CMB International Securities | Equity Research | Sector Initiation

China CIS market

Beginning of multi-year growth cycle; Initiate BUY on Willsemi and GalaxyCore

We initiate coverage on China CIS sector with a positive view, as we believe Chinese CIS players will be major beneficiaries of China semi localization and expanding global CIS market (7.2% 21E-26E CAGR). We are positive on growth potential on smartphone multi-cam/3D sensing adoption and automotive/medical applications. Recent semi supply tightness will also accelerate share gain for top CIS players. We initiate BUY on two Chinese CIS leaders, **Willsemi (603501 CH)** with TP of RMB370.75 (37% upside) and **GalaxyCore (688728 CH)** with TP of RMB48.19 (34% upside).

- **Global CIS market to grow to US$31.5bn in 2026E with 7.2% CAGR (21E-26E).** The image sensor is the heart of a camera, which empowers the vision of machines. Global CIS market grew 7.1% YoY to US$20.7bn in 2020 and Yole forecasted CIS market to expand to US$31.5bn in 2026E with 7.2% CAGR despite ongoing semi shortage. We believe China's largest two CIS players, Willsemi and GalaxyCore, will benefit from semi localization, high-end share gain and growing global CIS demand.
- **Mobile CIS: multi-cam and sensor spec upgrade to drive CIS demand.** Mobile CIS is the largest segment of global CIS market, accounting for 69% revenue in 2020. Mobile CIS market is expected to grow at 6% CAGR during 2020-26E. Major growth drivers mainly come from smartphone camera spec upgrade and increasing number of cameras per device. According to Yole, number of cameras per device will reach 3.2/3.3 in 2023E/24E, vs 2.7 in 2020.
- **Automotive CIS: ADAS adoption to boost rapid growth.** Cameras become the mainstream feature for vehicles. Automotive imaging market size is expected to double to US$8.7bn in 2024E vs. 2018. Major growth driver comes from rising ADAS adoption, which will increase the number of cameras per car. Total shipment of automotive image sensors reached 124mn in 2018, implying 1.6 camera per car, and it will double to 3.3 camera per car by 2024E, according to Yole.
- **Emerging opportunities: AR/VR/MR and medical applications.** We expect the booming VR/AR industry will accelerate demand for cameras. Oculus Quest 1/2 are equipped with 4 cameras, and Oculus Rift S has 5 cameras. Cheaper headsets from brands like Acer also have 2 cameras. We expect global VR headset shipment to pass 10mn for the first time in 2022E, as Apple is poised to announce its first VR/AR device in 2022E.
- **Initiate BUY on Willsemi and GalaxyCore,** which are global No.3/No.4 in CIS market in term of revenue and No.4/No.1 in terms of shipment in 2020. We expect Willsemi/ GalaxyCore to deliver 42%/ 47% FY20-23E EPS CAGR, and our TPs of **RMB370.75/ RMB48.19 are based on 50x FY22E P/E.** Willsemi now trades at 36.3x FY22E P/E, 1-sd below 2-yr historical fwd. P/E, which is attractive in our view. Risks include slower market growth, intense competition, worse-than-expected semi shortage and disruptive technology.

Valuation Table

Name	Ticker	Rating	Mkt Cap (US$ mn)	Price (LC)	TP (LC)	P/E (x) FY21E	P/E (x) FY22E	P/B (x) FY22E	ROE (%) FY22E
Willsemi	603501 CH	Buy	36,353	271.40	370.75	48.7	36.3	10.3	27.8
GalaxyCore	688728 CH	Buy	13,900	36.07	48.19	62.0	37.4	10.3	27.6

Source: Company data, Bloomberg and CMBIS estimates

OUTPERFORM (Initiation)

China Technology Sector

Lily Yang
3916 3716
lilyyang@cmbi.com.hk

Alex Ng
(852) 3900 0881
alexng@cmbi.com.hk

Willsemi (603501 CH)	
Target Price (RMB)	RMB 370.75
Up/Downside	+37%
Current Price (RMB)	RMB 271.40

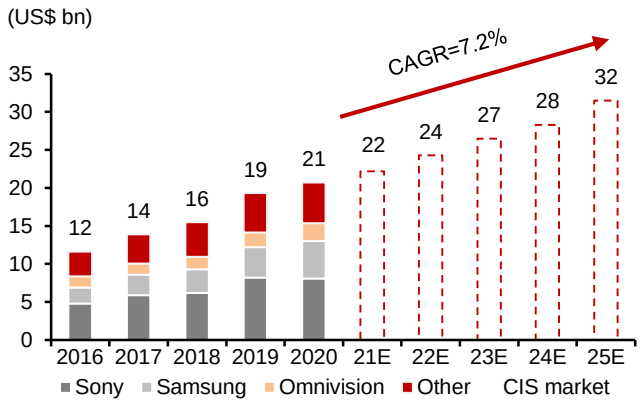
Source: Bloomberg, CMBIS

GalaxyCore (688728 CH)	
Target Price (RMB)	RMB 48.19
Up/Downside	+34%
Current Price (RMB)	RMB 36.07

Source: Bloomberg, CMBIS

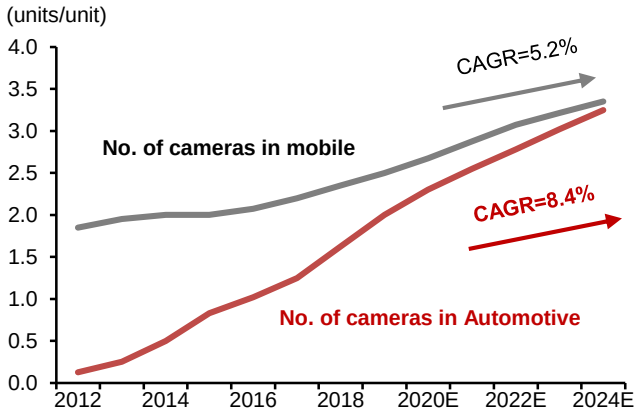
Focus Charts

Figure 1: CIS market to reach US$31.5bn in FY26E, with 7.2% 5-year CAGR (2021E-26E)



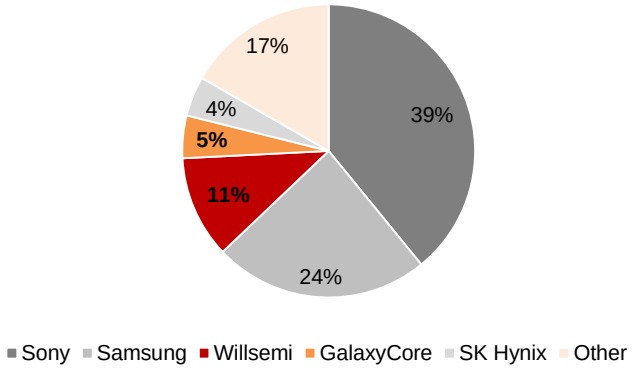
Source: Yole, CMBIS

Figure 2: Avg. number of cameras per mobile/vehicle to grow at 5.2%/8.4% CAGR



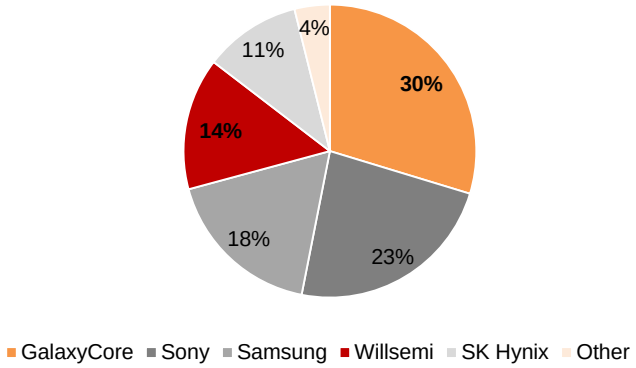
Source: Canalys, CMBIS

Figure 3: Global CIS revenue (2020): Willsemi/ GalaxyCore ranked No.3/No.4



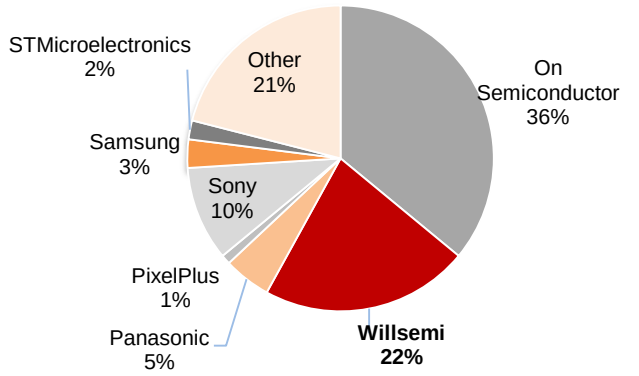
Source: Frost&Sullivan, CMBIS

Figure 4: Global CIS shipment (2020): GalaxyCore / Willsemi ranked No.1/No.4



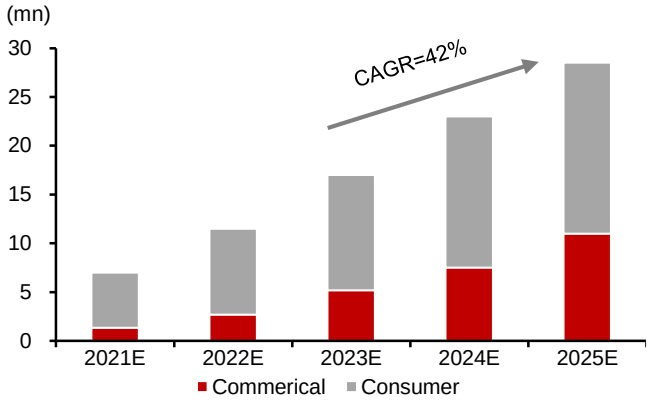
Source: Frost&Sullivan, CMBIS

Figure 5: On Semi, Willsemi, Sony share 68% of the automotive imaging sensor market (2018)



Source: Yole, CMBIS

Figure 6: Global VR headsets shipment to grow 42% CAGR (2021E-25E) and reach 10mn in 2022E



Source: Yole, CMBIS

Table of contents

Focus Charts 2
Investment Thesis 4
Willsemi (603501 CH, BUY, TP RMB370.75) 4
GalaxyCore (688728 CH, BUY, TP RMB48.19) 4
Global CIS industry: US$20.7bn market with 7.2% 2021-26E CAGR 5
What is CIS? It empowers the vision of machines 6
COVID-19, trade war and semi shortage impact on global CIS market 8
Mobile CIS: multi-cam trend and sensor spec upgrade 9
Mobile CIS market to grow at 6% CAGR 2021E-26E 9
Camera ugprade remains the key differentiating feature on smartphone 10
Major mobile CIS players: Sony, Samsung and Willsemi 11
Automotive CIS: ADAS adoption to drive rapid growth 12
Automotive imaging market to double to US$8.7bn in 2024E 12
Major automotive CIS players: On Semi, Willsemi and Sony 13
Other opportunities: AR/VR/MR and medical applications 14
AR, VR and MR are at inflection point. 14
Medical applications 15
Comeptitive Landscape 16
Business model: IDM, Fabless and Fab-lite 16
Willsemi, Sony and Samsung dominate the high-end CIS market 17
Finanacials comparison: Willsemi vs Galaxycore 19
Willsemi (603501 CH) 20
GalaxyCore (688728 CH) 33

Investment Thesis

We believe Chinese CIS players will rise with global CIS market boom. At the backdrop of US-China trade tensions, China CIS industry is gaining global market share rapidly and benefit from expanding global CIS market (7.2% 21E-26E CAGR). We are positive on growth potential on smartphone multi-cam/3D sensing adoption and automotive/medical applications. We initiate BUY on two Chinese CIS leaders, **Willsemi (603501 CH)** with TP of RMB370.75 and **GalaxyCore (688728 CH)** with TP of RMB48.19.

Willsemi (603501 CH, BUY, TP RMB370.75)

We believe Willsemi, global No.3 CIS player, will accelerate share gain during current supply chain tightness, given its established diversified product portfolio, stronger relationship with foundries and more bargaining power for production capacity. We expect its product mix to move towards high-end CIS, driven by smartphone camera spec upgrade and automotive/medical applications. It will drive blended ASP and profitability ahead.

We initiate at BUY with TP of RMB370.75, as Willsemi is our top pick in CIS sector. We derive our TP by applying 50x FY22E P/E, 1 SD above the 2-year historical forward P/E. We believe this valuation is justified given 1) its leading position in CIS market with a global presence, 2) its integrated semiconductor platform with diversified product portfolio and 3) continued share gain due to business expansion and advances in technology.

GalaxyCore (688728 CH, BUY, TP RMB48.19)

We believe GalaxyCore, global No.5 player, will maintain its leading position in low-to mid-end CIS market (No.1 market share in term of shipment in 2020) and penetrate into the high-end CIS market. The company will change its fabless model to fab-lite model, lifting the production capacity for high-end CIS products.

We initiate at BUY with TP of RMB48.19. Our TP is based on 50x FY22E P/E, as we take GalaxyCore as a rising star which is well poised to embrace the CIS boom.

Figure 7: Peers valuation

Company	Ticker	Mkt Cap US$(mn)	Price (LC)	P/E (x) FY21E	P/E (x) FY22E	P/B (x) FY21E	P/B (x) FY22E	ROE (%) FY21E	ROE (%) FY22E
Global CIS peers									
Willsemi	**603501 CH**	**36,353**	**271.40**	**48.7**	**36.3**	**14.2**	**10.3**	**28.5**	**27.8**
GalaxyCore	**688728 CH**	**13,900**	**36.07**	**62.0**	**37.4**	**14.5**	**10.3**	**23.4**	**27.6**
Sony	SONY US	123,130	97.64	11.7	16.4	2.6	2.2	23.4	16.6
Samsung	005930 KS	373,427	73,300.00	12.3	10.2	1.7	1.5	14.0	15.2
STMicroelectronics	STM FP	39,001	36.50	22.6	19.9	4.0	3.4	19.4	18.9
ON Semi	ON US	17,867	41.50	16.7	14.9	4.4	3.5	22.1	22.1
Peers Avg.				**29.0**	**22.5**	**6.9**	**5.2**	**21.8**	**21.4**
Peers Median				**19.7**	**18.1**	**4.2**	**3.5**	**22.7**	**20.5**
China fabless peers									
Willsemi	**603501 CH**	**36,353**	**271.40**	**48.7**	**36.3**	**14.2**	**10.3**	**28.5**	**27.8**
GalaxyCore	**688728 CH**	**13,900**	**36.07**	**62.0**	**37.4**	**14.5**	**10.3**	**23.4**	**27.6**
Gigadevice	603986 CH	16,981	165.75	73.3	55.2	8.9	7.8	12.7	15.0
Maxscend	300782 CH	21,224	412.59	66.6	49.9	25.7	17.7	44.9	38.2
Goodix	603160 CH	7,670	108.70	38.5	29.7	5.6	4.8	15.4	17.3
SG Miceo	300661 CH	12,639	349.13	180.8	132.3	44.2	34.9	24.7	26.0
Peers Avg.				**78.3**	**56.8**	**18.8**	**14.3**	**24.9**	**25.3**
Peers Median				**64.3**	**43.7**	**14.3**	**10.3**	**24.0**	**26.8**

Source: Bloomberg and CMBIS, as of 23 Aug 2021.

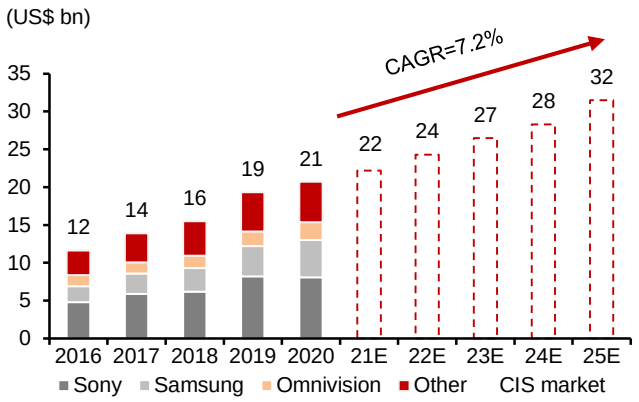
Global CIS industry: US$20.7bn market with 7.2% 2021-26E CAGR

Global CIS market grew 7.1% YoY to US$20.7bn in 2020, and is expected to grow 7.2% CARG to US$31.5bn in 2026E (vs. prior forecast of 6% CAGR and US$28.4bn), according to Yole. The largest CIS segment is **mobile market** (69% of 2020 revenue), mainly driven by smartphone camera spec upgrade and increasing number of cameras per device. In addition, other CIS markets are poised to deliver strong growth, including **automotive (e.g. ADAS), security and industrial**, and **VR/AR and medical markets.**

CIS market growth has been outperforming global semiconductor industry in past decade, as CIS revenue accounted for 5.1% of global semiconductor industry in 2021E from 1.7% in 2010, as a result of 1) strong demand for cameras across end markets, 2) US-China trade war and Huawei ban, 3) recent disrupted logistics due to pandemic, and 4) semi shortage due to strong demand in several markets, e.g. automotive and security.

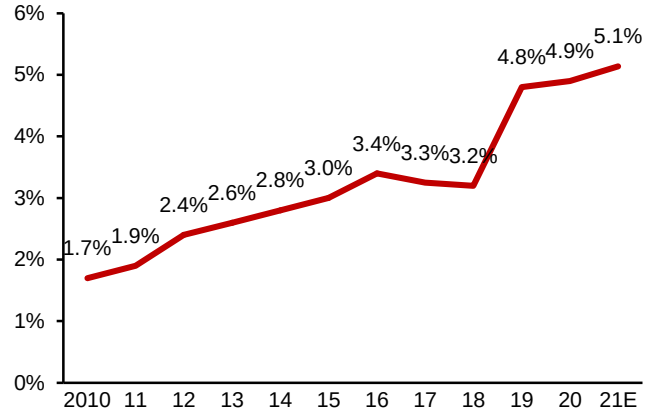
Top CIS players are poised to accelerate share gain during ongoing semi shortage, given stronger bargaining power for capacity amid robust downstream demand. We are positive on **Willsemi (603501 CH)/ GalaxyCore (688728 CH)**, who ranked as No.3/No.4 in global CIS market in term of revenue and No.4/No.1 in terms of shipment in 2020.

