

# Examining China's Semiconductor Self-Sufficiency

## Present and Future Prospects



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Research Analyst

**Randy Abrams**, [randy.abrams@credit-suisse.com](mailto:randy.abrams@credit-suisse.com)

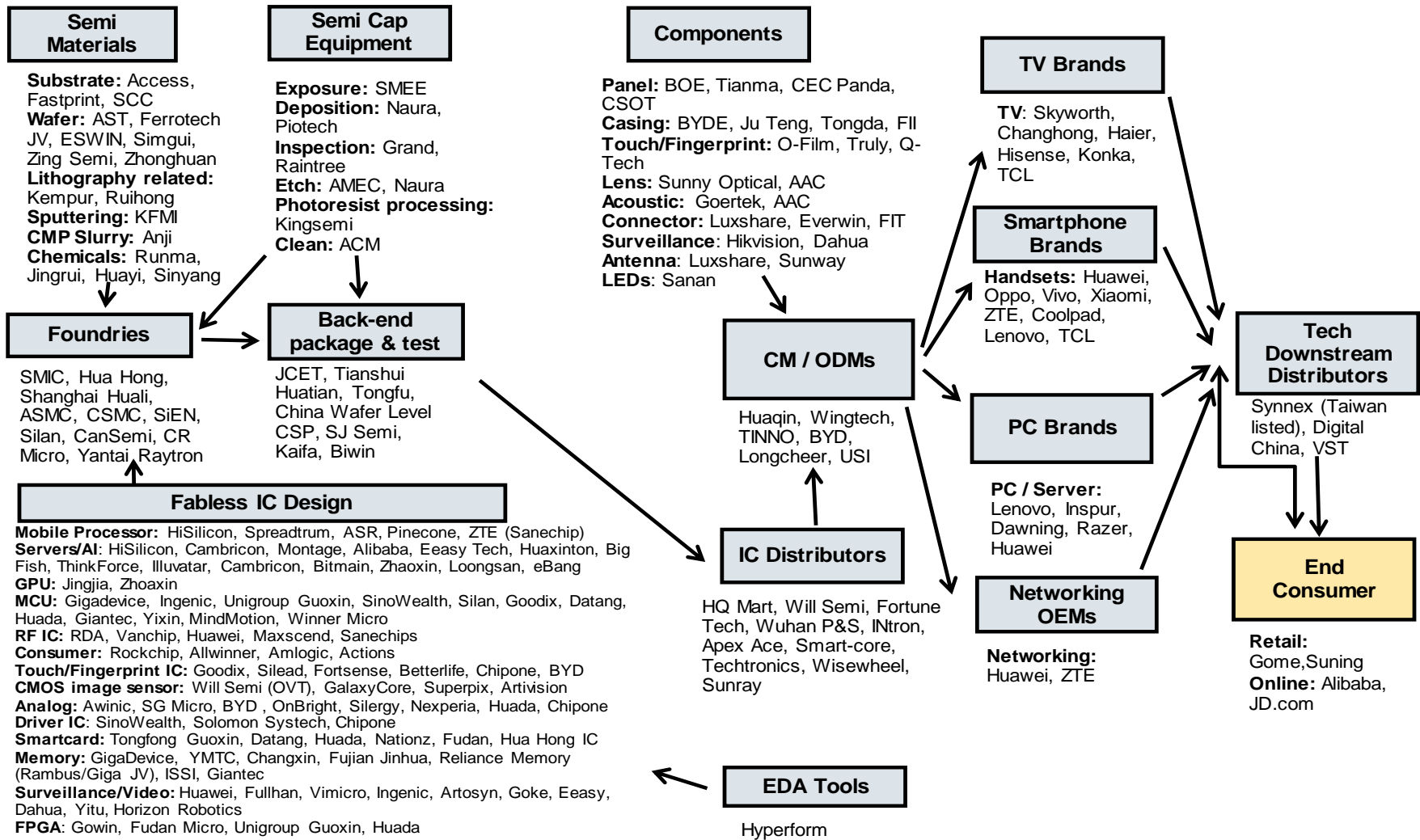
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# Examining China's Semiconductor Self-Sufficiency

## Present and Future Prospects

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

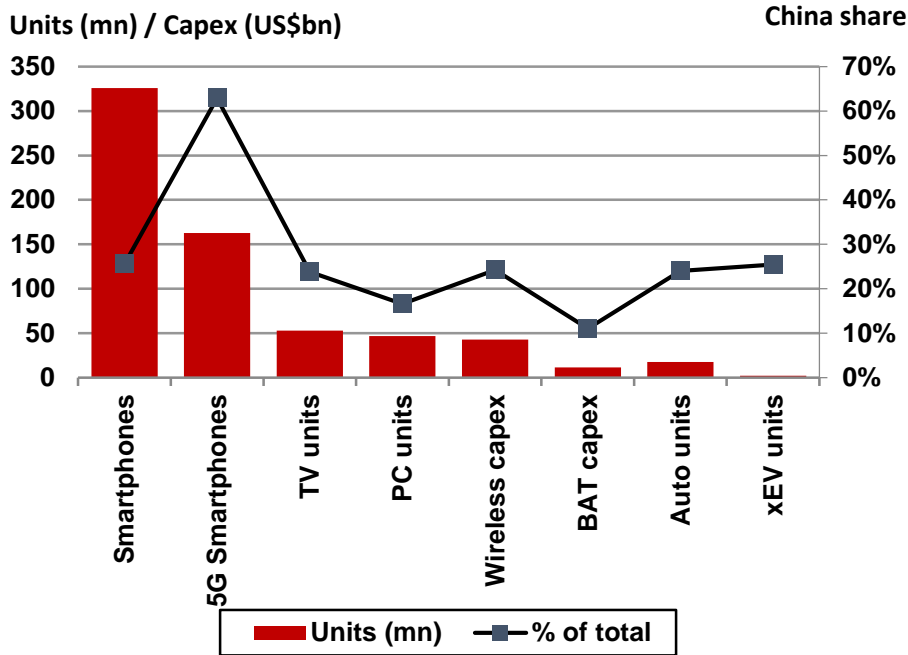
# China building out its tech and semi ecosystem



