, €439.0)
AU Optronics (2409.TW, NT\$13.75)
Acer Group (2353.TW, NT\$23.75)
Airtac (1590.TW, NT\$1130.0)
Aichip Tech (3661.TW, NT\$821.0)
All Ring (0187.TW, NT\$323.5)
Amkor Technology Inc. (AMKR.OQ, \$18.79)
Amlogic (68099.SS, Rmb78.67)
Analog Devices Inc. (ADI.OQ, \$160.54)
Andes (6533.TW, NT\$340.0)
Anj Technology (688019.SS, Rmb355.0)
Apple Inc. (AAPL.OQ, \$127.83)
Applied Materials Inc. (AMAT.OQ, \$109.22)
Aspeed (5274.TW, NT\$2000.0)
Asustek (2367.TW, NT\$276.0)
Bestechinc SH (686808.SS, Rmb382.98)
Broadcom Ltd (AVGO.OQ, \$459.27)
CR Micro (688396.SS, Rmb69.3)
Cadence Design System (CDNS.OQ, \$137.62)
Casetek Holdings Limited (5294.TW)
Catcher Technology (2474.TW, NT\$200.0)
Chicony (2385.TW, NT\$87.2)
China State Construction International Holdings (3311.HK, HK\$4.81)
ChipMOS Technologies Inc. (8150.TW, NT\$35.7)
Chipbond (6147.TW, NT\$74.5)
Chroma (2360.TW, NT\$193.5)
Chunghua Precision (6510.TWO, NT\$974.0)
Compal Electronics (2324.TW, NT\$20.8)
Corconec Corp (5371.TWO, NT\$38.38)
Delta Electronics (2308.TW, NT\$294.5)
E Ink Holdings Inc (0069.TWO, NT\$44.55)
ENJOSTAR Inc. (2448.TW, NT\$86.0)
Egis Technology Inc. (6462.TWO, NT\$164.5)
Elen Microelectronics Corp (0458.TW, NT\$168.0)
Everlight Electronics Co Ltd (2393.TW, NT\$44.3)
Faraday Technology Corporation (3035.TW, NT\$51.0)
GIGACOM (2443.TW, NT\$99.0)
Giant Manufacturing Co Ltd (8921.TW, NT\$284.0)
Gigadevice (603986.SS, Rmb225.0)
GlobalFoundries (unlisted)
Goodix (603160.SS, Rmb155.7)
HTC Corp (2458.TW, NT\$28.3)
Himax Technologies, Inc. (HIMX.OQ, \$8.36)
Hua Hong Semiconductor Limited (1347.HK, HK\$48.5)
Huatan (002185.SZ, Rmb16.05)
Inari Amertron (INAR.KL, RM2.99)
Innolux Corporation (3481.TW, NT\$13.05)
Intel Corp. (INTC.OQ, \$57.99)
JCEC (005084.SS, Rmb47.17)
KLA Corporation (KLAC.OQ, \$314.08)
KYEC (0449.TW, NT\$39.0)
Kingpak Technology (6238.TWO)
Kinsus Interconnect Tech (3189.TW, NT\$87.2)
Lam Research Corp. (LRCX.OQ, \$580.02)
Largan Precision (3008.TW, NT\$2790.0)
MPI (6223.TWO, NT\$128.0)
Macronix (2337.TW, NT\$38.3)
Marvell Technology Group Ltd. (MRVL.OQ, \$53.81)
Maxscend (300782.SZ, Rmb660.0)
MediaTek Inc. (2454.TW, NT\$972.0)
Microchip Technology Inc. (MCHP.OQ, \$153.25)
Micron Technology Inc. (MU.OQ, \$85.5)
Montage (688009.SS, Rmb68.07)
NAURA (002371.SZ, Rmb231.01)
NSIG (608126.SS, Rmb36.91)
NVIDIA Corporation (NVDA.OQ, \$521.01)
Nan Ya Printed Circuit Board (8046.TW, NT\$216.5)
Nanya Technology (2408.TW, NT\$84.3)
Navitas (002405.SZ, Rmb15.78)
Novatek Microelectronics Corp Ltd (3034.TW, NT\$401.0)
ON Semiconductor Corp. (ON.OQ, \$38.52)
Parade Technologies (4066.TWO, NT\$1315.0)
Pegatron (4938.TW, NT\$76.0)
Powertech Technology (6239.TW, NT\$100.0)
QUALCOMM Inc. (QCOM.OQ, \$163.77)
Quanta Computer (2382.TW, NT\$51.2)
Radiant Opto-Electronics (6176.TW, NT\$117.5)
Realtek Semiconductor (2379.TW, NT\$473.5)
Richwave (4968.TW, NT\$553.0)
SCREEN (725.T, ¥8.860)
SG Micro (300661.SZ, Rmb313.98)
SUNCOR (2436.T, ¥2.413)
Samsung Electronics (005930.KS, ₩87.300)
Sanan Optoelectronics Co. Ltd (807030.SS, Rmb32.87)
Semiconductor Manufacturing International Corp. (6081.HK, HK\$29.6)
Sh Wayne (600641.SS, Rmb16.9)
Shanghai Sinyang (300236.SZ, Rmb52.31)
Shin-Etsu Chemical (4063.T, ¥19.290)
Silergy (6415.TW, NT\$2600.0)
Silicon Mtn Tec (SHAO.OQ, \$50.33)
Sunny Optical (2382.HK, HK\$221.0)

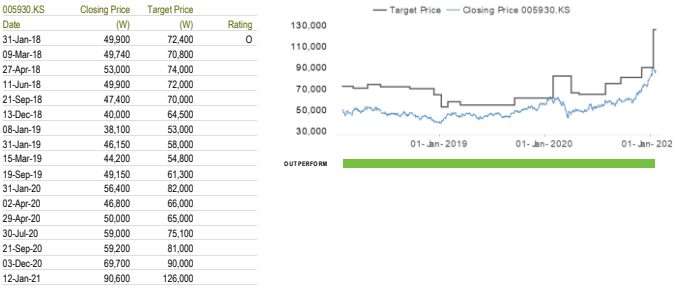
Texas Instruments Inc. (TXN.OQ, \$174.19)
Tokyo Electron (8035.T, ¥44.130)
Tongfu (002156.SZ, Rmb29.38)
Topoint Technology Co Ltd (0021.TW, NT\$27.3)
Tower Semiconductor (TSEM.OQ, \$29.7)
Tower Semiconductor (TSEM.TA, ngrs970.0)
Tripod Technology (3044.TW, NT\$127.0)
Unimicron Technology Corp (3037.TW, NT\$92.4)
United Microelectronics (2303.TW, NT\$52.1)
Vanguard International Semiconductor (5347.TWO, NT\$118.5)
VeriSilMicroSH (688521.SS, Rmb83.83)
Visual Photonics Epitaxy Co., Ltd (2465.TW, NT\$113.5)
WINGTECH (600745.SS, Rmb127.15)
Will Semi (603501.SS, Rmb314.89)
Win Semiconductors Corp (3105.TWO, NT\$445.0)
Wistron (3231.TW, NT\$30.0)
X-FAB (XFAB.PA, €7.02)
ZTE (0763.HK, HK\$24.2)
ZTE (000063.SZ, Rmb35.86)
eMemory (3529.TWO, NT\$674.0)

Disclosure Appendix

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3-Year Price and Rating History for Samsung Electronics (005930.KS)



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