Figure 8: Global CIS market to reach US$31.5bn in FY26E, with 7.2% 5-year CAGR (2021E-26E)



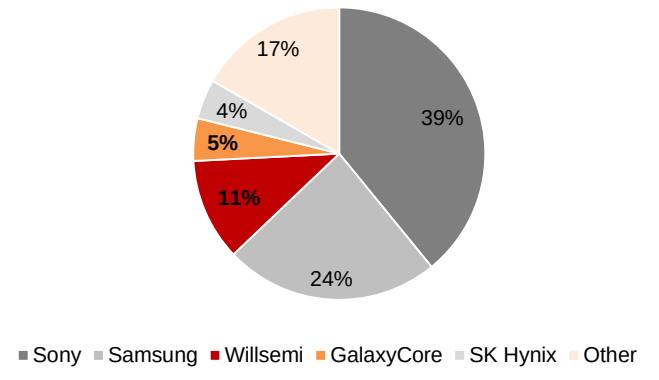
Source: Yole, CMBIS

Figure 9: CIS revenue as a % of semiconductor industry: from 1.7% in 2010 to 5.1% in 2021E



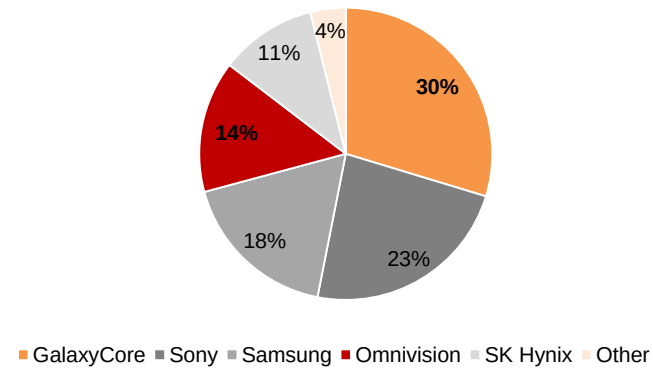
Source: Yole, CMBIS

Figure 10: Global CIS revenue: Willsemi/ GalaxyCore ranked No.3/No.4 in 2020



Source: Frost&Sullivan, CMBIS

Figure 11: Global CIS shipment: GalaxyCore / Willsemi ranked No.1/No.4 in 2020

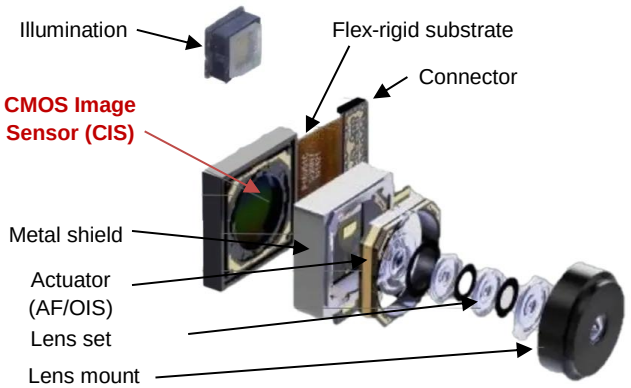


Source: Frost&Sullivan, CMBIS

What is CIS? It empowers the vision of machines

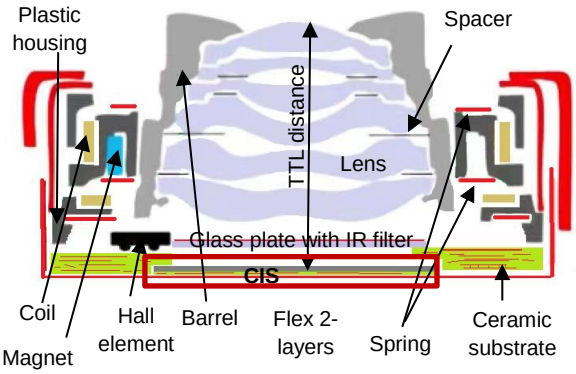
The image sensor is the heart of a camera and the cameras are the eyes of the machines. The camera technology helps the machines to collect and process vision data, which assists the applications in smartphones, autonomous vehicles, industry automation, surveillance, healthcare and more.

Figure 12: CMOS Image Sensor (CIS) is a key component in camera module



Source: Yole, Wannatek, Oppo, CMBIS

Figure 13: General camera module structure: rear camera of Apple

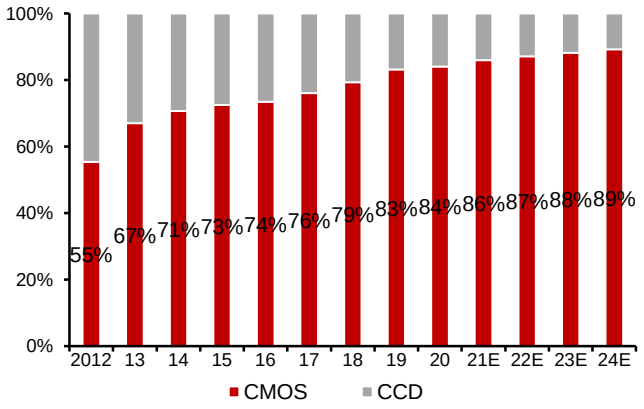


Source: Yole, CMBIS

There are two types of image sensors, the CCD (Charged Coupled Devices) image sensor and **CMOS** (Complementary Metal Oxide Semiconductor) image sensor. Both types are capable of converting captured optical image signals into output digital signals.

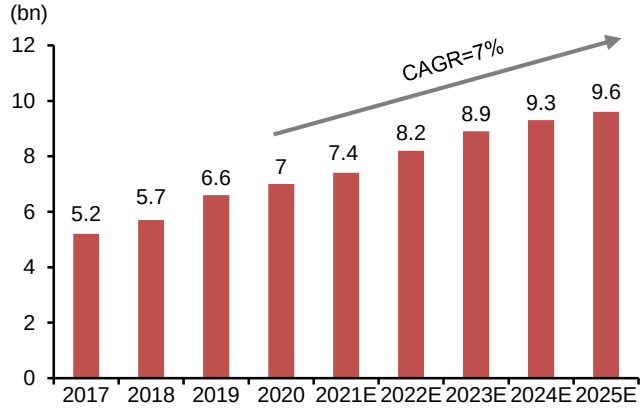
CMOS image sensor (CIS) dominates image sensor market with 84% share in 2020. Back to 2012, the market split between CCD and CMOS was 55.4%/44.6%. But soon CIS became popular **given its low cost and low power consumption.** It was widely used in mobile markets, while CCD image sensors is more favored in the applications required higher image quality.

Figure 14: CMOS image sensor keeps gaining shares in the image sensor market



Source: Frost & Sullivan, CMBIS

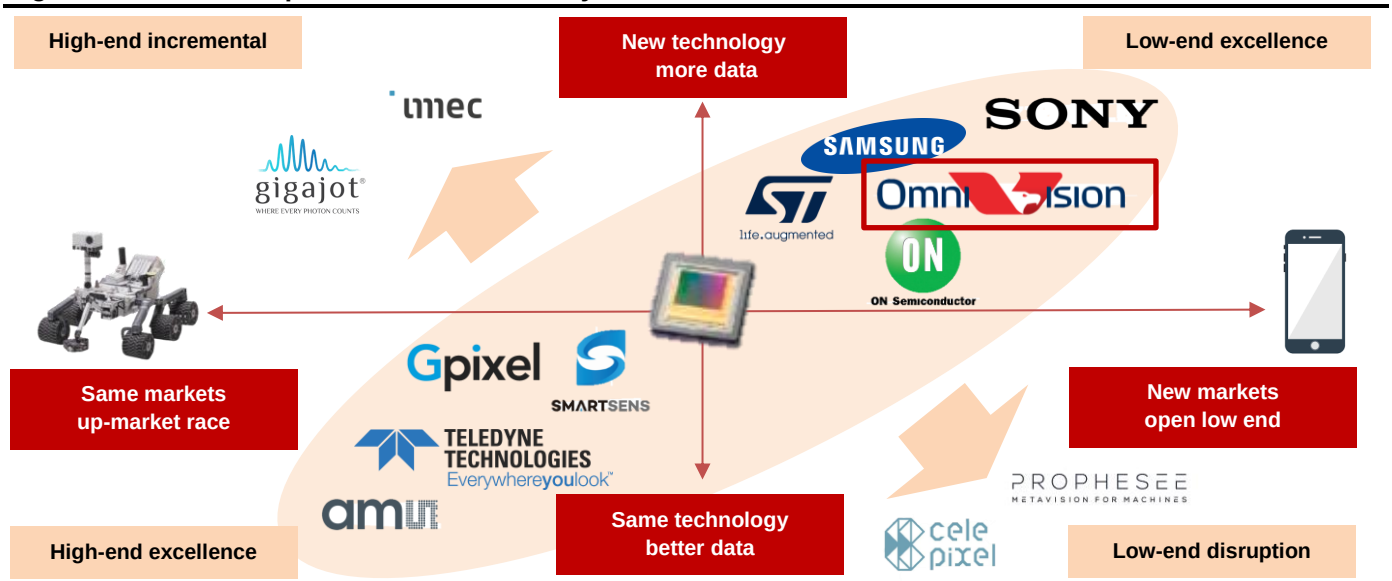
Figure 15: CIS shipment growing fast driven by increasing demand



Source: Yole, CMBIS

Sensing has opened up many opportunities in various sectors. We believe CIS market will have great growth opportunities, backed by strong demand from mobile, automotive, VR/AR, medical, security, etc. According to Yole, **CIS shipment is estimated to grow at 7% CAGR (2020-25E).**

Figure 16: Innovation path for the CIS industry



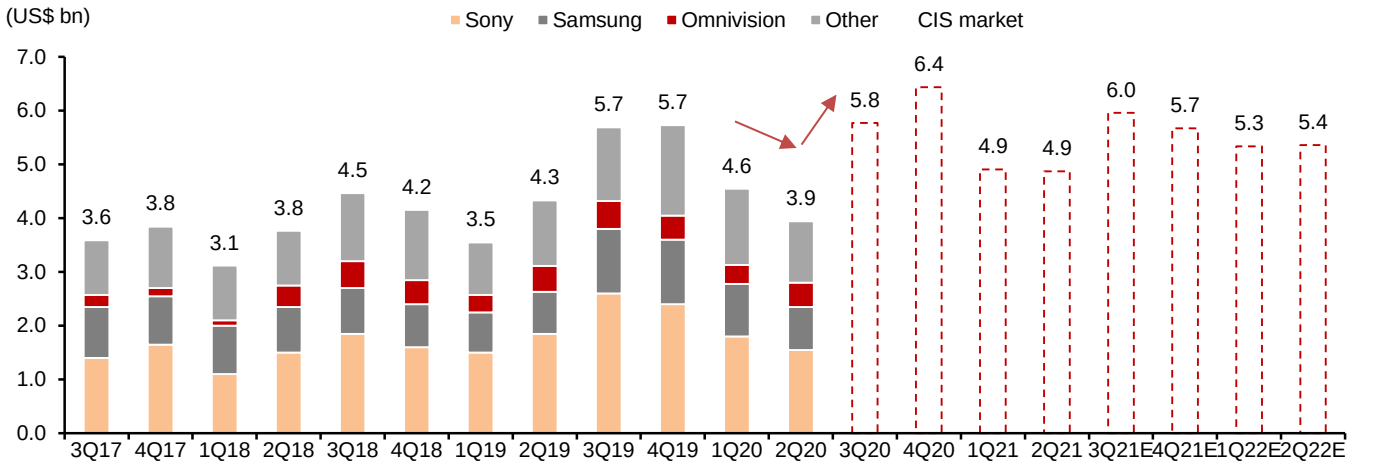
Source: Yole, CMBIS

COVID-19, trade war and semi shortage impact on global CIS market

We believe the logistics disruption on CIS market in 2020 due to pandemic outbreak was only short term and CIS market soon recovered from the strong demand in several end markets, such as consumer, automotive and security.

As for trade war and Huawei ban, the impact was different to each player. In mobile market, Sony was the main CIS player hit by Huawei ban, while **Samsung and Willsemi were key beneficiaries**. **In security CIS market, Willsemi and Smartsens have gained share** as Hikvision, Dahuha and Sensetime were on the "entity list".

Figure 17: CIS market dynamics by quarter: Market rebound in 3Q20 after temporarily disruption in logistics



Source: Yole, CMBIS

Smaller CIS players outperformed in 2020, according to Yole. Sony (No.1 CIS player) did not grow, while Samsung/Willsemi/GalaxyCore (No. 2/3/4) grew 13%/45%/75% YoY respectively. In near term, semi shortage remains the key concern on global CIS market. The demand is strong while the battle for 90nm shifting to 28nm nodes capacity will be intense. **We believe top players who can secure production capacity will benefit the most in the near term.**

We expect Chinese CIS players to benefit from close links with TSMC and new capacity from HLMC and SMIC. Willsemi is adopting a fabless business model, and it maintains tight relationship with foundries, such as TSMC and SMIC. Willsemi also seeks cooperation opportunities with new suppliers to reduce the risks in outsourcing processing. Its subsidiary, Beijing Haowei Technology, signed contracts with 3 semiconductor suppliers to expand production capacity and paid the deposits. For GalaxyCore, the company will use its IPO proceeds to invest in 12-inch manufacturing lines to increase the capacity of high-end CIS productions. The top 5 foundries for GalaxyCore were Samsung (38%), SMIC (17%), Cansemitech (8%), Huahong (7%) and WLCSP (5%) in 2020.

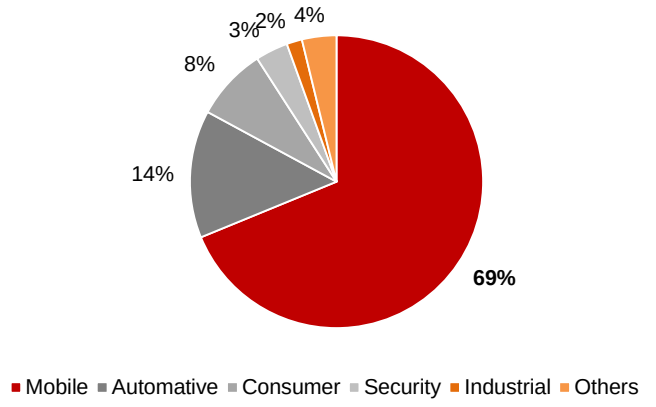
Mobile CIS: multi-cam trend and sensor spec upgrade

Mobile CIS market to reach US$24.2bn with 6% CAGR 2021E-26E

Mobile CIS is the largest segment of global CIS market, accounting for 69% revenue in 2020. Mobile CIS market is expected to grow at 6% CAGR during 2020-26E, based on Yole.

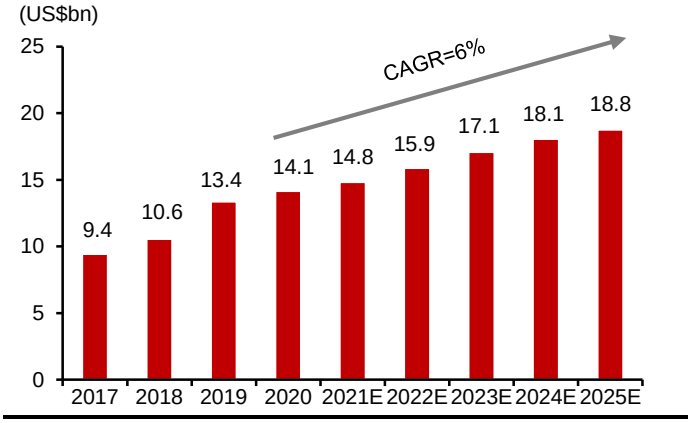
Major growth drivers will mainly come from smartphone camera upgrade and continued increase in number of cameras per device, given a mature smartphone market. According to Yole, number of cameras per device will reach 3.2/3.3 in 2023E/24E, vs 2.7 in 2020. As the amount of optical components is directly proportional to number of cameras, demand for CIS will continue to be strong.