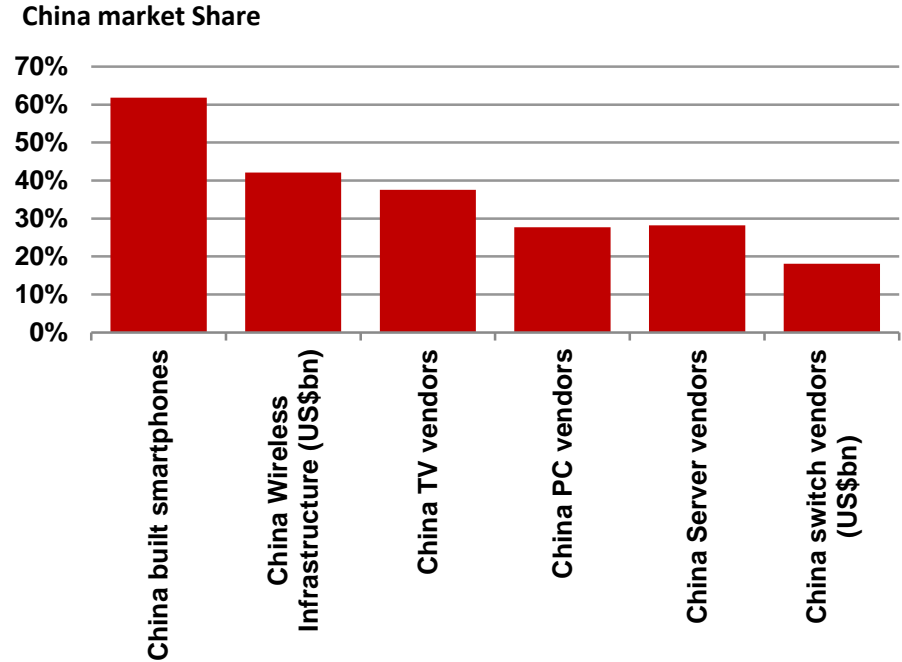
Source: Company data, Credit Suisse

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

China as a market about 25% of tech product demand



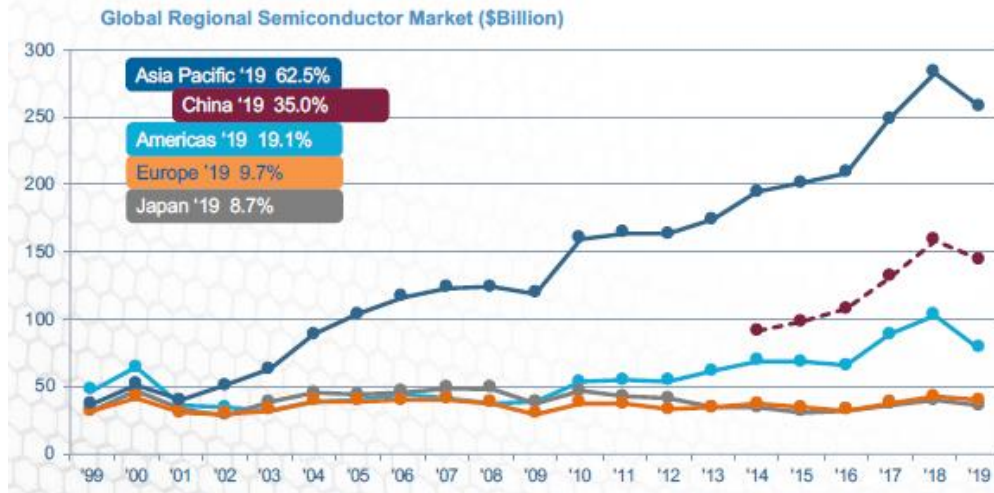
China domestic suppliers gaining higher global share



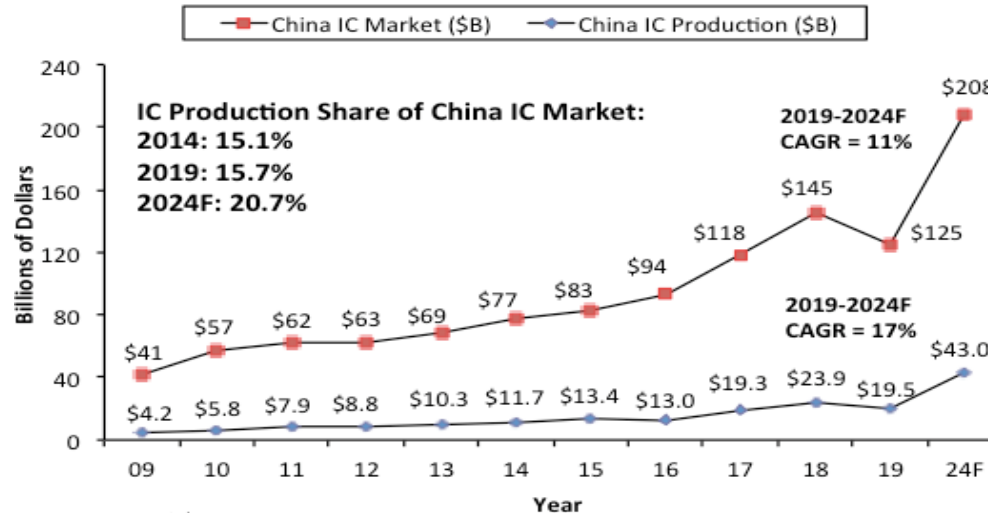
Source: IDC, Omdia, Company Data, Credit Suisse Estimates

# 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



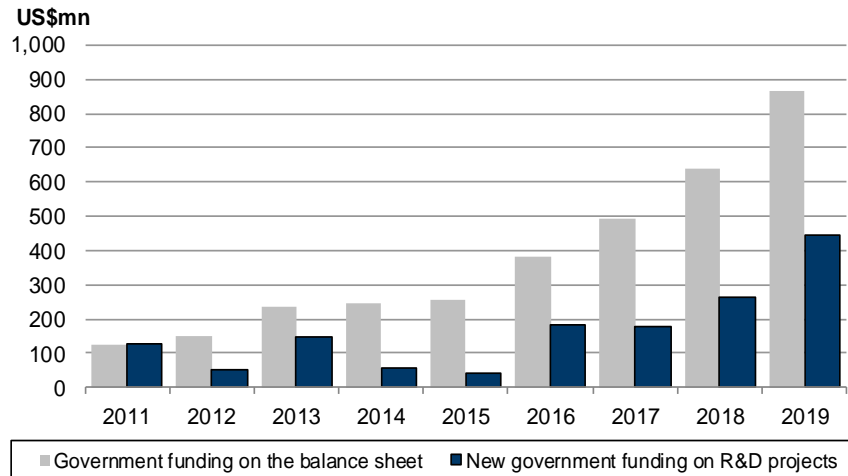
Source: IC Insights

# China providing policy support for its IC industry

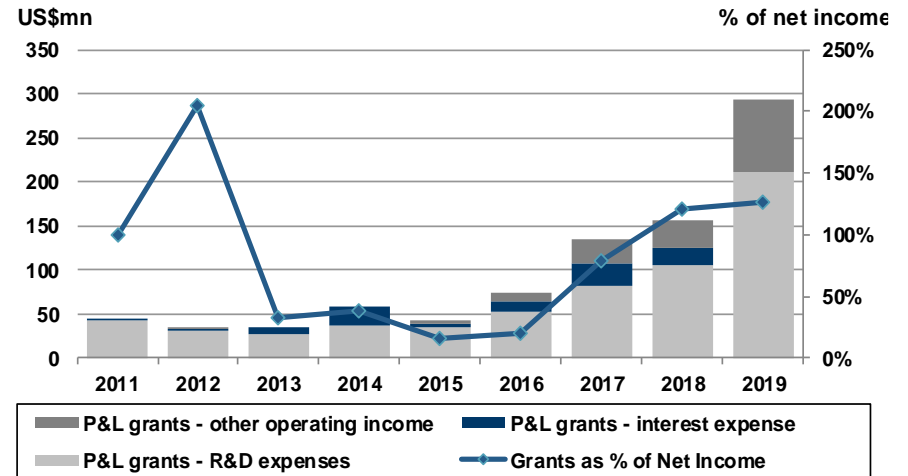
Target sector	Change	New	Old	Previous Policy
IC manufacturing	Added	Waive the 1 <sup>st</sup> 10 year corporate income tax for IC manufacturing companies or projects for 28nm or below if in operations for over 15 years	1st 5 years profit tax exempt & 50% reduction in the next 5 years for ICs <65nm set 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 <sup>st</sup> 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 <sup>nd</sup> 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 funding for advanced foundry growing