Figure 18: Mobile application accounted for 69% of CIS revenue in 2020



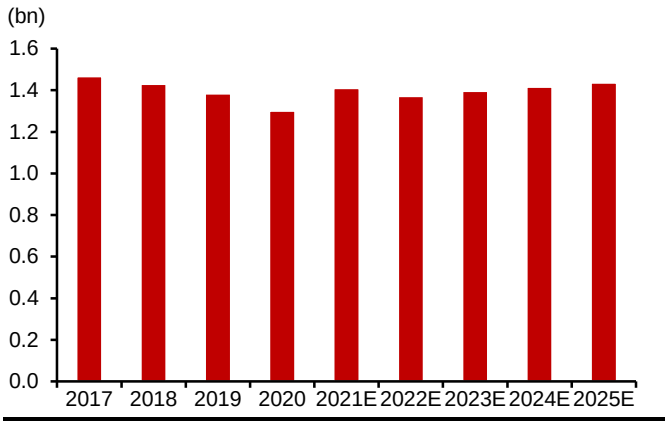
Source: Frost and Sullivan, CMBIS

Figure 19: Mobile CIS market to grow at 6% 2021E-26E CAGR



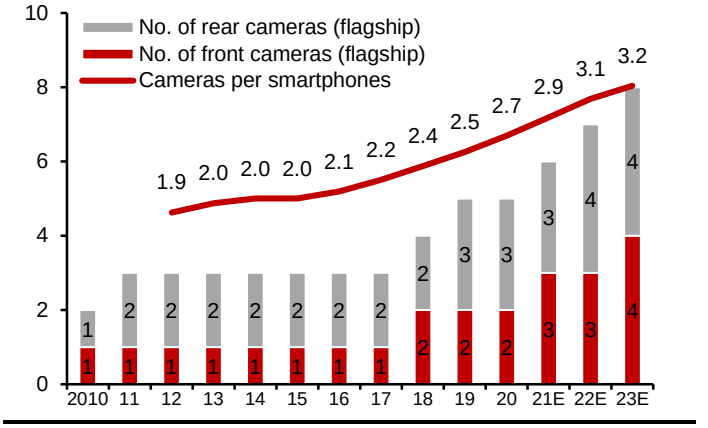
Source: Yole, CMBIS

Figure 20: Smartphone production (2017-2025E) remains stable



Source: Yole, CMBIS

Figure 21: Increasing number of cameras in the front and rear of continues to be the driver of CIS



Source: Yole, GalaxyCore Prospectus, CMBIS

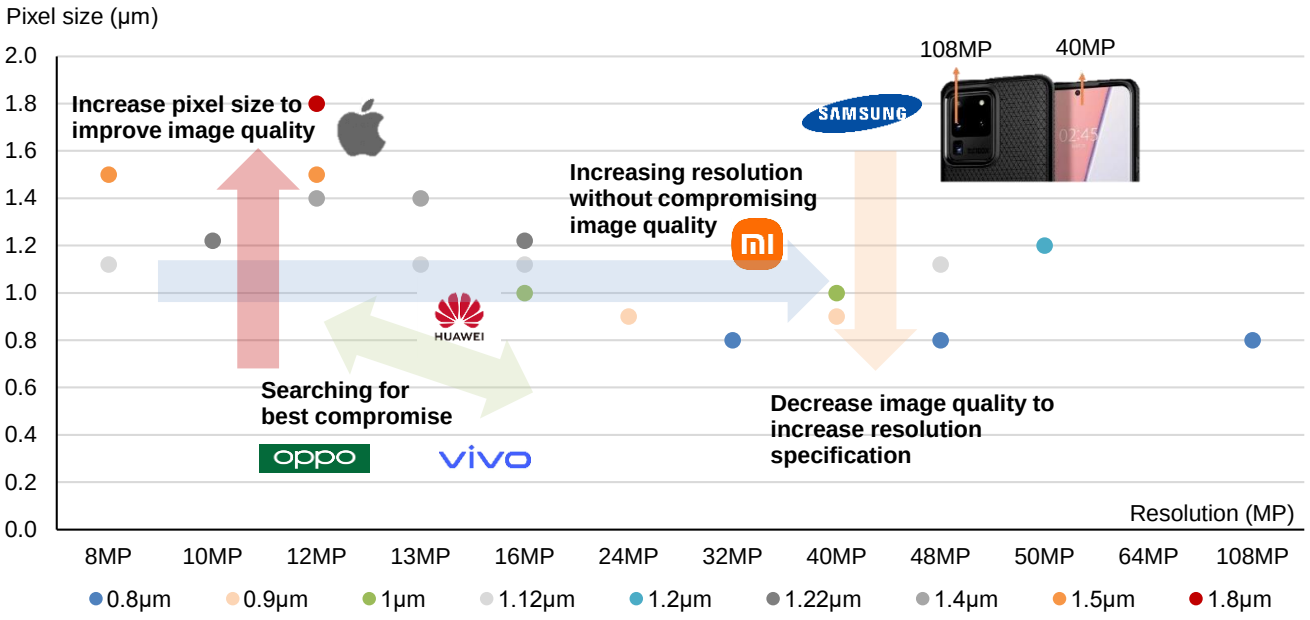
Camera ugprade remains the key differentiating feature on smartphone

In 2000, the first generation of smartphone with one single camera was launched. Later in 2011, the smartphone with dual-camera in the rear was introduced. The number of cameras in both front and rear kept increasing. Different OEMs have different preferences in image sensors.

Figure 22: Apple vs. Huawei: rear camera in the flagship model evolution route

Source: GalaxyCore Prospectus, CMBIS

Figure 23: Mobile OEMs CMOS image sensor pixel size and resolution (2021)

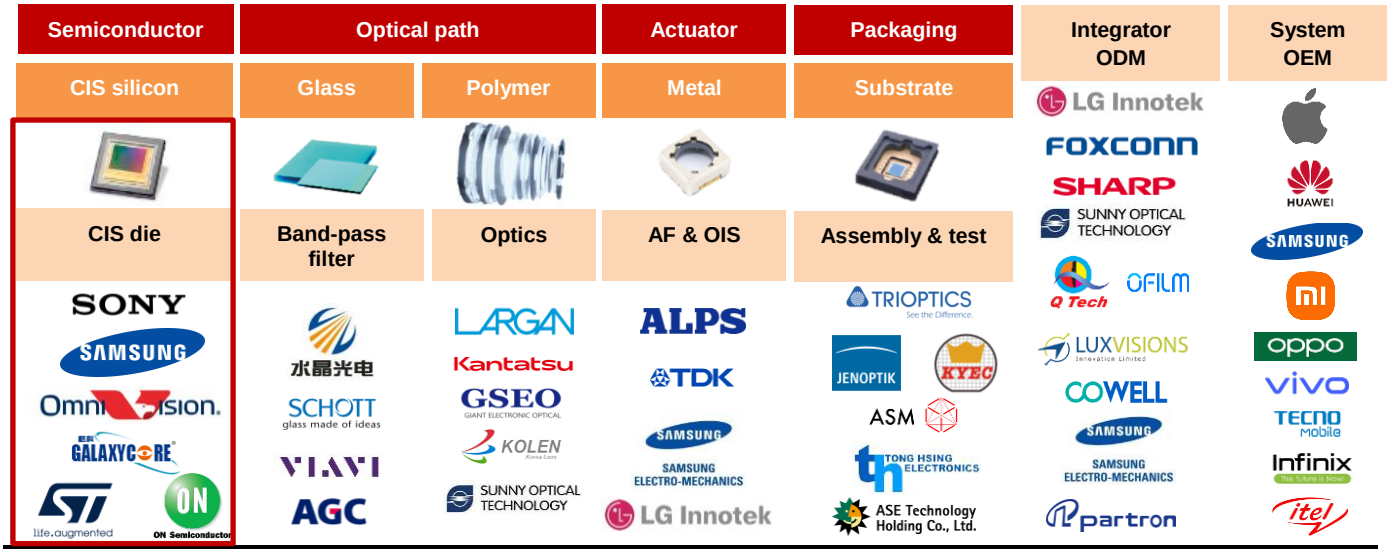


Source: Yole, CMBIS

Major mobile CIS players: Sony, Samsung and Willsemi

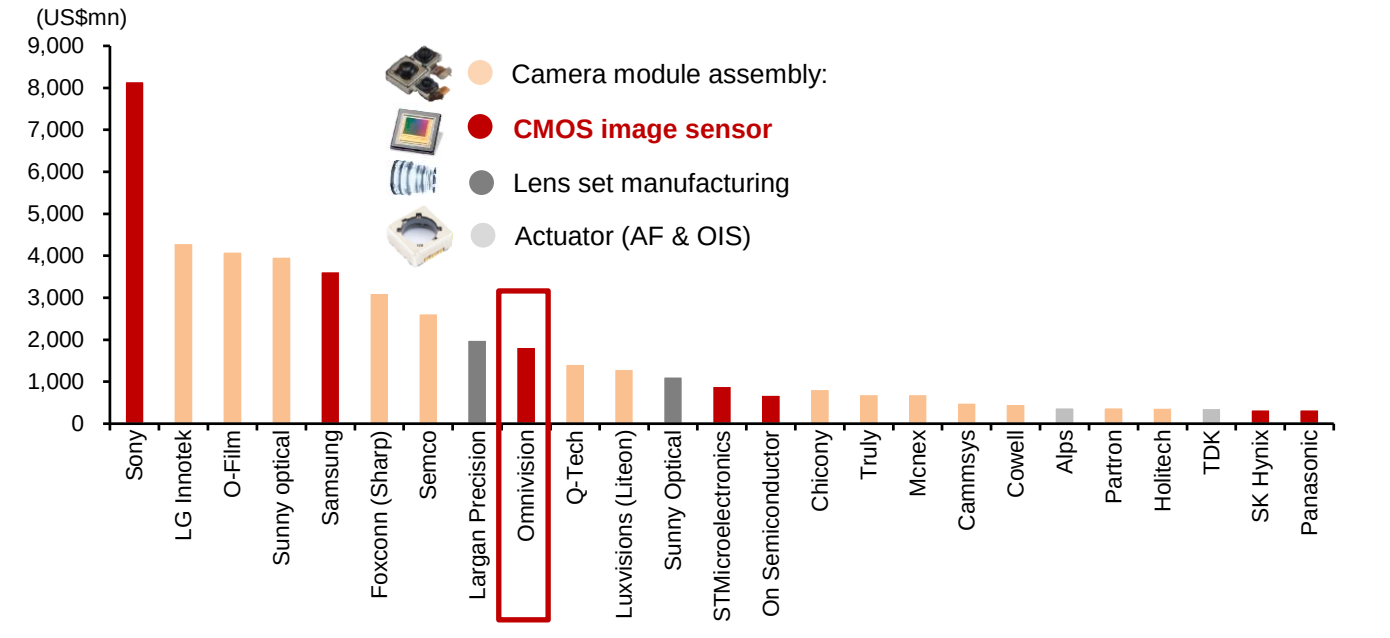
Major CIS players in mobile and consumer supply chains include **Sony, Samsung, Willsemi, Galaxy core, STMicroelectronics and On Semiconductor.** There are four key components in CMOS camera module market, including CIS (46%), camera module assembly (30%), lens set manufacturing (15%) and actuator (9%). Among the four categories of camera components, CIS is one of the best subsectors to invest given its 1) greater market size and 2) higher barrier and more concentrated market. Sony, Samsung and Willsemi are the top 3 players, accounting for 73% of market share in 2019.

Figure 24: Camera module supply chain



Source: Yole, CMBIS

Figure 25: CMOS camera module market (2019): Willsemi ranked top 3 mobile CIS player



Source: Yole, CMBIS

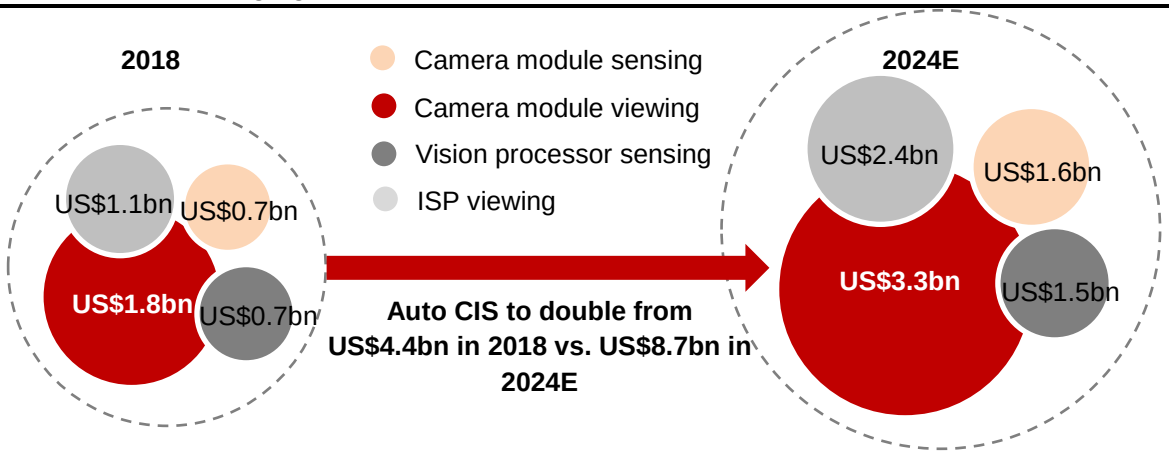
Automotive CIS: ADAS adoption to drive rapid growth

Automotive imaging market to double to US$8.7bn in 2024E

Cameras become the mainstream feature for vehicles. Automotive CIS market size is expected to double to US$8.7bn in 2024E compared to 2018, based on Yole. Within subsectors, camera module sensing and viewing will account for 56% of auto CIS revenue in 2024.

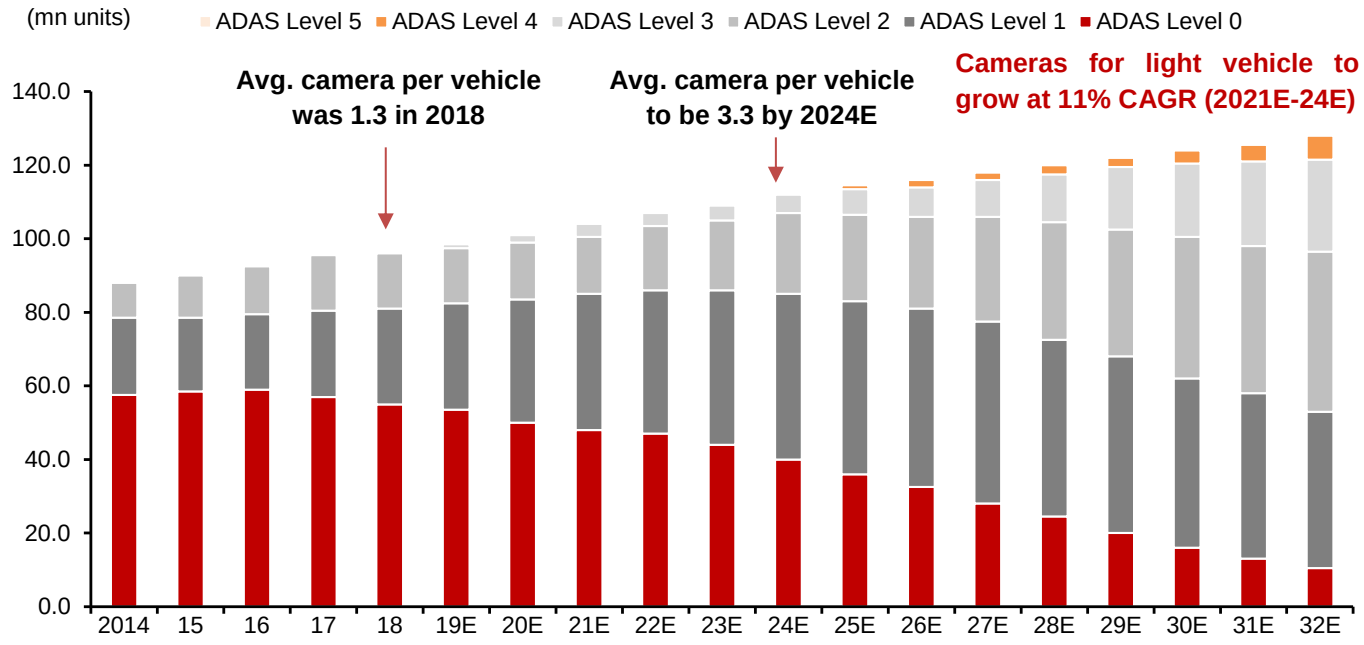
Major growth driver of automotive CIS market come from rising adoption of ADAS, which will increase the number of cameras per car. According to Yole, total shipment of automotive image sensors reached 124mn in 2018, implying **1.6 camera installed per car in 2018**, and it is expected to **double to 3.3 camera per car by 2024E**.

Figure 26: Automotive imaging market to double from 2018 to 2024E



Source: Yole, CMBIS

Figure 27: Automotive market trend: ADAS will drive the demand for automotive camera modules



Source: Yole, CMBIS

Sales volume of light vehicles with ADAS (“Advanced Driver Assistance Systems”) Level 0 was ~55mn units (57%) in 2018. As ADAS penetration in automotive market is steadily increasing, the percentage of light vehicles with ADAS Level 0 will reduce to 36%, and vehicle camera shipment will reach to 364mn in 2024E, implying 11% CAGR (2021E-24E).

Figure 28: Cameras used for automitives: 6 for viewing plus 4 for ADAS

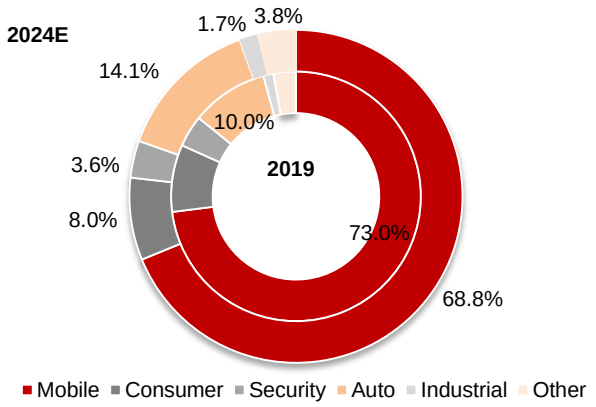
# of potenial cameras needed	
6 for viewing	**+2:** rear cameras for improving safety when driving backwards (andatory in U.S. since 2018); **+2:** rear camenra market is now supplemented by 360° surround approaches using four cameras all around the behicle; **+2:** recent mirror replacement cameras adds 2 more cameras on the side doors.
4 for ADAS	**+1:** camera on the top of the windshield, initially to mitigate collisions; +1: a stereo pair or a triple camera setup to improve 3Dperception, resolution and field of view; +1: surround-viewing ADAS camera for Level 3 and above

Source: SystemPlus, CMBIS

Major automotive CIS players: On Semi, Willsemi and Sony

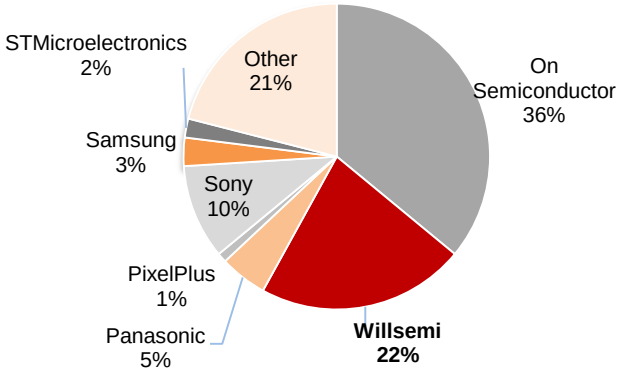
The top players in this field are On semiconductor, Willsemi and Sony, sharing 68% of the market in 2018. Looking forward, we believe Willsemi will enjoy the tailwind of automotive CIS market expansion given its leading position in this field. We expect Willsemi to continue market share gain in next few years, given its active collaboration with downstream players. With the latest automotive viewing and sensing solutions, Willsemi is now an NVIDIA DRIVE ecosystem partner. The company also works with a few DMS (“driver monitoring system”) companies, such as Ambarella, Smart Eye and Seeing Machines.