## SMIC's government funding for R&D ramping up

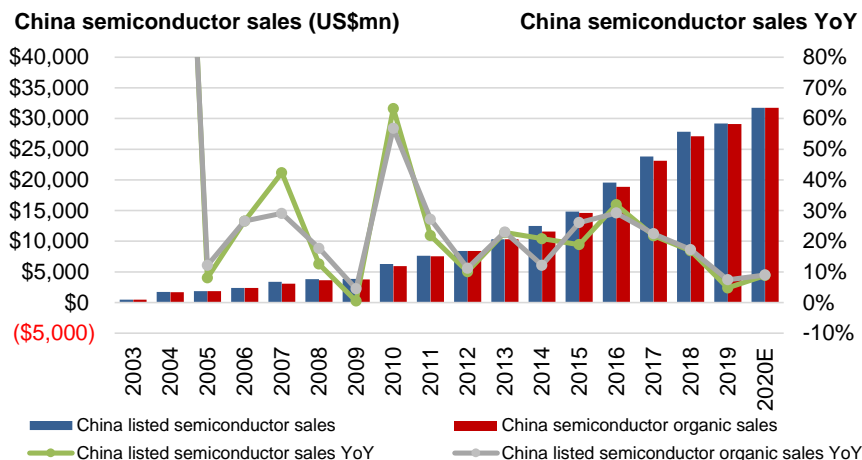


## Government grants recognized continues to grow

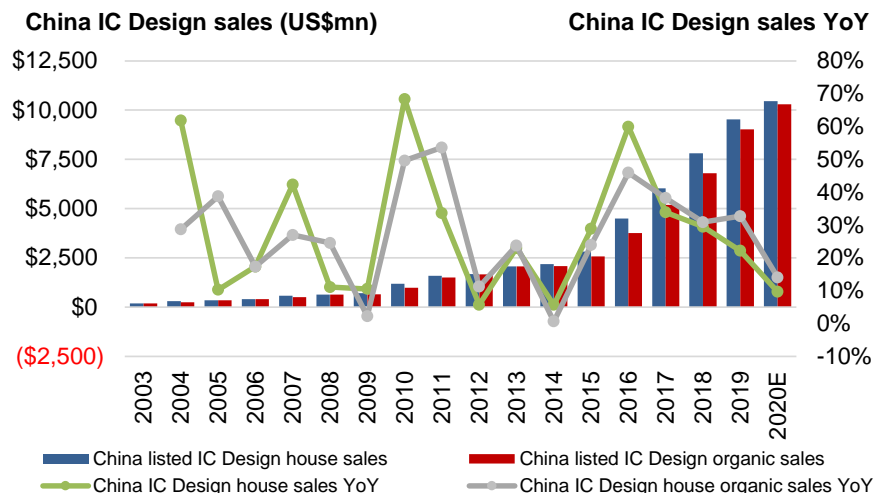


# China listed semiconductor sales rebounding

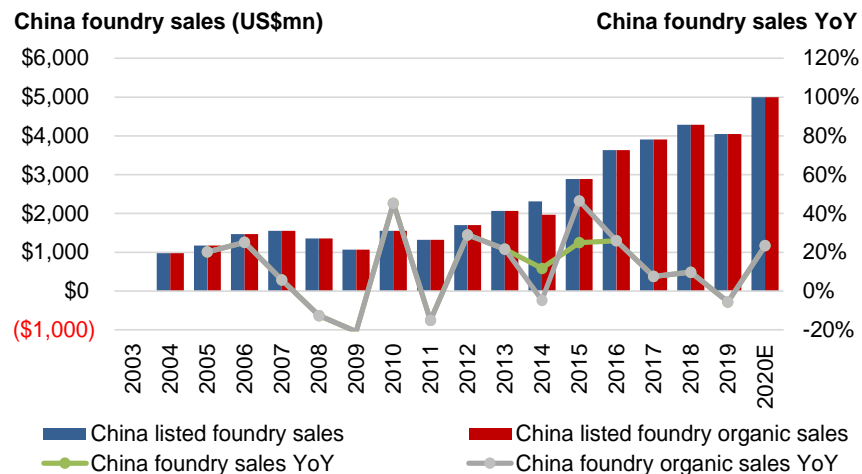
## China Semis: Trade/Tech war has moderated growth



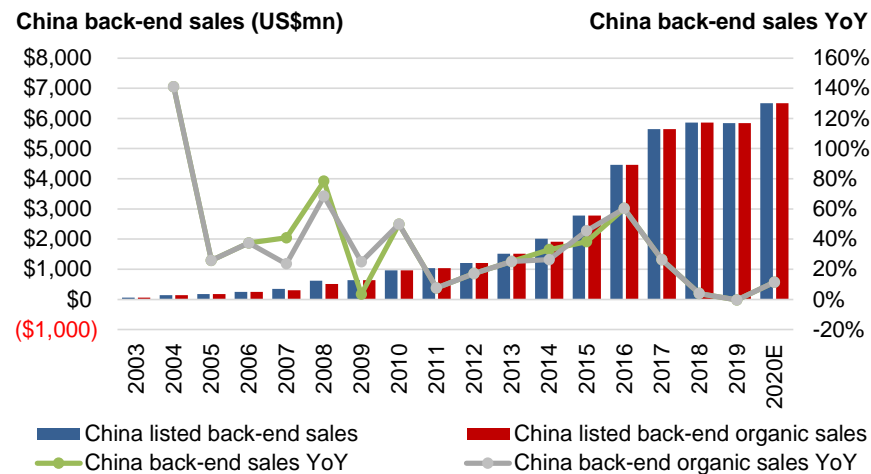
## China Fables: Sales growth decelerated in 2019-20