Figure 29: A growing market share of automotive imaging sensor (2019 vs. 2024E)



Source: Yole, CMBIS

Figure 30: On Semi, Willsemi, Sony share 68% of the automotive imaging sensor market (2018)



Source: Yole, CMBIS

Other opportunities: AR/VR/MR and medical applications

AR, VR and MR are at inflection point.

AR, MR and VR are bridging the digital world and the reality. AR and MR overlay the digital information on the real world, while VR uses virtual simulation to bring authentic experience to users and make them feel like they are experiencing the simulated reality firsthand. We believe the booming VR/AR industry will accelerate demand for cameras. Oculus Quest 1/2 have 4 cameras each, and Oculus Rift S has 5 cameras. Cheaper headsets from brands like Acer also have 2 cameras.

Figure 31: Introduction of AR/MR/VR

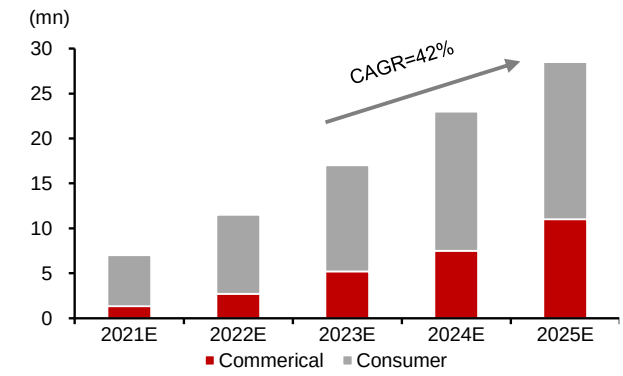
Augmented Reality (AR)	Mixed Reality (MR)	Virtual Reality (VR)
		
AR overlays computer-generated digital information on the real world.	Similar to AR, but digital information can interact with the reality.	VR uses virtual simulation to bring authentic experience to users.
Reality experience: Yes	Reality experience: Yes	Reality experience: No
Digital information: Yes, overlay on real world without interactions	Digital information: Yes, overlay on real world with interactions	Full immerse
Display: compete with ambient light. Resolution and field of view (FOV) vary with the applications.	Display: similar to AR, but a larger FOV is desirable.	Display: fully enclosed head mounted display (HMD). Resolution and FOV should match human eye.

Source: Yole, CMBIS

VR/AR are popular in games industry, and there is increasing adoption in training, design and social (chat and meetings) use cases. Popular VR games includes Beat Saber, Medal of Honor, Jurassic Park and Star Wars series that make VR a mature gaming platform. There are also a few even bigger AAA games in the pipeline.

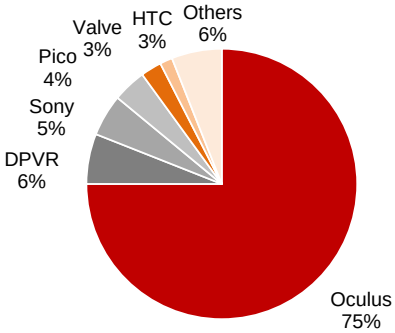
We expect global VR headset shipment to pass 10mn for the first time in 2022E, as Apple will announce its first VR/AR device. It will be similar to Qculus Quest VR headset rather than AR glasses. Meanwhile, **ASP of VR/AR devices are more affordable than before.** Oculus Quest 2 VR headset costs US$299 vs. US$399 for its previous generation.

Figure 32: Global VR headsets shipment to grow 42% CAGR (2021E-25E) and reach 10mn in 2022E



Source: IDC, CMBIS

Figure 33: Global TOP XR (VR&AR) brands' shipment share (1Q21): Oculus captured 75% of 1Q21 shipment



Source: System Plus Consulting, CMBIS

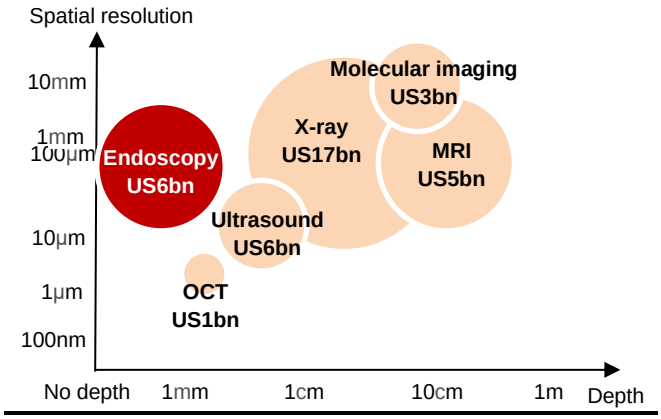
We expect Willsemi to become the major beneficiary of the boom in VR/AR. Willsemi already launched the product which targets facial authentication and eye tracking in smartphones and notebooks, as well as imaging for VR/AR headsets, drones and robots. Wilsemi's OCOVA wafer-level camera module is the first CameraCubeChip module with Nyxel technology and features the industry's smallest pixel size of 2.2 microns. The OC0VA is ideal for a wide range of consumer and industrial machine vision and 3D sensing applications.

Medical applications

With the development of semiconductor industry, medical-use camera modules are available at a low cost for medical applications, such as endoscopy. **The market has great potential as many camera modules are for single use.**

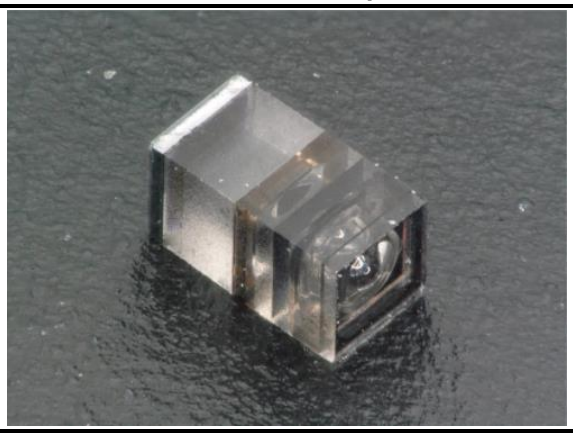
Willsemi has the world's smallest endoscopic camera (OVM6948) on a fully wafer bonded technology, with CIS, packaging and optic on the same wafer. The entire camera module is provided in a 0.65mm*1.2mm 4-pin package including a 0.58mm*0.58mm CIS die. The Company also has OH08A, Willsemi's next-generation 8 megapixel (MP) resolution CMOS image sensor for single-use and reusable endoscopes. The sensor is designed for endoscopes with a 10-12 mm outer diameter, such as gastroscopes, duodenoscopes, amnioscopes, laparoscopes and colonoscopes.

Figure 34: Medical imaging equipment landscape – 2019 global spending: Endoscopy



Source: Yole, CMBIS

Figure 35: Wllsemi's CameraCubeChip: the smallest camera in the world for endoscopes



Source: System Plus Consulting, CMBIS

Figure 36: Cameras for microscopy and next-generation sequencing: players ecosystem (2019)

Sensor manufacturers	Camera manufacturers	System manufacturers
HAMAMATSU PHOTON IS OUR BUSINESS	OLYMPUS, ANDOR, ZEISS, JENOPTIK	OLYMPUS, Nikon, Leica, ZEISS
SONY, ON Semiconductor, GPIXEL	TELEDYNE PHOTOMETRICS Everywhereyoulook	KEYENCE, THORLABS, BRUKER, MEIJI TECHNO
OmniVision, ams	SONY, HAMAMATSU PHOTON IS OUR BUSINESS, pco.	illumina, PACIFIC BIOSCIENCES, 华大基因 BGI, HITACHI, JEOL, ThermoFisher SCIENTIFIC

Source: Yole, CMBIS

Comeptitive Landscape

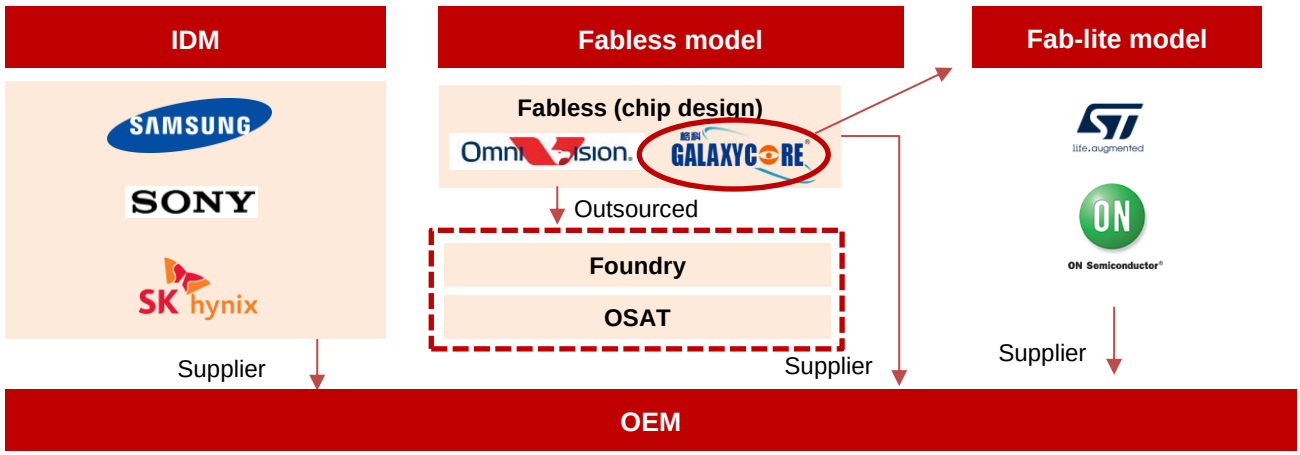
Business model: IDM, Fabless and Fab-lite

Prior to 1980, the Integrated Device Manufacturing ("IDM") business model dominated the semiconductor world. But its high barrier for new entrants and long production cycles limited the development of semiconductor industry. Later, with the rise of Taiwanese foundry business, companies can be specialized in each production procedure and the fabless model has become popular. Key players with IDM model are Samsung, Sony and SK Hynix. **Willsemi and GalaxyCore are fabless companies. The former type accounts for 67.3% market share.**

In recent years, as the degree of customized production in semiconductor industry has increased, the fab-lite model has emerged. It is a combination of the fabless model and the IDM model. For a fab-lite design company, the products with more standardized production procedures will adopt the fabless model, while the products that require special or highly itemized procedures will use the IDM model. In this way, both the efficiency and the quality of the products will be improved. Examples of this fab-lite companies include On Semiconductor and STMicroelectronics.

On 18 Aug 2021, GalaxyCore went IPO. In its prospectus, the use of IPO proceeds includes construction of 12-inch BSI wafer back-end production lines and 12-inch wafer manufacturing lines. The company will change its business model from fabless to fab-lite.

Figure 37: CIS peers business model comparison: IDM vs. Fabless vs. Fab-lite



Source: GalaxyCore prospectus, CMBIS

Although R&D efficiency is higher with IDM model, the risk of lower production capacity is greater if the demand from downstream market declines. In addition, capex of IDM companies increases the entry barrier for new players, and not all companies can afford the high upfront costs.

Figure 38: CIS peers business model comparison: IDM vs. Fabless vs. Fab-lite (Cont'd)

	IDM	Fabless	Fab-lite
R&D efficiency	High	High	**Low**
Production flexibility when demand fluctuates	High	Mid	**Low**
Capex and Depreciation	High	Mid	**NA**

Source: Yole, CMBIS

Willsemi, Sony and Samsung dominate the high-end CIS market

According to Frost & Sullivan, global mobile CIS shipment was 4.9bn in 2019:

1) The share of CIS's **resolution below 2M** (mainly used in feature phone cameras and some smartphone cameras) will continue to shrink;

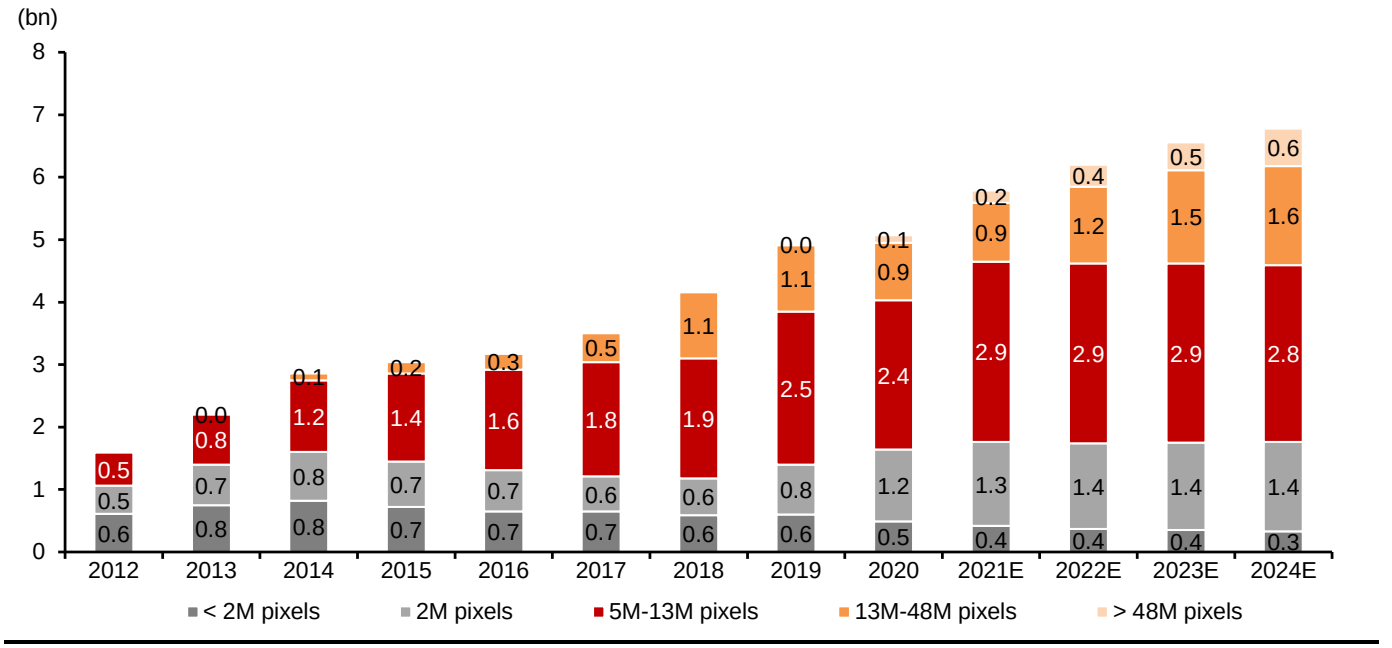
2) The share of CIS's **resolution of 2M** is (used in feature phone cameras and smartphone cameras) recovered from 2019, driven by its new function as a secondary camera that used in depth of field (DoF) photography and macro photography;

3) The share of CIS's **resolution of 5M-13M** (largely adopted in low-end smartphones) is expected to maintain its dominate position as it became the most popular choice since 2013;

4) CIS's **resolution between 13M-48M** (mainly used in most flagship smartphones) is steadily increasing its share and expected to grow at 19% CAGR (2021E-24E) and

5) CIS's **resolution above 48M** (used for high-end smartphones) has become a main battlefield for mainstream suppliers. The shipment of this new kind of CIS is estimated to grow at 44% CAGR (2021E-24E), reaching a market share of 8.8% in 2024E.

Figure 39: Global mobile CIS shipment by resolution



Source: Frost & Sullivan, CMBIS

Only Sony, Samsung and Willsemi are capable of manufacturing CIS with resolution of 64M and above. For tier 1 players, Sony still maintains the leading position for its high resolution CIS and broader offering of products, but Willsemi is catching up fast. **Although Willsemi has not entered into iPhone supply chain, it will be the upside opportunity in the future** as the company continues to make developments in leading-edge CMOS technologies.

Figure 40: CIS peers: product offering by resolution

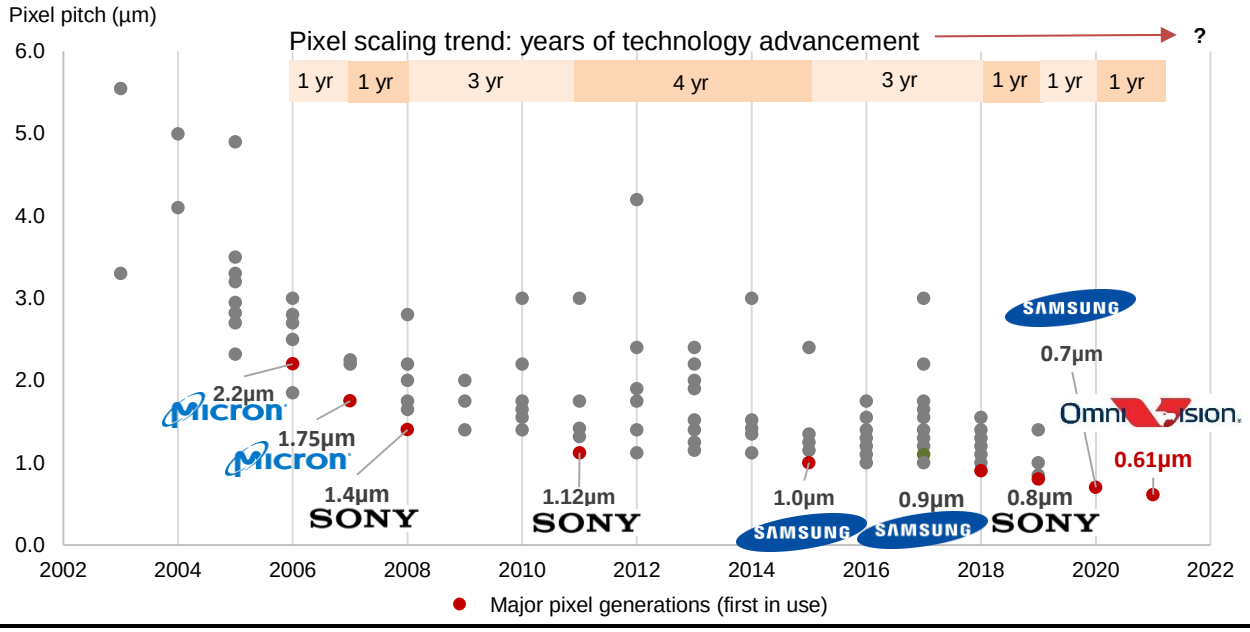
	Mobile market		Other markets	
	Resolution	Applications	Resolution	Applications
Sony	**-108M**	Mobile, tablet, etc.	**0.3M-150M**	Digital camera, security, auto, industrial, etc.
Samsung	**5M-108M**	Mobile, tablet, etc.	**1M-8M**	Auto, etc.
Willsemi	**0.3M-64M**	Mobile, tablet, etc.	**0.04M-64M**	Security, auto, digital camera, video conference etc.
SK Hynix	**0.3M-13M**	Mobile, tablet, etc.	**1M-5M**	Laptop, etc.
SuperPix	**0.08M-8M**	Mobile, tablet, etc.	**0.08M-8M**	Security, auto, laptop, etc.
GalaxyCore	**0.08M-16M**	Mobile, tablet, etc.	**0.08M-13M**	Auto, laptop, mobile payment, sports DV, etc.
Smartsenstech	NA	-	**0.3M-8M**	Security, industrial, IoT, etc.
Brigates	NA	-	**2M**	Security, auto, etc.
Gpixel	NA	-	**0.08M-103M**	Scientific experiments, etc.

Source: Galaxy prospectus, CMBIS

As for pixel size, it took 3 or 4 years for the industry to improve the pixel scaling from 1.4μm to 1.0μm from 2009 to 2018. But from 2019, the generation is speeding up its advancement. Each year, the pixel scaling is 0.1μm smaller than the previous year.

In May 2021, Willsemi is introducing the world's first 0.61μm pixel high resolution CMOS image sensor that will revolutionize the capabilities of next-generation mobile phone cameras. The new 0.61 μm pixel is 24% smaller in area than the previous generation 0.7 μm pixel solution, yet it can achieve higher Quantum Efficiency (QE) with better crosstalk and angular response than the 0.7 μm generation.

Figure 41: Pixel scaling trend: technology advancement is speeding up in recent years



Source: Yole, CMBIS

Finanacials comparison: Willsemi vs Galaxycore

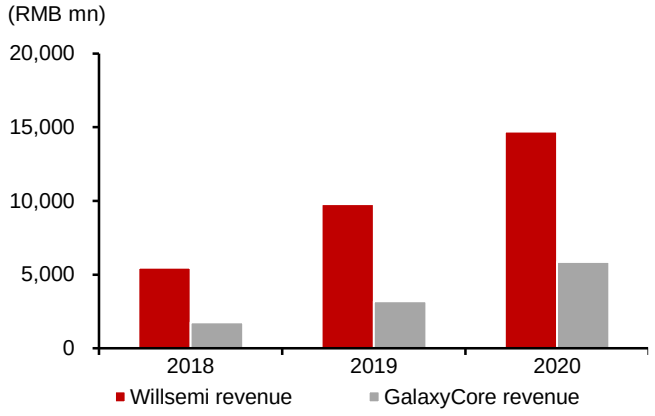
We believe Chinese CIS players will rise with global CIS market boom. At the backdrop of US-China trade tensions, CIS industry is one of key strengths of Chinese semiconductor sector. **According to Yole, smaller players outperformed the industry in 2020.** Sony, who holds the first place, did not grow. On the contrary, **Samsung grew 13%, Sartsens and SK Hynix grew at 30% YoY, while Willsemi/ GalaxyCore grew at 45%/75% YoY.**

Currently, Willsemi ranked No.3 based on revenue and No.4 based on shipment in 2020. The market shares are 12% and 5% respectively. We think these companies will continue deliver good results given the strong demand from various end markets.

We believe GalaxyCore will maintain its leading position in low- to mid-end CIS market (No.1 market share in term of shipment in 2020) **and starts to penetrate into the high-end CIS market soon.** The company will change its fabless model to fab-lite model, lifting the production capacity for high-end CIS products.

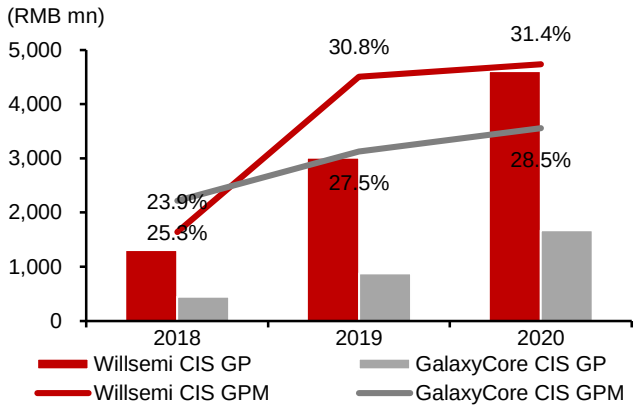
We think Willsemi will benefit from the current supply chain tightness, given its stronger relationships with the foundries and secured production capacity. We also expect Willsemi's product mix to move towards the high-end CIS, driven by smartphone camera upgrade and launch of more expensive high-end devices. It will help Willsemi to improve its blended ASP and profitability.

Figure 42: Willsemi vs. GalaxyCore: CIS revenue (2018- 2020)



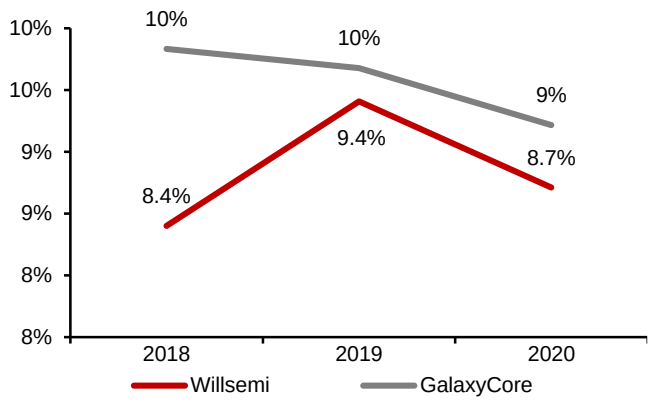
Source: Company data, GalaxyCore prospectus, CMBIS

Figure 43: Willsemi vs. GalaxyCore: CIS gross profit and margin analysis (2018-2020)



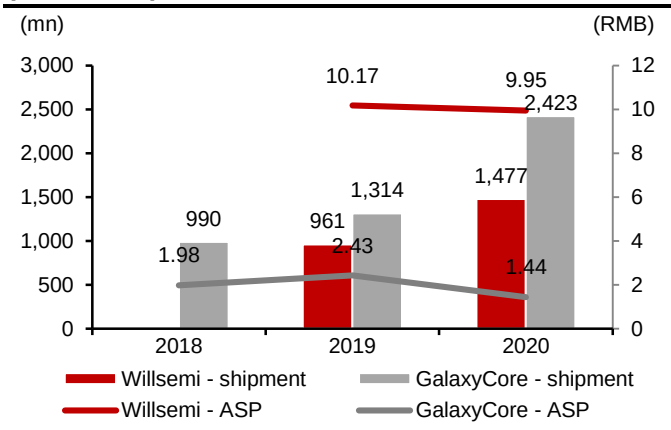
Source: Company data, GalaxyCore prospectus, CMBIS

Figure 44: Willsemi vs. GalaxyCore: R&D expense % revenue (2018- 2020)



Source: Company data, GalaxyCore prospectus, CMBIS

Figure 45: Willsemi vs. GalaxyCore: shipment vs. ASP (2018- 2020)



Source: Company data, GalaxyCore prospectus, CMBIS

Willsemi (603501 CH)

Global Top 3 CIS player with a diversified and established product portfolio

Willsemi is a top 3 manufacturer in global CIS market. We forecast Willsemi's revenue/NP to grow at 32%/43% 2020-23E CAGR, driven by strong demand for CIS from mobile, automotive, VR/AR and other fast-growing end markets. Despite recent supply chain shortage, we believe global CIS market will reach record-high in 2021 and re-accelerate in 2022 (8.9% YoY). We view recent correction as an attractive opportunity for investors to gain exposure to quality Chinese semi fabless names that can ride strategic trends. After recent correction, the stock now trades at attractive valuation of 36.3x FY22E P/E, 1-SD below 2-year historical fwd P/E. **We initiate at BUY with 12m TP of RMB370.75 (37% upside),** as we think Willsemi is an established player with diversified product portfolio. Our TP is based on 50x FY22E P/E, 1-SD above 2-yr historical fwd. P/E.

- **Leading Chinese contender in global CIS market.** Willsemi entered CIS market in 2018 through the acquisition of OmniVision. Willsemi is now a top 3 manufacturer in global CIS market. We expect its CIS business to grow at 32% CAGR during 2020E-23E. Looking forward, we expect growth of CIS market will be driven by 1) new smartphone upgrade cycle and rising ASP, 2) rising avg. number of cameras per device to 3.3 by 2024E (vs. 2.3 in 2020), and 3) surging CIS demand coming from VR/AR, ADAS and medical markets.
- **Top CIS players to accelerate share gain during semi shortage.** We believe Willsemi will benefit from market share gain amid recent supply chain tightness, given their stronger bargaining power and relationships with foundries. We expect its CIS product mix and profitability will continue to improve, backed by smartphone camera spec upgrade and expansion into automotive/medical markets.
- **Initiate at BUY with TP of RMB370.75.** We derive our TP of RMB370.75 by applying 50x FY22E P/E, 1 SD above 2-year historical forward P/E. Willsemi is currently trading 1-sd below historical P/E, which is very attractive. We believe this valuation is justified given 1) its leading position in CIS market with global presence, 2) its integrated semiconductor platform with diversified product portfolio and 3) accelerated share gain due to business expansion and advances in technology.
- Potential risks include 1) slower market growth, 2) intensified competition, 3) worse-than-expected semi shortage and 4) new disruptive technology.

Earnings Summary

(YE 31 Dec)	FY19A	FY20A	FY21E	FY22E	FY23E
Revenue (RMB mn)	13,632	19,824	29,203	36,723	45,061
YoY growth (%)	-	45.4%	47.3%	25.7%	22.7%
Gross profit (RMB mn)	3,734	5,930	9,482	12,176	14,987
Gross profit margin %	27.4%	29.9%	32.5%	33.2%	33.3%
Net profit (RMB mn)	466	2,706	4,838	6,487	7,904
Net profit margin %	3.4%	13.7%	16.6%	17.7%	17.5%
EPS (RMB)	0.76	3.21	5.58	7.48	9.11
YoY growth (%)	-	322.4%	73.7%	34.1%	21.8%
Consensus EPS (RMB)	-	3.21	5.30	6.78	8.58
P/E (x)	357.1	84.5	48.7	36.3	29.8
P/B (x)	21.0	20.4	14.2	10.3	7.7
ROE (%)	5.9%	23.5%	28.5%	27.8%	25.4%
Net gearing (%)	23.5%	6.7%	net cash	net cash	net cash

Source: Company data, Bloomberg, CMBIS estimates

BUY (Initiation)

Target Price	RMB 370.75
Up/Downside	+37%
Current Price	RMB 271.40

China Technology Sector

Lily Yang
(852) 3916 3716
lilyyang@cmbi.com.hk

Alex Ng
(852) 3900 0881
alexng@cmbi.com.hk

Stock Data

Mkt Cap (RMBmn)	235,733
Avg 3 mths t/o (RMBmn)	2,538
52w High/Low (RMB)	345.00/165.08
Total Issued Shares (mn)	868.6

Source: Bloomberg

Shareholding Structure

Yu Renrong	31.48%
SX Weihao Equity Invest FD	9.31%
HKSCC	5.18%

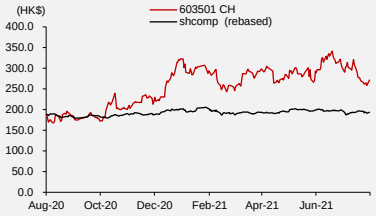
Source: Bloomberg

Share Performance

	Absolute	Relative
1-mth	-16.4%	-12.8%
3-mth	-9.1%	-7.5%
6-mth	-10.1%	-4.5%

Source: Bloomberg

12-mth Price Performance



Source: Bloomberg

Auditor: BDO

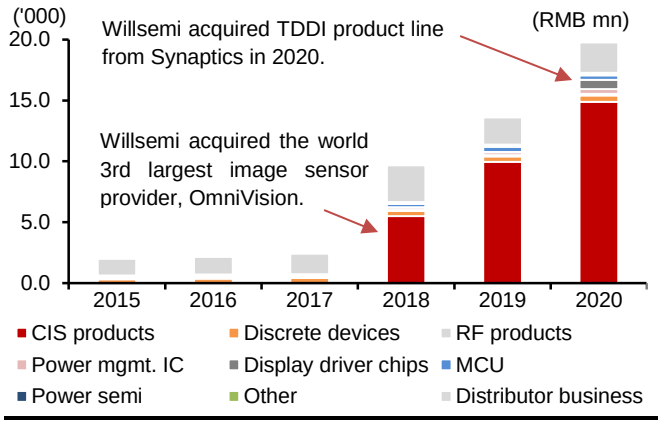
Investment Summary

Will Semiconductor ("Willsemi") **is global top 3 manufacturer in CIS market.** It offers a broad variety of semiconductor products including CIS, discrete devices, RF products, power mgmt. IC, display driver chips, MCU, power semi, etc. The Company entered CIS market in 2018 through acquisition of OmniVision, an expert in advanced imaging solutions for a variety of industrial and consumer markets. **CIS business accounted for 75% of FY20 revenue and we expect this segment to grow at 32% CAGR during 2020E-23E, back by strong demand from mobile, VR/AR and automobile electronics.**

We estimate 32%/43% revenue/earnings CAGR during FY20-23E, benefiting from expansion in CIS products and strong product portfolio with potential synergies.

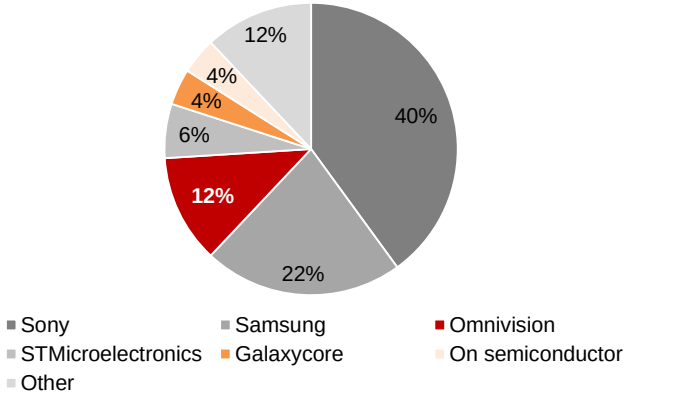
We initiate at BUY with TP of RMB370.75, as we think Willsemi is an established player with diversified product portfolio. We derive our TP of RMB370.75 by applying 50x FY22E P/E, 1 SD above the 2-year historical forward P/E. We believe this valuation is justified given 1) its leading position in CIS market with a global presence, 2) its integrated semiconductor platform with diversified product portfolio and 3) expected share gain due to business expansion and advances in technology.

Figure 46: Willsemi revenue breakdown: CIS business expansion since 2018



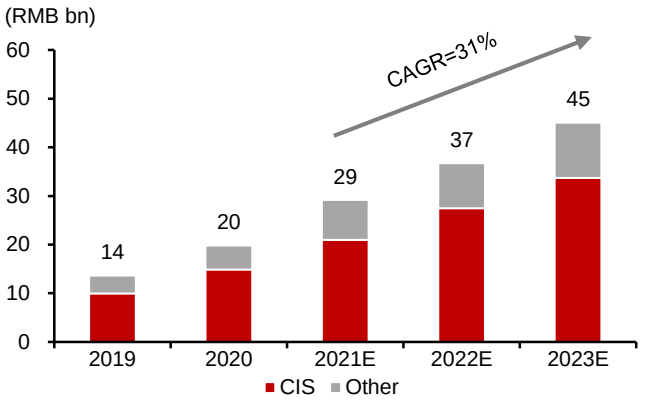
Source: Company data, CMBIS

Figure 47: Global CIS revenue (2020): Willsemi ranked No.3 with 12% market share



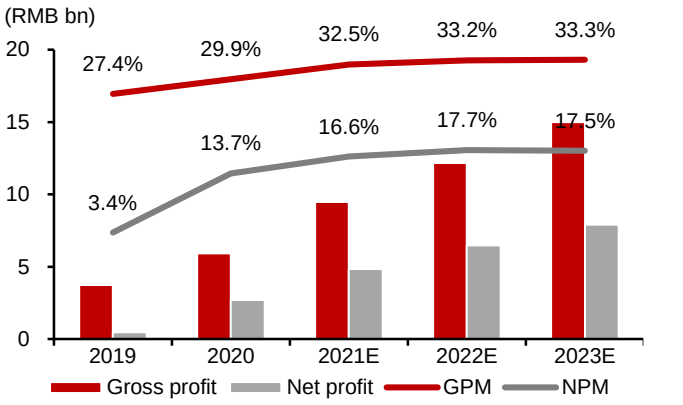
Source: Yole, CMBIS

Figure 48: Revenue to grow at a CAGR of 31% (FY20E-23E)



Source: Company data, CMBIS estimates

Figure 49: Net profit to grow at a CAGR of 43% (FY20E-23E)



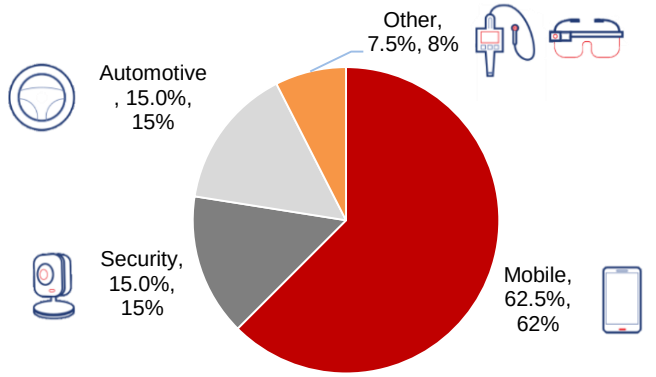
Source: Company data, CMBIS estimates

Leading Chinese contender in global CIS market

Willsemi: Top 3 manufacturer in global CIS market

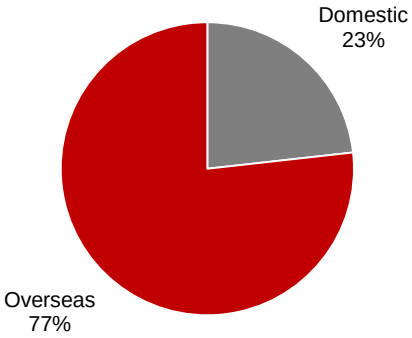
Will Semiconductor ("Willsemi") is a China-based company, offering a broad category of semiconductor products including CMOS image sensors, display driver chips, semiconductor discrete devices, radio frequency (RF) products, power management integrated circuits (IC), transient voltage suppressers (TVS), metal-oxide-semiconductor field-effect transistors (MOSFET), schottky diodes, etc. (Figure 1).