## China foundry: Rebounding in 2020



## China Back-end: M&A boosted 2015-16, rebounding in '20

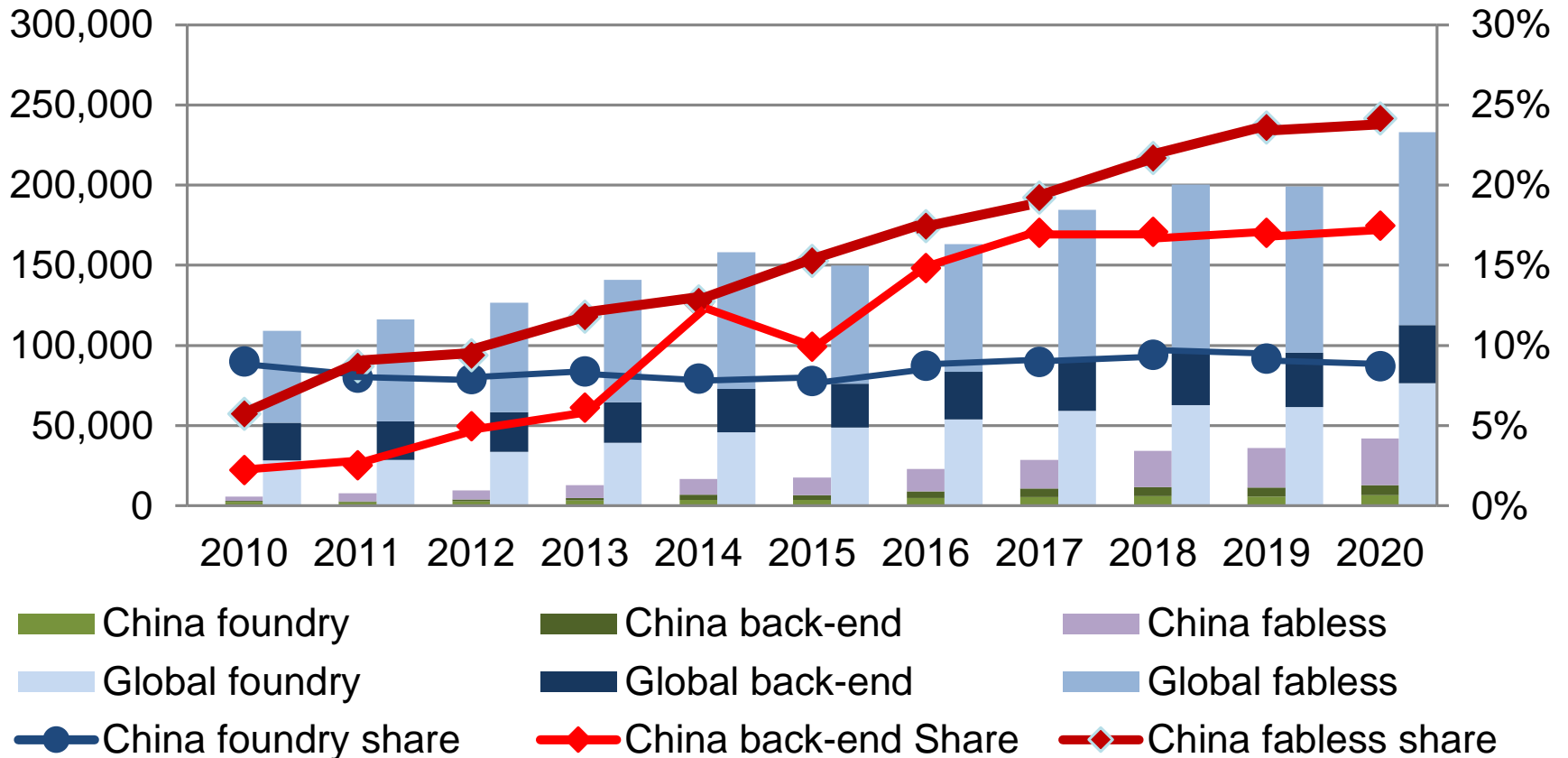




# China has been gaining industry share in semis

## Semiconductor sales (US\$m)

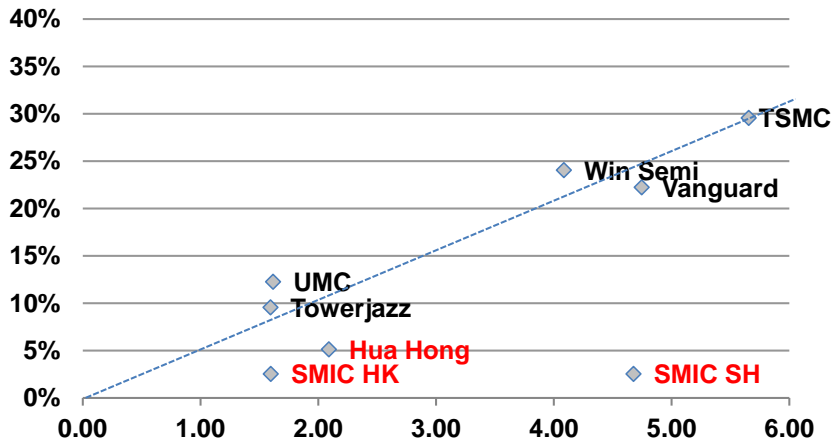
## China market share (%)



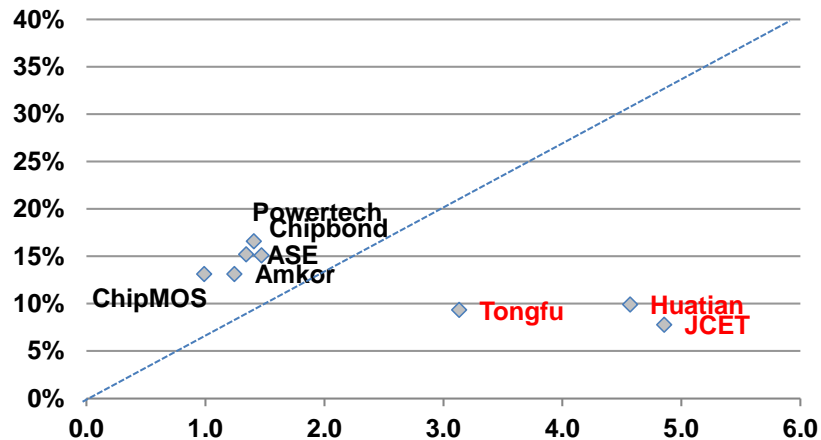
Source: Company Data, Gartner, Credit Suisse estimates

# High China valuations provide access to capital

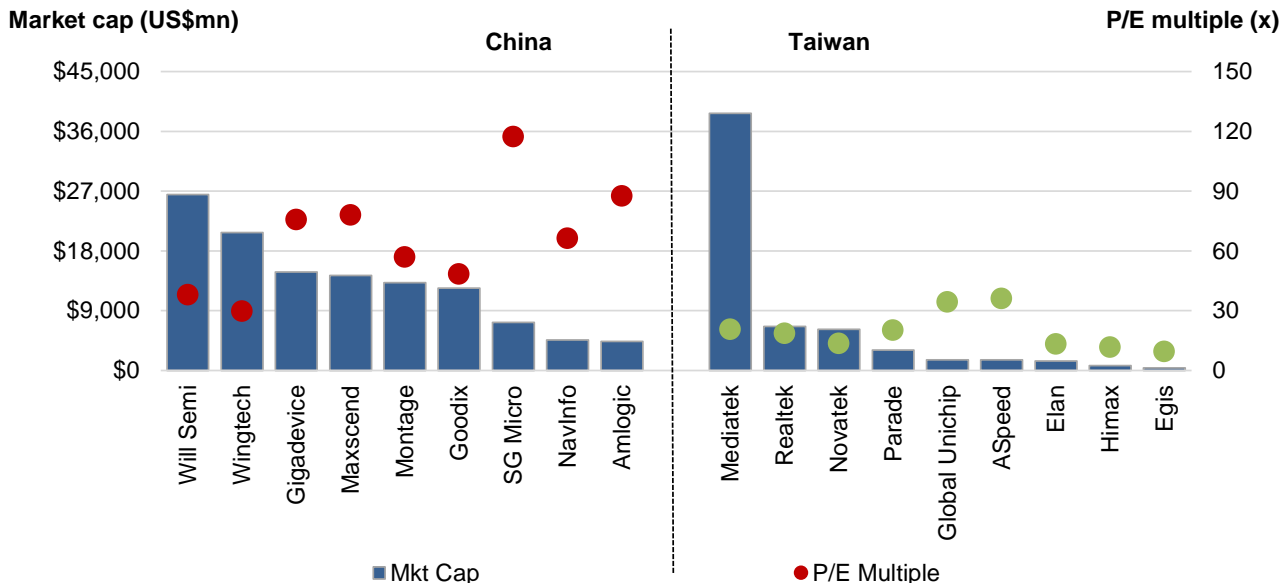
China foundries at similar multiples despite lower ROE



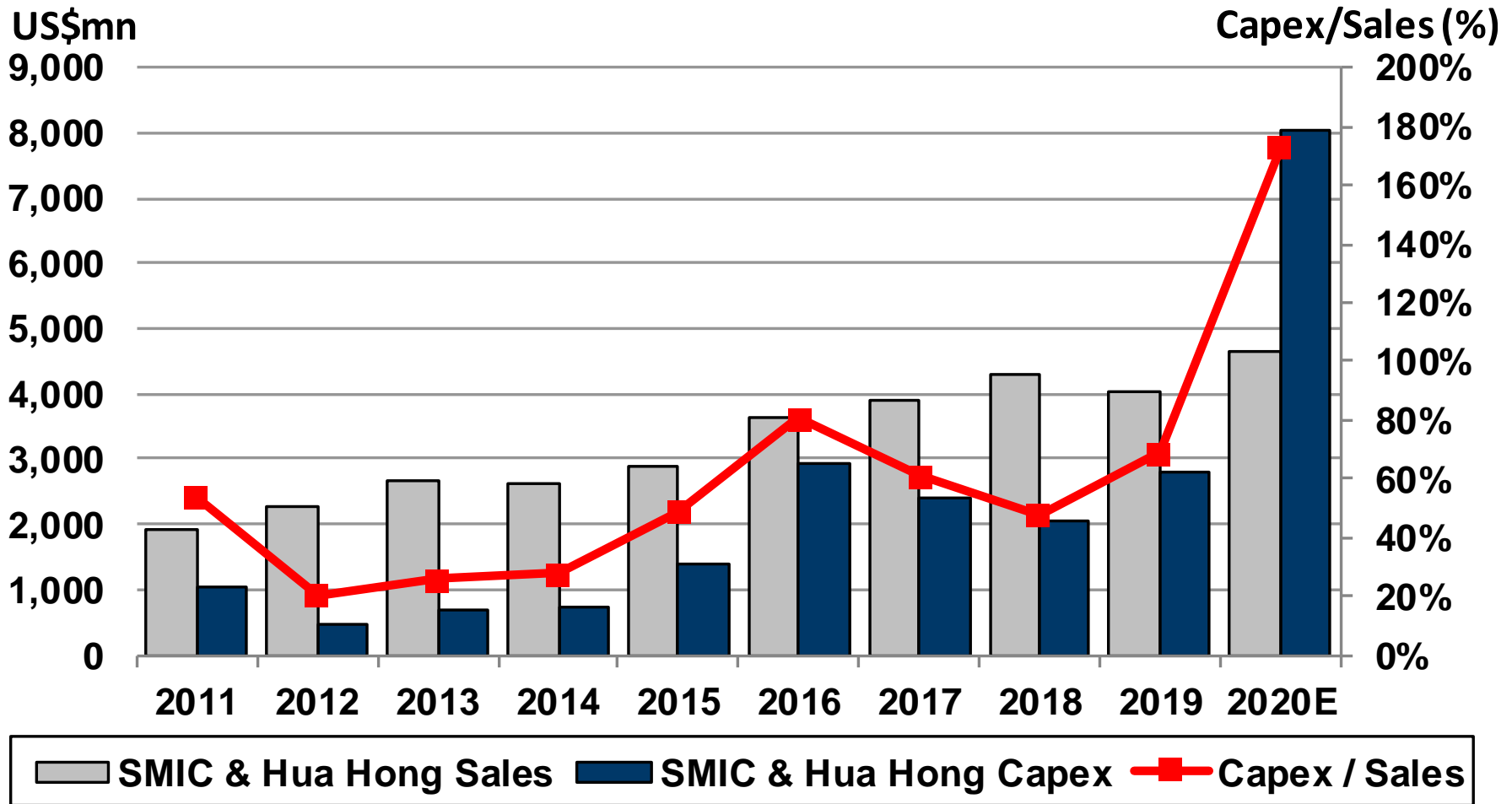
China back-end at a large premium despite lower ROEs