Figure 50: Willsemi: advanced imaging solutions to a variety of industrial and consumer markets



Source: Company data, CMBIS

Figure 51: Willsemi geographical revenue breakdown (2020): the Company has a strong global presence



Source: Company data, CMBIS

Willsemi entered CIS market in 2018 through its acquisition of OmniVision. The deal size was ~US$2.2bn. OmniVision develops advanced imaging solutions to a variety of industrial and consumer markets. Its products include CMOS image sensor, ASIC, CameraCubeChip, LCOS, and power management. Its end market application covers automotive, medical, mobile devices, security, IoT/emerging, computing and others. After the acquisition, Willsemi's revenue increased 304% in 2018. **Willsemi is now a top 3 manufacturer in global CIS market (Figure 2). The CIS business accounted for 75% of Willsemi's total revenue in 2020 and we expect this segment to grow at 32% 2020E-23E CAGR.**

Diversified businesses to generate synergies

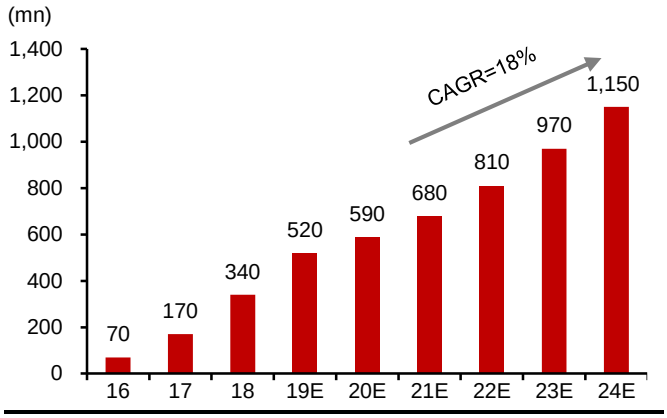
Touch and Display Driver Integration driver chip (TDDI)

Touch and display driver integration ("TDDI") improves displays' design and manufacturability. When combined with full in-cell designs, TDDI provides for display layers, superior touch performance, lower costs, reduced power consumption, accelerated time to market, and greater reliability.

Since its first generation in 2015, TDDI shipment was picking up quickly from 40mn in 2015 to 590mn in 2020, representing a 2020E-23E CAGR of 54% driven by the demand from smartphones. Looking forward, TDDI will be widely applied in the other markets as well, especially in the auto electronics. According to Frost & Sullivan, TDDI shipment will reach 1,150mn in 2024, growing at 45% CAGR (2020E-23E).

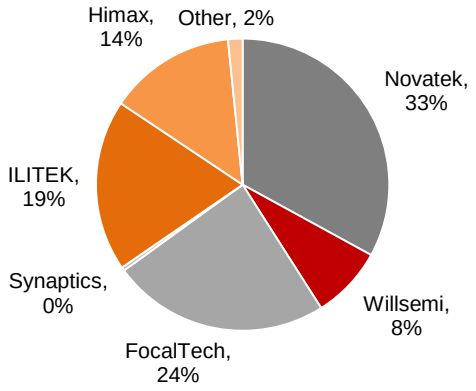
In 2020, Willsemi acquired some assets from Synaptics (NASDAQ: SYNA), expanding its display driver business. The assets acquired was TDDI product line for LCD mobile displays in Asia, while Synaptics retained its automotive TDDI product line and discrete touch and discrete display driver product lines supporting LCD and OLED for the mobile market. According to Synaptics, the assets sold under the asset purchase agreement had a carrying value of approximately US$33.6mn as of the closing date of the transaction in April 2020 for cash consideration of US$138.7mn.

Figure 52: Global TDDI shipment forecast: market to grow at 18% 2020E-23E CAGR



Source: Frost &Sullivan, CMBIS

Figure 53: Willsemi is the top 5 supplier of TDDI (2020)



Source: Omdia, CMBIS

Financial analysis

Expect 32%/43% CAGR for revenue/net profit in FY20-23E

In 2020, Willsemi achieved 45%/481% YoY growth in revenue/net profit. Looking forward, **we estimate the Company to grow at 32%/43% revenue/earnings CAGR during FY20-23E**, benefiting from its core business expansion in CIS market and a diversified product portfolio with potential synergies. **We think Willsemi is a compelling proxy for investors to capture opportunity in the fast-growing CIS market.**

Figure 54: Major assumptions

RMB mn	FY19	FY20	FY21E	FY22E	FY23E
CIS	9,946	14,876	20,968	27,468	33,706
…YoY	-	*50%*	*41%*	*31%*	*23%*
Analog devices	784	1,043	1,664	2,240	2,929
…YoY	-	*33%*	*60%*	*35%*	*31%*
Display driver chips	30	774	1,591	2,329	2,984
…YoY	-	*2515%*	*106%*	*46%*	*28%*
Power semi	120	167	350	551	811
…YoY	-	*40%*	*109%*	*57%*	*47%*
MCU	429	368	584	734	901
…YoY	-	*-14%*	*59%*	*26%*	*23%*
Other	2,323	2,596	4,046	3,400	3,730
…YoY	-	*12%*	*56%*	*-16%*	*10%*
Total	**13,632**	**19,824**	**29,203**	**36,723**	**45,061**
…YoY	-	*45%*	*47%*	*26%*	*23%*
Gross margin	**27.3%**	**29.7%**	**32.5%**	**33.2%**	**33.3%**

Source: Company data, CMBIS estimates

Figure 55: P&L forecast

RMB mn	FY19	FY20	FY21E	FY22E	FY23E
Revenue	**13,632**	**19,824**	**29,203**	**36,723**	**45,514**
…YoY	-	*45.4%*	*47.3%*	*25.7%*	*22.8%*
Gross profit	**3,734**	**5,930**	**9,482**	**12,176**	**15,059**
GPM (%)	27.4%	29.9%	32.5%	33.2%	33.1%
SG&A	(1,132)	(1,147)	(1,501)	(1,856)	(2,185)
…% of rev	*-8.3%*	*-5.8%*	*-5.1%*	*-5.1%*	*-4.8%*
R&D	(1,282)	(1,727)	(2,190)	(2,754)	(3,414)
…% of rev	*-9.4%*	*-8.7%*	*-7.5%*	*-7.5%*	*-7.5%*
Operating profit	**785**	**2,956**	**5,429**	**7,320**	**8,922**
OPM (%)	*5.8%*	*14.9%*	*18.6%*	*19.9%*	*19.6%*
…YoY	-	*276.5%*	*83.7%*	*34.8%*	*21.8%*
Net profit	**466**	**2,706**	**4,838**	**6,487**	**7,907**
NPM (%)	*3.4%*	*13.7%*	*16.6%*	*17.7%*	*17.4%*
…YoY	-	*481.2%*	*78.8%*	*34.1%*	*21.8%*

Source: Company data, CMBIS estimates

Figure 56: CMBIS estimates vs consensus

	CMBIS			Consensus			Diff (%)		
RMB mn	FY21E	FY22E	FY23E	FY21E	FY22E	FY23E	FY21E	FY22E	FY23E
Revenue	29,203	36,723	45,061	27,633	34,821	42,117	6%	5%	7%
Gross Profit	9,482	12,176	14,987	8,953	11,354	13,979	6%	7%	7%
Operating profit	5,429	7,320	8,918	5,220	6,717	8,472	4%	9%	5%
Net profit	4,838	6,487	7,904	4,636	5,986	7,589	4%	8%	4%
EPS (RMB)	5.576	7.477	9.110	5.298	6.785	8.577	5%	10%	6%
Gross Margin	32.5%	33.2%	33.3%	32.4%	32.6%	33.2%	0.1 ppt	0.5 ppt	0.1 ppt
Operating Margin	18.6%	19.9%	19.8%	18.9%	19.3%	20.1%	-0.3 ppt	0.6 ppt	-0.3 ppt
Net Margin	16.6%	17.7%	17.5%	16.8%	17.2%	18.0%	-0.2 ppt	0.5 ppt	-0.5 ppt

Source: Bloomberg, CMBIS estimates

Valuation

Initiate with BUY rating and TP of RMB370.75 (37% upside)

We initiate at BUY with TP of RMB370.75, as we think Willsemi is an established player with diversified product portfolio. We derive our TP by applying 50x FY22E P/E, 1 SD above the 2-year historical forward P/E. We believe this valuation is justified given 1) its leading position in CIS market with a global presence, 2) its integrated semiconductor platform with diversified product portfolio and 3) expected share gain due to business expansion and advances in technology.

We take the recent volatility as an attractive opportunity for investors to gain exposure to quality Chinese semi fabless names that can ride strategic trends. The stock is now trading at 36.3x 2022E P/E vs. 56.8x of its peers.

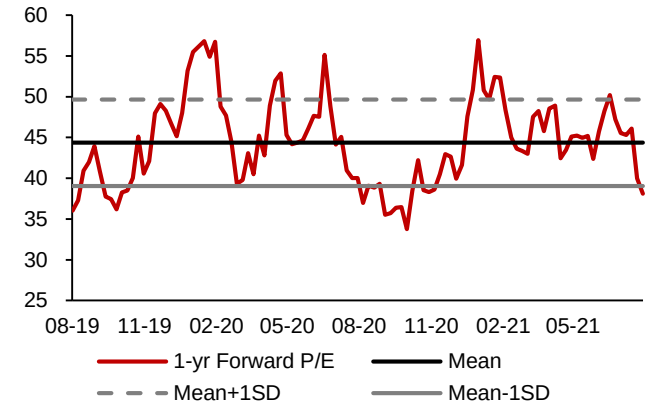
Potential risks include 1) less-than-expected market growth, 2) intensified competition, 3) worse-than-expected semi shortage and 4) new disruptive technology.

Figure 57: Peers valuation

		Mkt Cap	Price	P/E (x)		P/B (x)		ROE (%)	
Company	Ticker	US$(mn)	(LC)	FY21E	FY22E	FY21E	FY22E	FY21E	FY22E
Global CIS peers									
Willsemi	**603501 CH**	**36,353**	**271.40**	**48.7**	**36.3**	**14.2**	**10.3**	**28.5**	**27.8**
GalaxyCore	**688728 CH**	**13,900**	**36.07**	**62.0**	**37.4**	**14.5**	**10.3**	**23.4**	**27.6**
Sony	SONY US	123,130	97.64	11.7	16.4	2.6	2.2	23.4	16.6
Samsung	005930 KS	373,427	73,300.00	12.3	10.2	1.7	1.5	14.0	15.2
STMicroelectronics	STM FP	39,001	36.50	22.6	19.9	4.0	3.4	19.4	18.9
ON Semi	ON US	17,867	41.50	16.7	14.9	4.4	3.5	22.1	22.1
Peers Avg.				**29.0**	**22.5**	**6.9**	**5.2**	**21.8**	**21.4**
Peers Median				**19.7**	**18.1**	**4.2**	**3.5**	**22.7**	**20.5**
China fabless peers									
Willsemi	**603501 CH**	**36,353**	**271.40**	**48.7**	**36.3**	**14.2**	**10.3**	**28.5**	**27.8**
GalaxyCore	**688728 CH**	**13,900**	**36.07**	**62.0**	**37.4**	**14.5**	**10.3**	**23.4**	**27.6**
Gigadevice	603986 CH	16,981	165.75	73.3	55.2	8.9	7.8	12.7	15.0
Maxscend	300782 CH	21,224	412.59	66.6	49.9	25.7	17.7	44.9	38.2
Goodix	603160 CH	7,670	108.70	38.5	29.7	5.6	4.8	15.4	17.3
SG Miceo	300661 CH	12,639	349.13	180.8	132.3	44.2	34.9	24.7	26.0
Peers Avg.				**78.3**	**56.8**	**18.8**	**14.3**	**24.9**	**25.3**
Peers Median				**64.3**	**43.7**	**14.3**	**10.3**	**24.0**	**26.8**

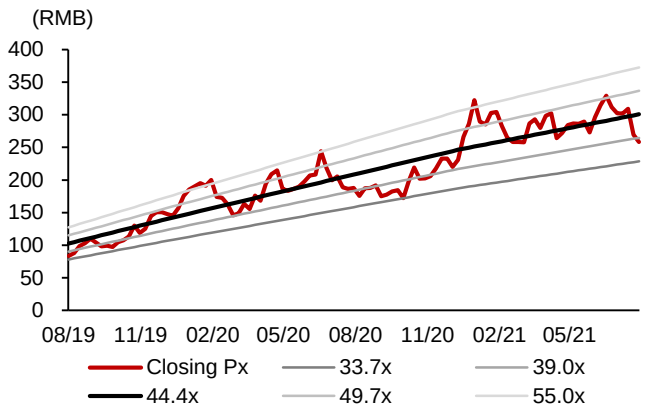
Source: Bloomberg and CMBIS, as of 23 Aug 2021.

Figure 58: 12M forward P/E chart



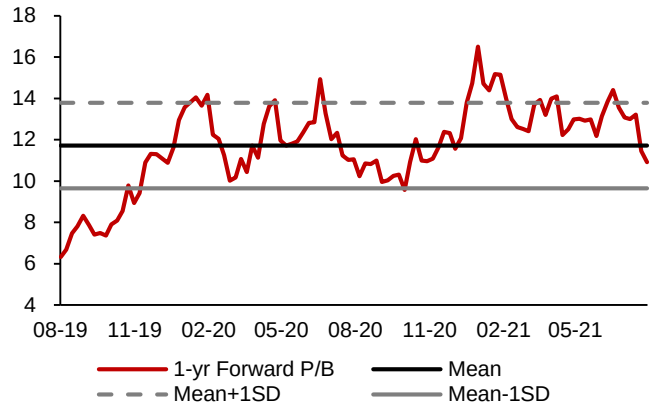
Source: Company data, CMBIS estimates

Figure 59: 12M forward P/E band



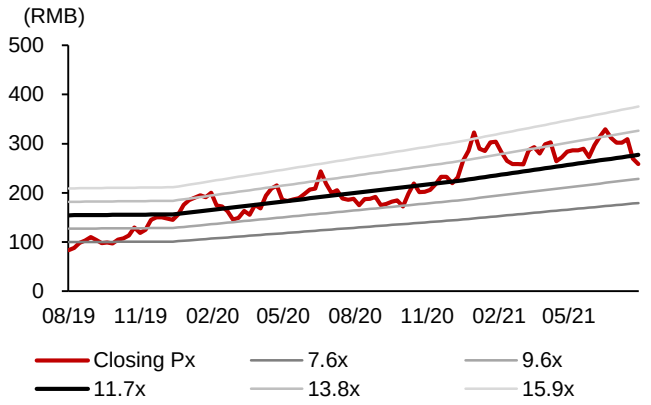
Source: Company data, CMBIS estimates

Figure 60: 12M forward P/B chart



Source: Company data, CMBIS estimates

Figure 61: 12M forward P/B band



Source: Company data, CMBIS estimates

Investment Risks

Less-than-expected market growth

The majority of the company's CIS products are used in mobile devices, which is subject to the impact of macroeconomic fluctuations. The company's business may be negatively affected by 1) downward cycle of global economy, 2) changes of geopolitical environment, 3) slowing down of mobile market growth, such as delay in smartphone upgrade, and 4) less-than expected increase in number of cameras used per devices.

Intensified competition

In recent years, the competition in CIS market has intensified with the rapid growth of downstream market. Although Willsemi is a leading company in CIS, the company is subject to the fast technology advancement as many of its competitors have continued to improve their products and try to increase their market share. As the competition gets intensified, it may hurt the company as well as its peers' margin and profitability.

Worse-than-expected semi shortage

The company's growth is also affected by the development of semiconductor industry. Due to the large initial investment of wafer manufacturers and semiconductor assembly and test vendors, there will be long production cycle that may lead to capacity constraints. With the capacity expansion, the semiconductor industry may experience overcapacity in the following years. Therefore, it is crucial for the fabless IC design companies to have strong and stable relationship with the semiconductor foundry. If the company cannot establish a stable supply chain in manufacturing, it may not be able to deliver its products in a timely manner and adversely impact on the company's future business.

New disruptive technology

The CIS industry is experiencing increasing technology advancement, given the continuous demand for performance upgrade from downstream markets. If the company cannot keep up the pace of market development or upgrade existing products and technologies in a timely manner to maintain their market position, it will have an adverse impact on the company's business.