China fabless at a substantial premium P/E to Taiwan (66x vs. 20x)



# China foundries' capex above their sales in 2020



Source: Company Data, Credit Suisse estimates

# Domestic and Overseas players adding to China fabs

Origin Country	Company	Fab Site	Wafer size	Segment	Node (nm)	Installed (WPM)	Next phase planned	Final Capacity (WPM)
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	30,000
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	YMTC	Wuhan	12"	3D NAND	3D NAND	20,000	30,000	300,000
<b>Upcoming fabs by domestic companies</b>						<b>176,000</b>	<b>199,000</b>	<b>905,000</b>
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	20,000	10,000	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
<b>Upcoming fabs by overseas companies</b>						<b>467,000</b>	<b>193,000</b>	<b>740,000</b>

# Recap of key themes

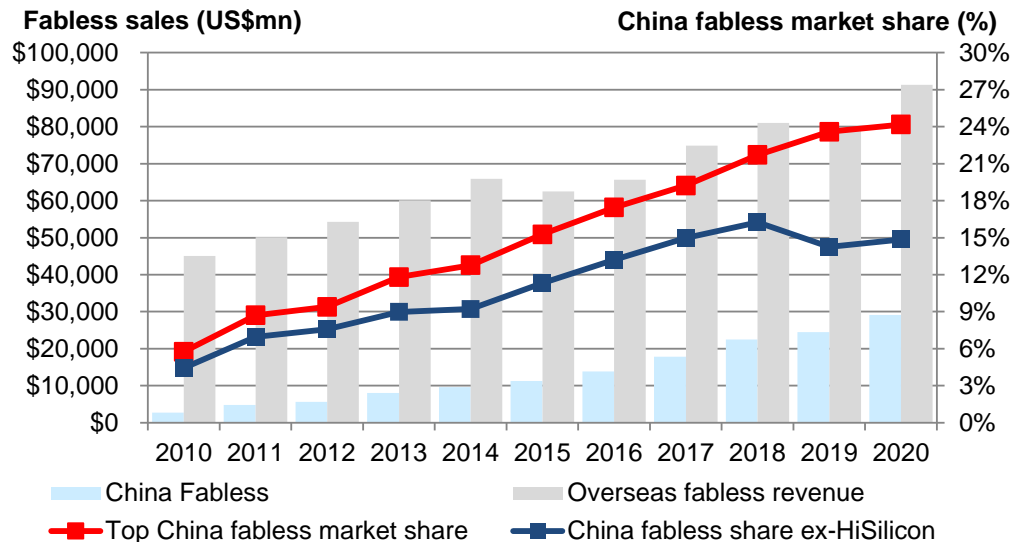
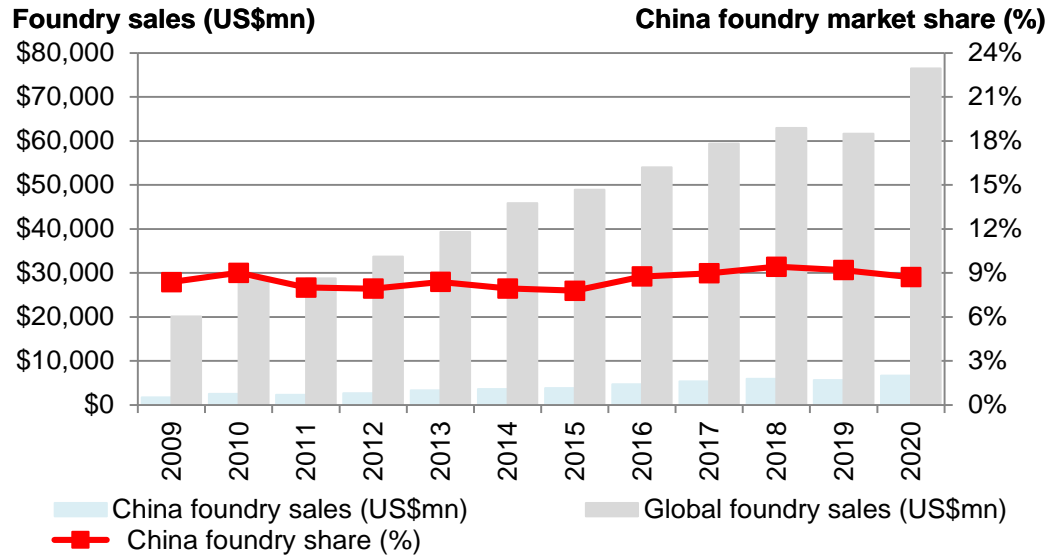
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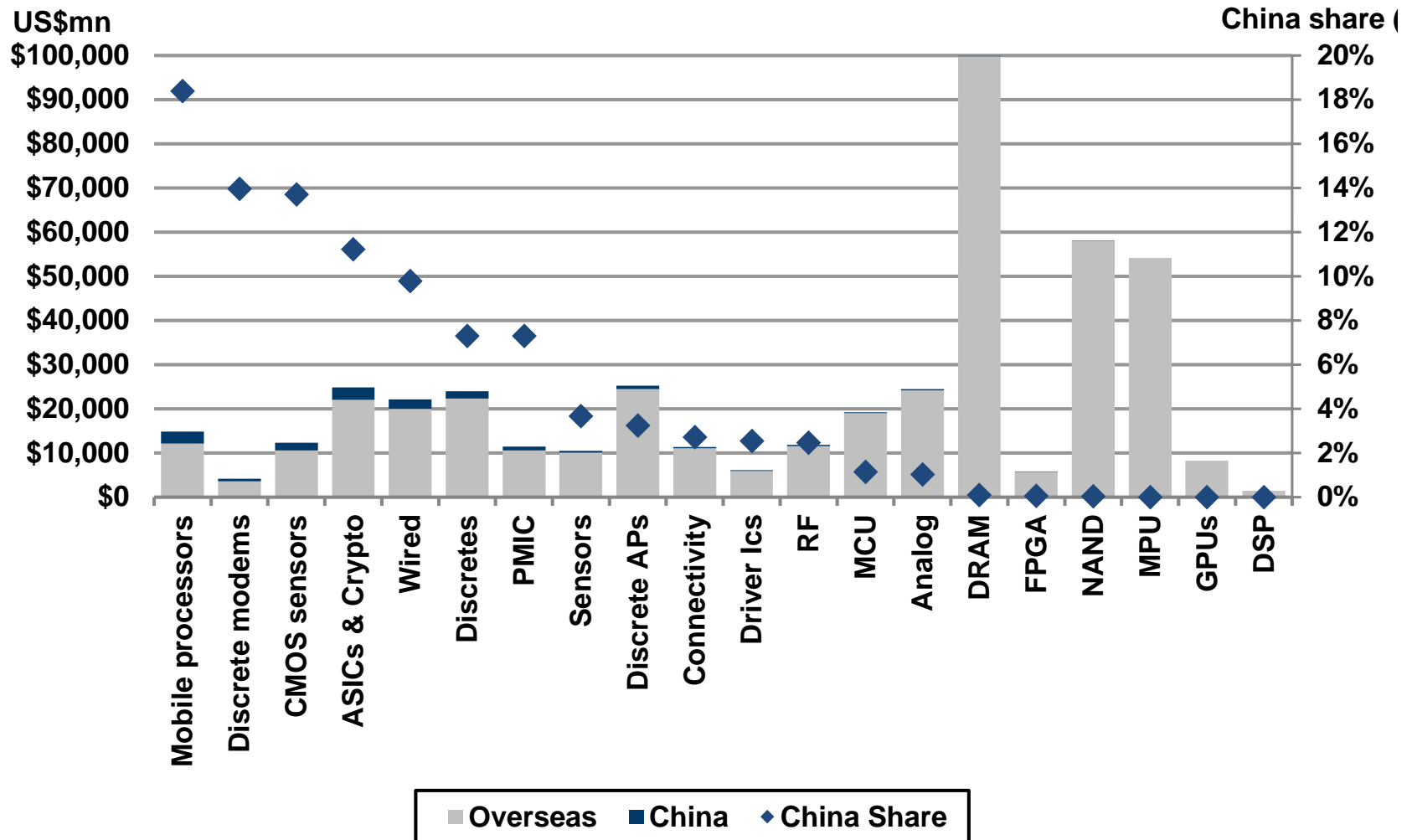
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# Q&A Details

# China foundry share stagnant, fabless share rising



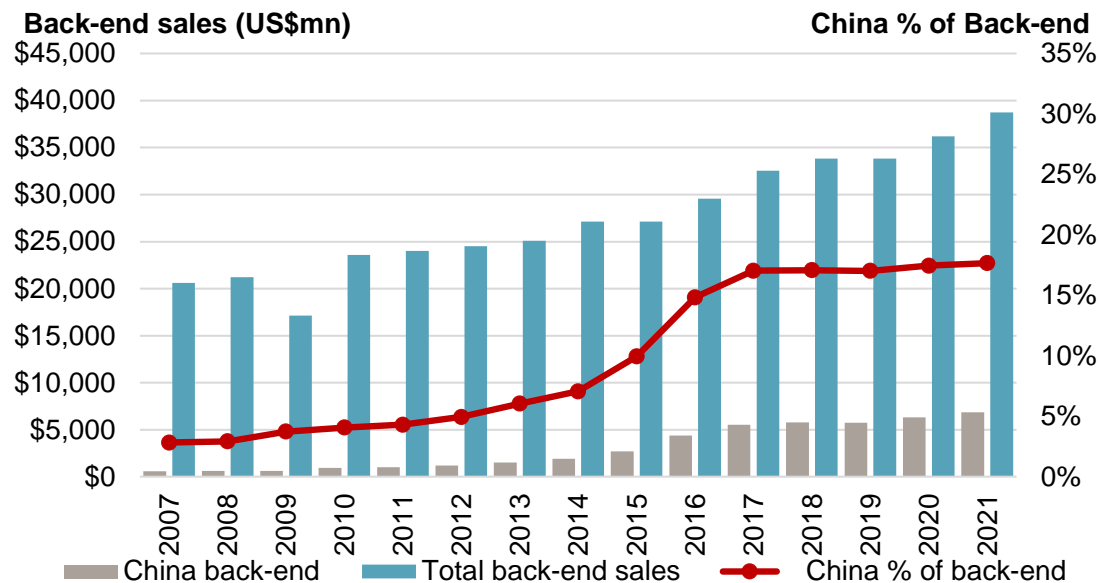
# China targeting to share gains in more IC categories



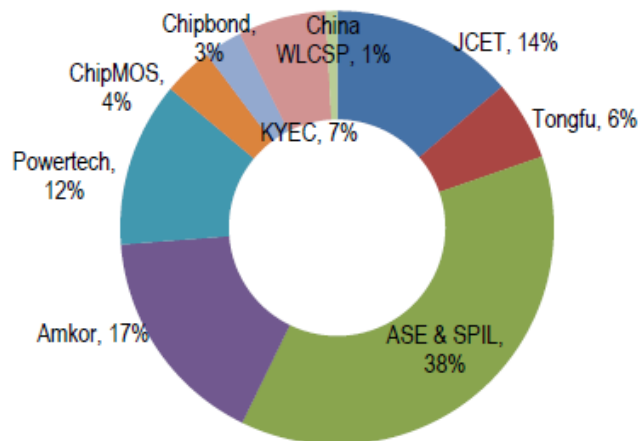
Source: Gartner, Company Data, Credit Suisse estimates



# China OSATs gaining share following M&A



**Accumulated capex share 2014-19**



# China has low share in equipment and materials

## China equipment suppliers still very small vs global players

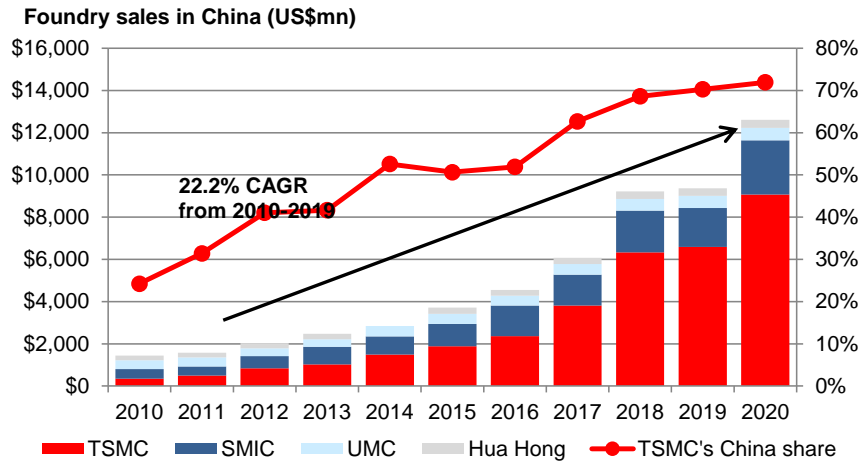
	2019 Size (\$bn)	Incumbent equipment suppliers						Emerging China suppliers		
		ASML	Applied Materials	Lam Research	KLA Tencor	Tokyo Electron	Screen	AMEC	Naura	ACM
Deposition	\$12.0		44%	19%		10%		1.1%	0.9%	0.1%
Lithography	\$11.7	83%	0%							
Etch	\$10.8		18%	45%		28%		1.1%	0.8%	
Process Control	\$6.2	5%	11%		54%					
Material Removal/Clean	\$3.7		18%	34%		24%	10%	0.7%	0.8%	0.6%
Fab Automation	\$2.9		5%							
Photoresist Processing (Track)	\$2.1					91%	6%			
CMP	\$1.4		66%							
RTP	\$1.4		40%			20%	4%		1.7%	
Ion Implant	\$1.2		60%							
Wafer Level Packaging	\$2.1					14%				
<b>Total Market</b>	<b>\$55.5</b>	<b>18%</b>	<b>19%</b>	<b>14%</b>	<b>7%</b>	<b>14%</b>	<b>3%</b>	<b>0.5%</b>	<b>0.5%</b>	<b>0.2%</b>