In addition, the design companies need to maintain a high degree of sensitivity to the trend of mainstream technology advancement based on changes in market demand and technological development.

US-China trade tension

The development of semiconductor industry needs the cooperation from all the global participants. Any further geopolitical relationship changes may hinder the development of CIS development. The design companies have technology cooperation with foreign EDA suppliers and IP licensors. If trade frictions continue to escalate and the scope of the technology ban expands, it may hurt the company's business.

COVID-19 impact

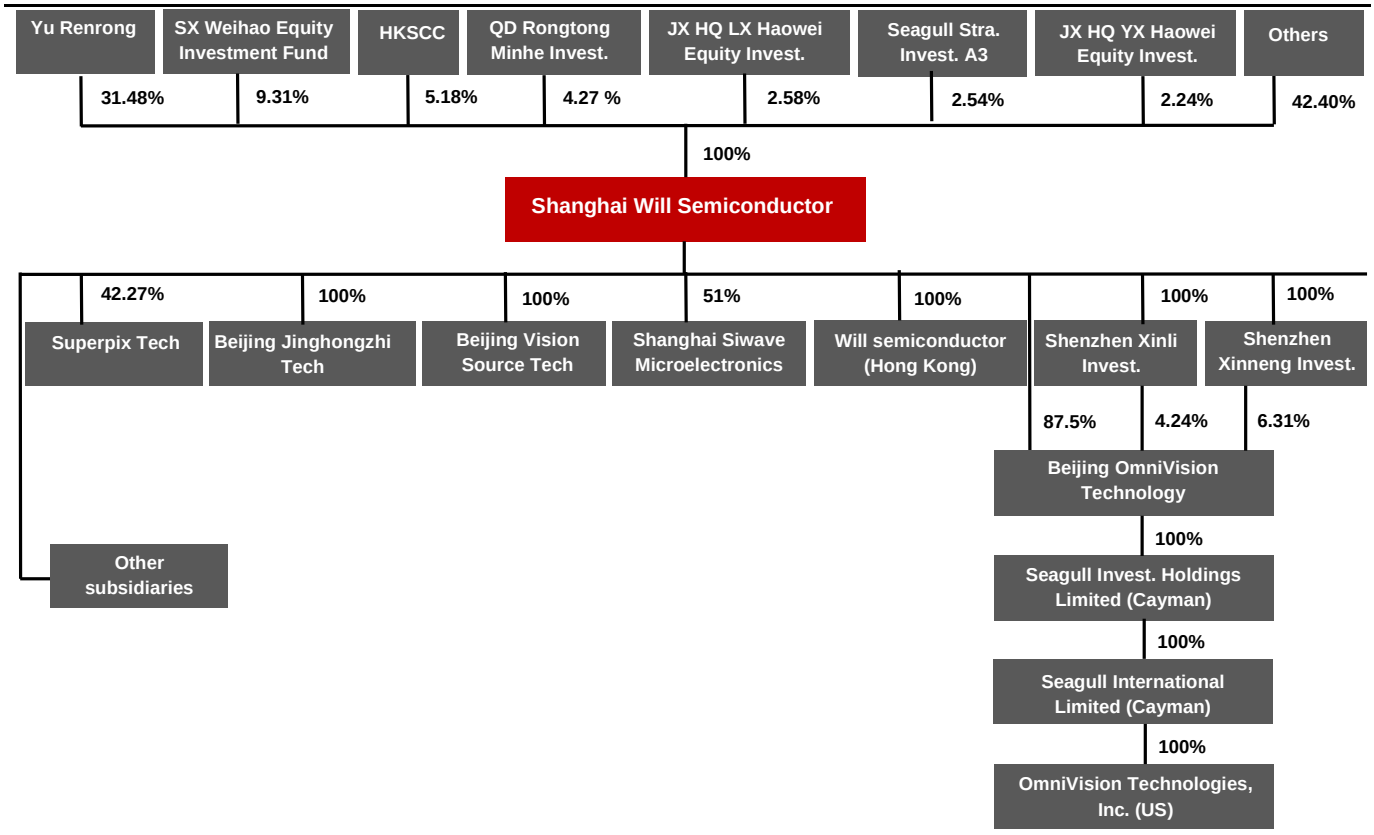
Although the world has suppresses the spread of the pandemic to a great extent, there is risk that the pandemic has a longer impact on our lives. It may negatively affect the supply chain and end market demand, such as decrease in market share of high-ASP products.

Appendix 1 – Business milestone

Year	Milestone
2007	Company established.
2013	The company acquired Hong Kong Huaqing (100% equity) and Beijing Jinghongzhi (100% equity). Before this acquisition, Wilsemi was mainly engaged in design and sales of semiconductor discrete devices, such as TVS, MOSFET, and power management IC. Hong Kong Huaqing and Beijing Jinghongzhi were engaged in the distribution of semiconductor products business.
2014	The company acquired Beijing Taihe Zhiheng Technology Co., Ltd. (100% equity). Taihe Zhiheng Tech is the first domestic chip design company to provide support for multiple digital TV transmission standards with independent intellectual property rights in China. It has also expended to SoC chip design.
2015	The company acquired Wuxi Zhongpu Microelectronics and established Shanghai Weijue to increase the company's research and development in radio frequency (RF) products.
2016	The company established two new subsidiaries, Shanghai Panju and Shanghai Sijiu, focusing on MEMS and broadband carrier chips businesses.
2017	The company's new subsidiary, Wei Zimei, is committed to research and develop the high-performance IC products. The company's product line has been further expanded.
2018	The company entered into CIS market, after acquired Beijing Omnivision Technology (85.53% equity), Superpix (42.27% equity) and Beijing Vision Source Technology Development (79.93% equity).
2020	The company acquired display driver integrated chip (TDDI) business (Asia team) from Synaptics Incorporated.

Source: Company data

Appendix 2 – Shareholding structure



Source: Company data, Bloomberg and CMBIS. * Non exhaustive subsidiaries list.

Appendix 3 – Key management

Name	Age	Position Title	Experience
Yu Renrong	55	Chairman	From 1990 to 1998, Mr. Yu worked at Inspur Group and Longyue Electronics (HK) Beijing Office; from 1998 to 2001, he served as the Chairman of Beijing Huaqing Xingchang Technology & Trade Co., Ltd.; from 2006 to 2007, he served as the chairman of HK Waching electronic (Group) Ltd.; from 2005 to 2011, he was the vice chairman and general manager of the company; in 2020, he served as the executive partner of Hangzhou Haoxin Equity Investment Partnership Ltd. His current positions include: 1) executive director and manager of Beijing Jinghongzhi Technology Co., Ltd. (since 2001); 2) executive director and general manager of Shenzhen Jinghongzhi Electronics Co., Ltd. (since 2003); 3) chairman of the comapny (since 2011); 4) chairman of Beijing Taihe Zhiheng Technology Co., Ltd. (since 2014); 5) chairman of ChinaUniChip Technologies Inc. (since 2015); 6) director of Wuhan Guohe Technology Co., Ltd. (since 2014); 7) executive partner of Shanghai Jingen Asset Management Partnership (Limited Partnership) (since 2015); 8) chairman of Wuhan Weir Semiconductor Co., Ltd. (since 2017); 9) director and general manager of Beijing OmniVision Technology Co., Ltd. (since 2017); 10) director of New Henghui Electronics Co., Ltd. (2018); 11) supervisor of Qingdao Qingen Asset Management Co., Ltd. (since 2018); 12) executive director and manager of Beijing OmniVision Yizhuang Technology Co., Ltd (2018).
Yang Hongli	56	Director	Since 1996, Mr. Yang has various positions in OmniVision technologies. His current positions include but not limited to: 1) president and president of OmniVision Technologies, Inc. (since 2010); 2) director and president of Seagull Investment Holdings Limited, director and president of Seagull International Limited, director of OmniVision Investment Holding (BVI) Ltd., and director of SoongChingLing Foundation (USA) (since 2016); 3) director of the company.
Lv Dalong	59	Director	From 1983 to 1992, Mr. Lv was an engineer of the Air Force Engineering Design and Research Bureau; after 1992, he had various positions in China Township Enterprise Investment and Development Co., Hainan Deren Industrial Co., Ltd. and etc. He currently serves as director, executive director and manager in various investment companies. Since 2020, he serves as a director of the company.
Ji Gang	45	Director, Deputy General Manager	Prior to 2008, Mr. Ji worked at Pioneer Microelectronics (Shanghai) Co., Ltd. and Shanghai Advanced Semiconductor Manufacturing Co. He currently serves as 1) deputy general manager and director of the company, 2) director of Wuxi Zhongpu Microelectronics Co., 3) executive director of Shanghai Weizimei Electronic Technology Co., Ltd., 4) director of Shanghai Yiyi Semiconductor Co., 5) chairman of Jiangsu Weida Semiconductor Co., 6) director of Beijing Haowei Technology Co., Ltd. and 7) executive director of Shaoxing Weihao Semiconductor Technology Co., Ltd.
Jia Yuan	47	Director, CFO, Secretary of the Board of Directors	Prior to 2011, Mr. Jia worked at Shanghai Certified Public Accountants Co., Ltd. and BDO China SHU LUN PAN Certified Public Accountants LLP. Since 2011, he serves as the company's CFO and secretary of the board of directors. He also has various positions such as supervisor and director at 1) Beijing Taihe Zhiheng Technology Co., Ltd. (since 2014); 2) Wuxi Zhongpu Microelectronics Co., Ltd. (since 2014); 3) Shanghai Weijue Microelectronics Co., Ltd. (since 2015) and etc.
Liu Yue	60	Director	From 1984 to 1988, Mr. Liu was an engineer at Beijing Semiconductor Factory; from 1988 to 1991, he was the department manager of Beijing Capital Technology Development Company of China International Trust and Investment Group. Since 1991, he was the senior engineer in the Institute of Microelectronics of Peking University. His current positions include but not limited to:1) director and general manager of Beijing Beidayuhuan Microelectronics System Co., Ltd., 2) director of Beijing Jade Bird Yuanxin Microsystem Technology Co., Ltd., 3) chairman and general manager of Beijing Qingxin Huachuang Investment Management Co., Ltd., 4) legal representative of Beijing Qingyuan Huaxin Investment Management Co., Ltd., 5) director of Beijing Sicheng Semiconductor Co., Ltd., 6) independent director of NAURA Technology Group.
Chen Hongyi	79	Independent director	From 1981 to 2007, Mr. Chen served as a lecturer, associate researcher, researcher, doctoral supervisor, director and director of the Academic Committee of the Institute of Microelectronics of Tsinghua University; he has retired in April 2008. Currently, he has served as 1) independent director of Suzhou Guoxin Technology Co. (since 2019), Ltd, 2) independent director of the company (since 2015) and 3) director of the company (since 2016).
Wang Haifeng	50	Independent director	From 1992 to 1994, Mr. Wang worked at the Public Security Department of Anhui Province; from 2004 to 2005, he was a visiting scholar at the Kennedy School of Government of Harvard University; from 2009 to 2011, he worked in the first branch of the Shanghai People's Procuratorate as the deputy director. He currently has various positions at 1) the Law Institute of the Shanghai Academy of Social Sciences as a researcher; 2) Grandall Law Firm; 3) China International Economic and Trade Arbitration Commission; 4) Third Branch of the Shanghai People's Procuratorate; 5) independent director of Yinyi Co., Ltd. (independent director),; 6) Antarctic E-commerce Co. Ltd. (independent director). Since March 2016, he has served as independent director of the company.
Wen Donghua	48	Independent director	Prior to 2004, Mr. Wen worked as a finance staff at Sichuan Chuantou Changcheng Special Steelco., Ltd. and Shanghai Fosun Pharmaceutical(Group)Co.,Ltd. From 2000 to 2003, he worked as lecturer and associate professor of Shanghai University of Finance and Economics. He also served as independent director of Fujian Haiyuan Composites Technology Co., Ltd. and Shanghai Kangda New Chemical Materials Co., Ltd. He has currently served as independent director of Shanghai Tianchen Co., Ltd. (since 2014) and Shanghai Xinmei Real Estate Co., Ltd

			(since 2017) and Anhui Kairun Co., Ltd. (2020). Since March 2015, he has served as independent director of the company.
Han Jie	55	Chairman of the Board of Supervisors, Supervisor of staff	From 1992 to 2013, Mr. Han worked at Beijing Galaxy Electronics Corporation, Beijing office of Hong Kong Science Exchange, Hong Kong RTI Shanghai office, Shanghai Viao Communication Technology Co., Ltd. and Shanghai Tianyida. Currently, he is the account manager of the company's sales department, supervisor of the company and chairman of the company's board of supervisors. Since 2020, he has been an executive director and manager of Hangzhou Yongzhi Equity Investment Co., Ltd.
Chen Zhibin	37	Supervisor	From 2007 to 2010, Mr. Chen was the manager of the investment banking department of JPMorgan Chase Bank Singapore branch; from 2010 to 2014, he was the vice president of Beijing Qingshi Huashan Capital Investment Consulting Co., Ltd. He currenly holds various positions including but not limited to 1) director at Beijing OmniVision Technologies, 2) director at Beijing Superpix Technology, 3) supervisor at Anji Microelectronics Technology(shanghai)co.,Ltd and etc.
Zhou Shuyang	28	Supervisor	Since 2017, Mr. Zhou has been the head of the securities department of Shanghai Weir Semiconductor Co., Ltd. and supervisor of Chengdu Jianyang Information Technology Co., Ltd.. Since June 2020, he has been a supervisor of the company.
Wang Song	45	General Manager	Prior to 2018, Mr. Wang worked at Toshiba Electronics Asia Co., Ltd. (Beijing office), Panasonic China Co., Ltd., ON Semiconductor (Hong Kong) Co., Ltd. (Beijing Office), Nidec Compressor (Beijing) Co., Ltd., Knowles Electronics (Shanghai) Co., Ltd. He currently serves as 1) senior vice president of OmniVision Technology (Shanghai) Co., 2) executive director of Shaoxing Haowei Semiconductor Co., Ltd.; 3) manager of Beijing Weihao Integrated Circuit Design Co., Ltd., 4) general manager and executive director of Howe Touch and Display Technology (Shenzhen) Co., Ltd.; 5) general manager of the company and etc.

Source: Company data, CMBIS

Financial Summary

Income statement

YE 31 Dec (RMB mn)	FY19A	FY20A	FY21E	FY22E	FY23E
Revenue	**13,632**	**19,824**	**29,203**	**36,723**	**45,061**
COGS	-9,898	-13,894	-19,721	-24,547	-30,074
Gross Profit	**3,734**	**5,930**	**9,482**	**12,176**	**14,987**
SG&A	-1,132	-1,147	-1,501	-1,856	-2,163
R&D exp.	-1,282	-1,727	-2,190	-2,754	-3,380
Financing exp.	-274	-275	-296	-245	-328
Other opex	-260	176	-66	-0	-199
Operating profit	**785**	**2,956**	**5,429**	**7,320**	**8,918**
Non-operating income	6	44	35	44	55
Non-operating exp.	-6	-9	-7	-9	-11
Pre-tax profit	**784**	**2,991**	**5,457**	**7,355**	**8,961**
Income tax expenses	-79	-308	-546	-736	-896
Net profit	**705**	**2,683**	**4,912**	**6,620**	**8,065**
Non-controlling interests	240	-23	74	132	161
Net profit to shareholders	**466**	**2,706**	**4,838**	**6,487**	**7,904**
Adj. EBITDA	**1,363**	**3,722**	**6,319**	**8,412**	**10,213**

Cash flow summary

YE 31 Dec (RMB mn)	FY19A	FY20A	FY21E	FY22E	FY23E
Pretax profit	**705**	**2,683**	**4,912**	**6,620**	**8,065**
D&A	578	765	889	1,091	1,295
Change in working capital	-1,037	-221	-2,371	-2,259	-813
Others	560	117	383	285	592
Net cash from operating	**805**	**3,345**	**3,812**	**5,737**	**9,139**
Capex	-743	-1,133	-1,444	-1,864	-2,401
Purchase/sale of	-93	-373	-46	0	0
Purchase/sale of subs	-805	-1,163	-489	0	0
Other	-87	38	383	318	339
Net cash from investing	**-1,728**	**-2,631**	**-1,596**	**-1,546**	**-2,062**
Change in shares	380	683	577	500	679
Change in debt	1,017	1,567	1,676	1,354	961
Dividend/interests paid	-319	-413	-583	-1,074	-1,339
Other	41	-3	239	0	0
Net cash from financing	**1,120**	**1,835**	**1,909**	**781**	**301**
Net change in cash	**198**	**2,548**	**4,125**	**4,971**	**7,377**
Cash, beginning	2,921	3,116	5,423	9,548	14,519
Exchange difference	-2	-241	0	0	0
Cash, end	**3,116**	**5,423**	**9,548**	**14,519**	**21,896**

Balance sheet

YE 31 Dec (RMB mn)	FY19A	FY20A	FY21E	FY22E	FY23E
Current assets	**10,881**	**13,913**	**21,788**	**28,138**	**39,040**
Cash & equivalents	3,161	5,456	9,574	14,546	21,923
Trade & other receivables	2,577	2,583	3,505	4,196	5,186
Inventories	4,366	5,274	7,979	8,525	10,968
Other current assets	777	600	730	871	964
Non-current assets	**6,596**	**8,735**	**10,212**	**10,990**	**12,097**
PPE	1,588	1,871	2,379	3,020	3,870
Intangibles	1,334	1,509	1,449	1,102	757
Goodwill	2,249	2,800	3,050	3,050	3,050
Other non-current assets	1,425	2,556	3,334	3,818	4,421
Total assets	**17,476**	**22,648**	**32,000**	**39,128**	**51,137**
Current liabilities	**7,606**	**6,845**	**8,487**	**8,223**	**11,523**
ST debt & LT debt to	4,101	3,041	2,485	2,769	2,808
Trade & other payables	3,027	2,544	5,344	4,743	7,945
Other current liabilities	478	1,260	658	711	769
Non-current liabilities	**1,915**	**4,278**	**6,534**	**7,604**	**8,526**
LT debt	928	3,182	3,232	4,303	5,224
Bonds payables	0	0	2,181	2,181	2,181
Other non-current liabilities	987	1,096	1,121	1,121	1,121
Total liabilities	**9,521**	**11,123**	**15,021**	**15,827**	**20,049**
Total equity	**7,955**	**11,525**	**16,979**	**23,301**	**31,088**
Share capital	864	868	868	868	868
Reserves	6,650	7,248	7,748	8,248	8,748
Retained earnings	1,002	3,895	7,976	13,016	19,173
Other equities	-589	-772	28	677	1,646
Minority interests	29	286	360	492	654
Total liabilities and equity	**17,476**	**22,648**	**32,000**	**39,128**	**51,137**