## China silicon wafer suppliers far behind global suppliers

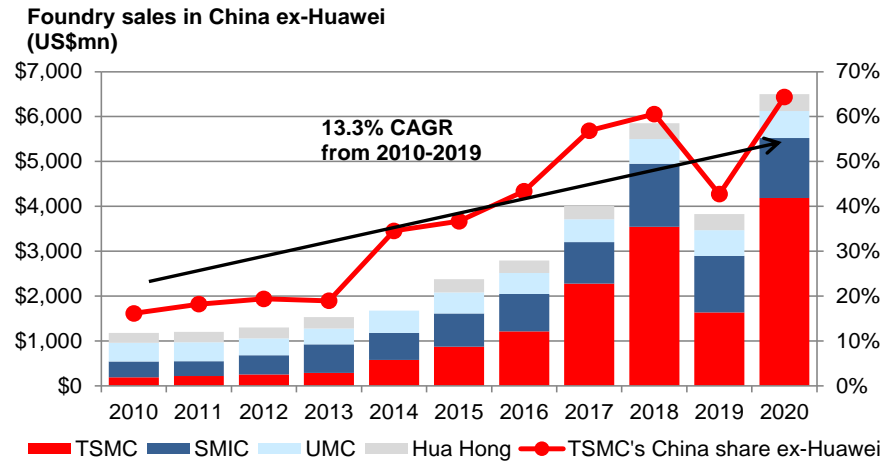
China players	Market share	Global players	Market share	Asian players to displace Western
NSIG	0% for 12". 1-2% for 8"	Shin-Etsu	30%	✓
Tianjin Zhonghuan Semiconductor	<3%	SUMCO	27%	✓
<b>Regional players in China</b>	<b>Market share</b>	GlobalWafers	18%	✓
Ferrotec – GlobalWafers JV	5% for 8"	Siltronic	15%	
GRINM Semiconductor Materials	~1% for <8"?	SK Siltron	10%	✓

# TSMC outpacing SMIC at local China fabless

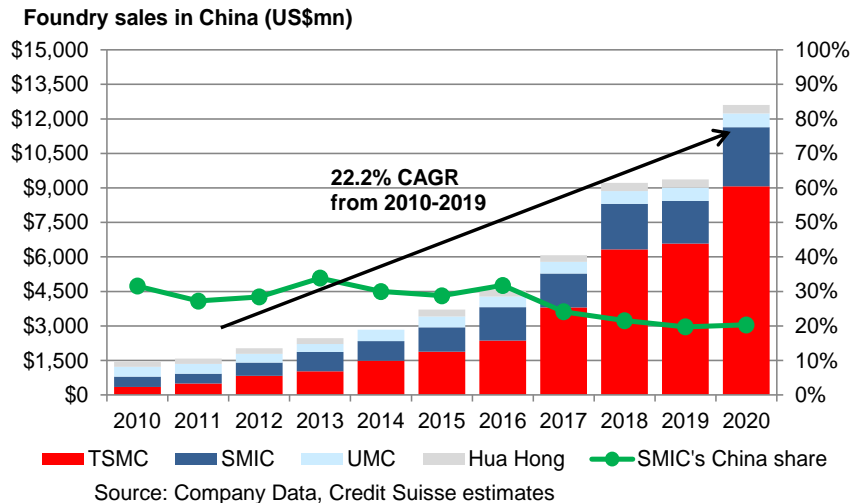
## TSMC has gained share of China customers



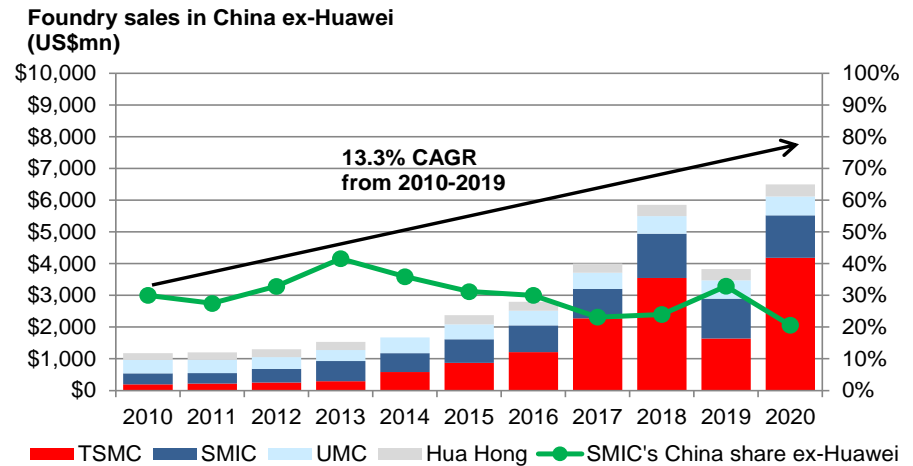
## TSMC gains ex-Huawei have slowed



## SMIC has lagged TSMC's share gains



## SMIC share ex-Huawei has declined



# 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 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
Syantiant	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

# China foundries target a broad range of applications

Company	English	CR Micro	ASMC	XMC	Huahong	Huali	SMIC
	Chinese	华润微	上海先进	武汉新芯	华虹半导体	上海华力	中芯国际
Node	0.5μm	✓	✓		✓		
	0.35μm	✓	✓		✓		✓
	0.25μm	✓			✓		✓
	0.18/0.15μm	✓			✓		✓
	0.13/0.11μm	✓			✓		✓
	90nm			✓	✓		✓
	65/55nm			✓	✓	✓	✓
	45nm			✓			
	40nm					✓	✓
	28nm					✓	✓
	22nm					✓	
	14nm					✓	✓
Application	Logic			✓	✓	✓	✓
	Analog	✓			✓	✓	✓
	Power	✓	✓		✓	✓	✓
	Display driver IC				✓	✓	✓
	CMOS image sensor			✓	✓	✓	✓
	Memory	✓		✓	✓	✓	✓
	Radio frequency	✓		✓	✓	✓	✓
	MEMS	✓	✓		✓	✓	✓
Capacity in 2019	6"	116	24	0	0	0	0
	8"	111	29	0	178	0	228
	12"	0	0	135	23	169	221

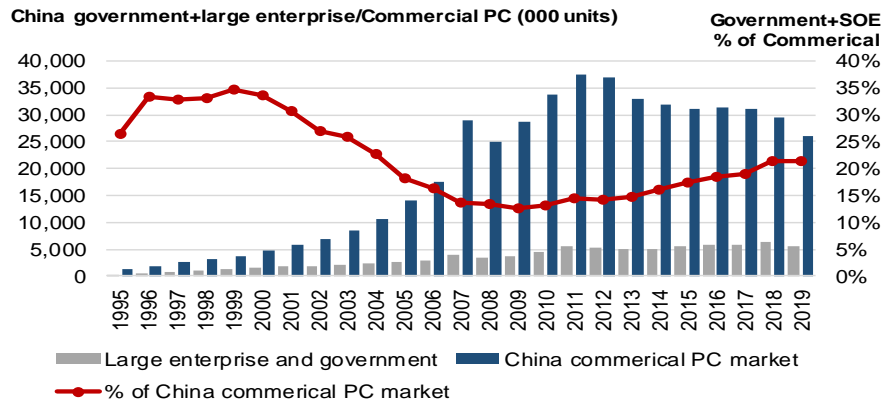
Source: Company Data, Credit Suisse

# China's CPU suppliers target domestic PCs/Servers

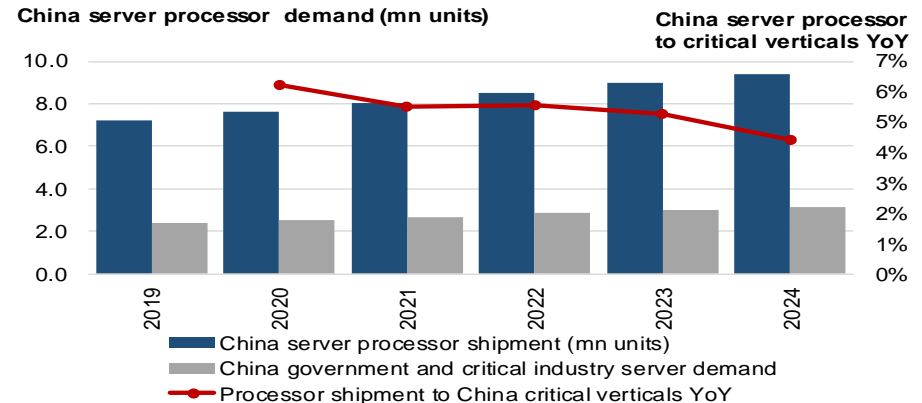
Comparison for the technology development for the major China CPU fabless

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

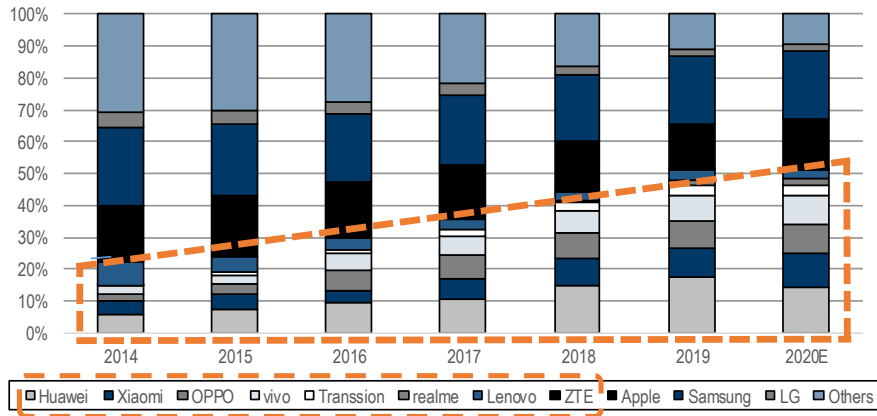


# China's RF suppliers target the mobile front-end

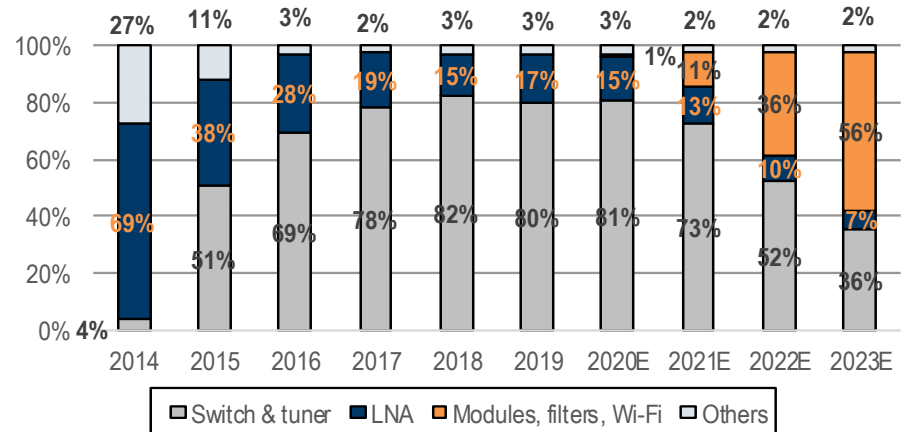
China has a diverse range of RF suppliers targeting the smartphone front-end

	Maxscend	Vanchip (MediaTek)	Huawei HiSilicon	UniSOC	OnMicro (Huntersun)	Will Semi	Etra Semi	RadRock
	卓胜微	唯捷创芯			昂瑞微 (中科汉天下)	韦尔半导体	宜确半导体	锐石创芯
Switch	X	X	X	X	X	X	X	X
LNA	X		X	X	X	X	X	
PA	X	X	X	X	X		X	X
Filter	X	X	X					
Module	X	X	X		X			X
	Kangxi	Lansus	China UniChip	Smarter Micro	CanaanTek	Microgate	Deqing Huaying	Shoulder
	康希通信	飞骧科技	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
Switch	X	X	X		X			
LNA	X				X			
PA	X	X	X	X				
Filter						X	X	X
Module	X	X	X		X			

China's smartphone OEMs had 51% share in 2019



Maxscend diversifying into modules and launching filters



## Companies Mentioned (Price as of 16-Nov-2020)

**AAC Technologies** (2018.HK, HK\$43.65)  
**AECOM** (ACM.N, \$49.51)  
**ASE Industrial Holdings** (3711.TW, NT\$71.9)  
**Actions** (ACTS), BE\*1.0)  
**Actions** (ACTS), BE\*1.16)  
**Actions** (ACTS), BE\*1.16)  
**Actions** (ACTS), BE\*1.16)  
**Alibaba Group Holding Limited** (9988.HK, HK\$254.0)  
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**Amkor Technology Inc.** (AMKR.OQ, \$13.3)  
**Amlogic** (688099.SS, Rmb170.0)  
**Aspeed** (5274.TW, NT\$1220.0)  
**BOE** (000725.SZ, Rmb5.38)  
**BYD Electronic** (0285.HK, HK\$36.6)  
**CF Micro** (688396.SS, Rmb63.65)  
**Cambricon** (688256.SS, Rmb179.2)  
**ChipMOS Technologies Inc.** (6150.TW, NT\$30.0)  
**Chipbond** (6147.TW, NT\$64.7)  
**Dahua** (002236.SZ, Rmb22.9)  
**Dahua Tech** (002236.ZK, Rmb22.96)  
**Digital China** (000304.SZ, Rmb31.36)  
**Egis Technology Inc.** (6462.TWO, NT\$162.0)  
**Elm Microelectronics Corp** (2455.TW, NT\$133.5)  
**Fortune Tech** (300493.SZ, Rmb8.97)  
**GUC** (3443.TW, NT\$344.0)  
**Gigawave** (603986.SS, Rmb200.5)  
**Goertek** (002241.ZK, Rmb41.47)  
**Goodix** (603160.SS, Rmb178.46)  
**Haier Smart Home** (600990.SS, Rmb28.73)  
**Hi Silicon** (Unlisted)  
**Himax Technologies, Inc.** (HIMX.OQ, \$4.19)  
**Hua Hong Semiconductor Limited** (1347.HK, HK\$31.3)  
**Huazqin** (Unlisted)  
**Huahuan** (002185.SZ, Rmb15.38)  
**Huayi Elec** (600290.SS, Rmb2.25)  
**Huayi Tencent** (0419.HK, HK\$0.169)  
**JCEC** (600584.SS, Rmb42.47)  
**JD.com** (JD.O, \$92.08)  
**JD.com** (JD.O, \$92.08)  
**Jingrui Holdings** (1862.HK, HK\$2.09)  
**Lenovo Group Ltd** (0992.HK, HK\$5.17)  
**Luxshare** (002475.SZ, Rmb52.79)  
**Maxssend** (300782.SZ, Rmb522.37)  
**MediaTek Inc.** (2454.TW, NT\$694.0)  
**Montage** (688008.SS, Rmb17.03)  
**NAURA** (002371.SZ, Rmb179.4)  
**NAURA** (002371.ZK, Rmb181.87)  
**NavInfo** (002495.SZ, Rmb16.41)  
**Novatek Microelectronics Corp Ltd** (3034.TW, NT\$291.0)  
**Panda Holding** (600599.SS, Rmb6.02)  
**Parade Technologies** (4986.TW, NT\$1085.0)  
**Piotech** (Unlisted)  
**Powertech Technology** (6239.TW, NT\$91.7)  
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