Key ratios

YE 31 Dec (RMB mn)	FY19A	FY20A	FY21E	FY22E	FY23E
Revenue by segment					
CMOS	9,779	14,697	20,734	27,175	33,345
TDDI	0	744	1,547	2,274	2,917
Others	3,853	4,383	6,922	7,274	8,799
Total	**13,632**	**19,824**	**29,203**	**36,723**	**45,061**
CMOS %	*71.7%*	*74.1%*	*71.0%*	*74.0%*	*74.0%*
Growth (%)					
Revenue	40.5%	45.4%	47.3%	25.7%	22.7%
Adj. EBITDA	92.4%	173.1%	69.8%	33.1%	21.4%
Net profit	221.1%	481.2%	78.8%	34.1%	21.8%
Profit & loss ratio (%)					
Gross margin	27.4%	29.9%	32.5%	33.2%	33.3%
EBITDA margin	10.0%	18.8%	21.6%	22.9%	22.7%
Net profit margin	3.4%	13.7%	16.6%	17.7%	17.5%
Balance sheet ratio					
Net debt/total equity (%)	23.5%	6.7%	net cash	net cash	net cash
Debt/EBITDA	3.7	1.7	1.3	1.1	1.0
Interest coverage	4.8	12.5	20.4	30.5	26.7
Cash conversion cycle (days)	130.9	123.1	108.5	106.8	99.5
Profitability (%)					
ROE	5.9%	23.5%	28.5%	27.8%	25.4%
ROA	2.7%	11.9%	15.1%	16.6%	15.5%
Per share data (RMB)					
EPS	0.76	3.21	5.58	7.48	9.11
BVPS	12.94	13.33	19.16	26.29	35.08

Source: Company data, CMBIS estimates

CMB International Securities | Equity Research | Company Initiation

GalaxyCore (688728 CH)

Rising star well poised to ride the CIS boom

BUY (Initiation)

Target Price	**RMB 48.19**
Up/Downside	**+34%**
Current Price	**RMB 36.07**

GalaxyCore is a global No. 1 CIS manufacturer in term of shipment in 2020. We forecast GalaxyCore's revenue/NP to grow at 45%/56% 2020E-23E CAGR, driven by strong demand for CIS from downstream markets. Looking ahead, we believe GalaxyCore will strengthen its leadership in low- to mid-end segment and accelerate its expansion into high-end CIS market. **We initiate at BUY with 12-month TP of RMB48.19 (34% upside).** Our TP is based on 50x FY22E P/E, as we take GalaxyCore as a rising star well poised to embrace the CIS boom.

- **Rapid share gain with No.1 global shipment in 2020.** GalaxyCore took the first place in CIS shipment in 2020, with 30% market share globally. In 2019, GalaxyCore shipped 24% of global mobile CIS, among which its 13M CIS shipment reached a significant 31% share. We believe GalaxyCore will maintain its leadership in low- to mid-end market, while it will gain footprint in high-end CIS segment. With the IPO proceeds, the company will shift its fabless model to fab-lite model, lifting the production capacity for high-end CIS products.
- **Domestic leader in LCD display driver chip business.** According to Frost & Sullivan, global display panel shipment area increased from 140mn sqm in 2012 to 230mn sqm in 2019 (7.7% CAGR), and LCD accounted for 96% of shipment mix. Currently, China became the major manufacture location of LCD display panel (~50% of global production). We expect production of LCD supply chain, including display driver chips, will gradually shift to China. As the No.2 supplier in China, GalaxyCore will be the key beneficiary to enjoy market growth and share gain of Chinese suppliers.
- **Initiate at BUY with TP of RMB48.19.** We derive our TP of RMB48.19 by applying 50x FY22E P/E, as we view GalaxyCore as a rising star well poised to ride the market boom. We believe this valuation is justified given 1) its No.1 position in CIS products and future fab-lite business model to expand its capacity into high-end CIS segment. Initiate with BUY rating.
- **Potential risks** include 1) less-than-expected market growth, 2) intensified competition, 3) worse-than-expected semi shortage, 4) new disruptive technology and 5) slower-than-expected development of its CIS 12-inch production/manufacturing lines.

Earnings Summary

(YE 31 Dec)	FY19A	FY20A	FY21E	FY22E	FY23E
Revenue (RMB mn)	3,690	6,456	8,787	14,275	19,491
YoY growth (%)	-	74.9%	36.1%	62.5%	36.5%
Gross profit (RMB mn)	961	1,839	2,792	4,579	5,865
Gross profit margin %	26.0%	28.5%	31.8%	32.1%	30.1%
Net profit (RMB mn)	359	773	1,454	2,408	2,930
Net profit margin %	9.7%	12.0%	16.5%	16.9%	15.0%
EPS (RMB)	0.19	0.37	0.58	0.96	1.17
YoY growth (%)	-	94.7%	57.3%	65.7%	21.6%
Consensus EPS (RMB)	-	-	-	-	-
P/E (x)	189.8	97.5	62.0	37.4	30.8
P/B (x)	256.3	27.7	14.5	10.3	7.7
ROE (%)	135.0%	28.4%	23.4%	27.6%	24.9%
Net gearing (%)	108.0%	11.0%	net cash	net cash	net cash

Source: Company data, Bloomberg, CMBIS estimates

China Technology Sector

Lily Yang
(852) 3916 3716
lilyyang@cmbi.com.hk

Alex Ng
(852) 3900 0881
alexng@cmbi.com.hk

Stock Data

Mkt Cap (RMBmn)	90,135
Avg 3 mths t/o (RMBmn)	na
52w High/Low (RMB)	41.00/32.82
Total Issued Shares (mn)	2,498.9

Source: Bloomberg

Shareholding Structure

Uni Sky Holding Ltd.	42.02%
Cosmos LP	12.43%
Hopefield Holding Ltd.	7.00%

Source: Company data

Share Performance

	Absolute	Relative
1-mth	na	na
3-mth	na	na
6-mth	na	na

Source: Bloomberg

Auditor: PWC

Investment Summary

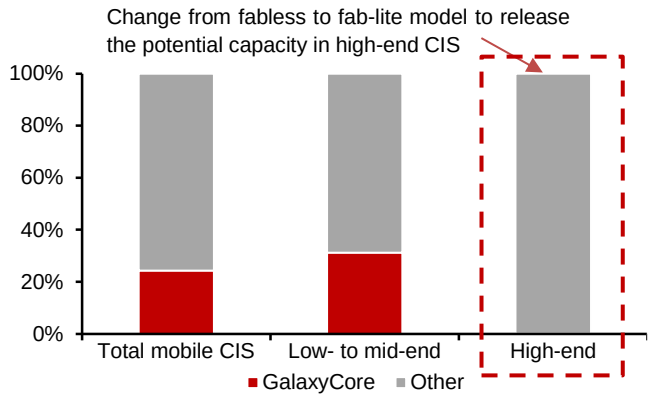
GalaxyCore is China's 2nd largest manufacturer and global top 4 manufacturer in CIS market. The company offers a broad category of semiconductor products including CMOS image sensors (CIS) and display driver chips. Its CIS business accounted for 91% of FY20 total revenue.

The company currently provides CIS products, from QVGA (80K pixels) to 13M pixels, LCD display driver chips, with resolution ranging between QQVGA and FHD. The company's products are widely used in consumer electronics and industrial applications, including tablets, laptops, wearable devices, mobile payments, automotive electronics, etc.

We estimate 45%/56% revenue/earnings CAGR during FY20-23E, benefiting from its No.1 market share in CIS products (shipment) and future fab-lite business model which will help the company to expand its capacity in high-end CIS products.

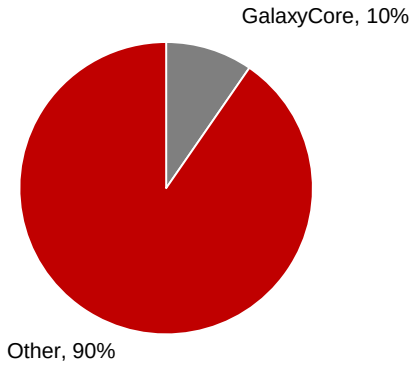
We initiate at BUY with TP of RMB48.19. We derive our TP of RMB48.19 by applying 50x FY22E P/E, as we take GalaxyCore as a rising star well poised to embrace the CIS boom.

Figure 62: GalaxyCore to change to fab-lite model to increase penetration in high-end CIS market



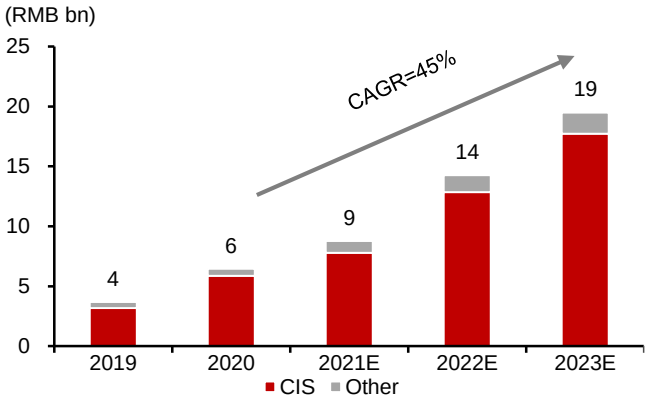
Source: Company data, CMBIS

Figure 63: GalaxyCore: No.2 supplier of LCD display driver chips in China market (2019 shipment)



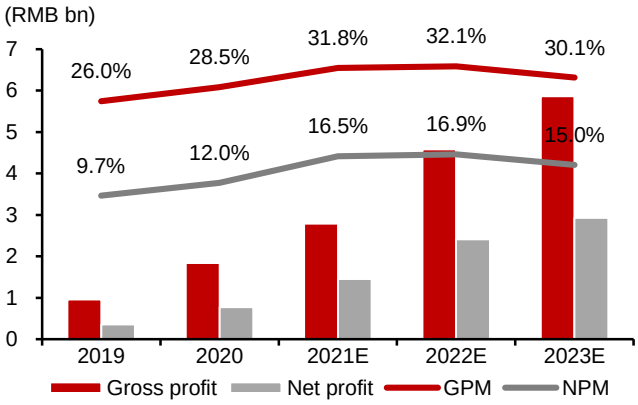
Source: Company data, CMBIS

Figure 64: Revenue to grow at a CAGR of 45% (FY20-23E)



Source: Company data, CMBIS estimates

Figure 65: Net profit to grow at a CAGR of 56% (FY20-23E)



Source: Company data, CMBIS estimates

Financial analysis

Expect 45%/56% CAGR for revenue/net profit in FY20-23E

In 2020, GalaxyCore achieved 75%/115% YoY growth in revenue/net profit. Looking forward, **we estimate the Company to grow at 45%/56% revenue/earnings CAGR during FY20-23E**, benefited from its core business expansion in CIS market and increasing display driver business. As the fab is expected to be ready by 2023E, additional depreciation cost will slightly erode the margin. However, we think **the fab-lite model will secure its high-end CIS capacity and drive up the blended product ASP**. We consider GalaxyCore is a compelling way for investors to capture opportunity in the fast-growing CIS market.

Figure 66: Major assumptions

RMB mn	FY19	FY20	FY21E	FY22E	FY23E
CIS	3,194	5,864	7,798	12,843	17,713
…YoY	-	*84%*	*33%*	*65%*	*38%*
Display driver	486	591	989	1,431	1,778
…YoY	-	*22%*	*67%*	*45%*	*24%*
Other	10	0	0	0	0
…YoY	-	*-96%*	*-100%*	*na*	*na*
Total	**3,690**	**6,456**	**8,787**	**14,275**	**19,491**
…YoY	-	*75%*	*36%*	*62%*	*37%*
Gross Margin	**27.5%**	**28.5%**	**31.8%**	**32.1%**	**30.1%**

Source: Company data, CMBIS estimates

Figure 67: P&L forecast

RMB mn	FY19	FY20	1H21	2H21E	FY21E	FY22E	FY23E
Revenue	**3,690**	**6,456**	3,686	5,101	**8,787**	**14,275**	**19,491**
…YoY	-	*74.9%*	51.0%	27.1%	*36.1%*	*62.5%*	*36.5%*
Gross profit	**961**	**1,839**	**1,198**	**1,594**	**2,792**	**4,579**	**5,865**
GPM (%)	26.0%	28.5%	32.5%	31.2%	31.8%	32.1%	30.1%
SG&A	(165)	(228)	(106)	(181)	(287)	(452)	(598)
…% of rev	*-4.5%*	*-3.5%*	*-2.9%*	*-3.5%*	*-3.3%*	*-3.2%*	*-3.1%*
R&D	(357)	(595)	(252)	(450)	(703)	(1,213)	(1,754)
…% of rev	*-9.7%*	*-9.2%*	*-6.8%*	*-8.8%*	*-8.0%*	*-8.5%*	*-9.0%*
Operating profit	**384**	**885**	754	871	**1,625**	**2,691**	**3,276**
OPM (%)	*10.4%*	*13.7%*	*20.4%*	*17.1%*	*18.5%*	*18.9%*	*16.8%*
Net profit	**359**	**773**	**644**	**810**	**1,454**	**2,408**	**2,930**
NPM (%)	*9.7%*	*12.0%*	*17.5%*	*15.9%*	*16.5%*	*16.9%*	*15.0%*
…YoY	-	*23.0%*	*92.1%*	*84.9%*	*79.5%*	*65.7%*	*21.6%*

Source: Company data, CMBIS estimates

Valuation

Initiate with BUY rating and TP of RMB48.19 (34% upside)

We derive our TP of RMB48.19 by applying 50x FY22E P/E, as we take the GalaxyCore as a rising star to embrace the CIS boom. We believe this valuation is justified given 1) its No.1 market share in CIS products (shipment) and future fab-lite business model, which will help the company to expand its capacity in high-end CIS products.

Potential risks include 1) less-than-expected market growth, 2) intensified competition, 3) worse-than-expected semi shortage, 4) new disruptive technology and 5) slower-than-expected development of its CIS 12-inch production/manufacturing lines.

Figure 68: Peers valuation

		Mkt Cap	Price	P/E (x)		P/B (x)		ROE (%)	
Company	Ticker	US$(mn)	(LC)	FY21E	FY22E	FY21E	FY22E	FY21E	FY22E
Global CIS peers									
Willsemi	**603501 CH**	**36,353**	**271.40**	**48.7**	**36.3**	**14.2**	**10.3**	**28.5**	**27.8**
GalaxyCore	**688728 CH**	**13,900**	**36.07**	**62.0**	**37.4**	**14.5**	**10.3**	**23.4**	**27.6**
Sony	SONY US	123,130	97.64	11.7	16.4	2.6	2.2	23.4	16.6
Samsung	005930 KS	373,427	73,300.00	12.3	10.2	1.7	1.5	14.0	15.2
STMicroelectronics	STM FP	39,001	36.50	22.6	19.9	4.0	3.4	19.4	18.9
ON Semi	ON US	17,867	41.50	16.7	14.9	4.4	3.5	22.1	22.1
Peers Avg.				**29.0**	**22.5**	**6.9**	**5.2**	**21.8**	**21.4**
Peers Median				**19.7**	**18.1**	**4.2**	**3.5**	**22.7**	**20.5**
China fabless peers									
Willsemi	**603501 CH**	**36,353**	**271.40**	**48.7**	**36.3**	**14.2**	**10.3**	**28.5**	**27.8**
GalaxyCore	**688728 CH**	**13,900**	**36.07**	**62.0**	**37.4**	**14.5**	**10.3**	**23.4**	**27.6**
Gigadevice	603986 CH	16,981	165.75	73.3	55.2	8.9	7.8	12.7	15.0
Maxscend	300782 CH	21,224	412.59	66.6	49.9	25.7	17.7	44.9	38.2
Goodix	603160 CH	7,670	108.70	38.5	29.7	5.6	4.8	15.4	17.3
SG Miceo	300661 CH	12,639	349.13	180.8	132.3	44.2	34.9	24.7	26.0
Peers Avg.				**78.3**	**56.8**	**18.8**	**14.3**	**24.9**	**25.3**
Peers Median				**64.3**	**43.7**	**14.3**	**10.3**	**24.0**	**26.8**

Source: Bloomberg and CMBIS, as of 23 Aug 2021.

Investment Risks

Less-than-expected market growth

The majority of the company's CIS products are used in mobile devices, which is subject to the impact of macroeconomic fluctuations. The company's business may be negatively affected by 1) downward cycle of global economy, 2) changes of geopolitical environment, 3) slowing down of mobile market growth, such as delay in smartphone upgrade, and 4) less-than expected increase in number of cameras used per devices.

Intensified competition

In recent years, the competition in CIS market has intensified with the rapid growth of downstream market. Although Galaxy is a top manufacturer of CIS, the company is subject to the fast technology advancement as many of its competitors have continued to improve their products and try to increase their market share. As the competition gets intensified, it may hurt the company as well as its peers' margin and profitability.

Worse-than-expected semi shortage

The company's growth is also affected by the development of semiconductor industry. Due to the large initial investment of wafer manufacturers and semiconductor assembly and test vendors, there will be long production cycle that may lead to capacity constraints. With the capacity expansion, the semiconductor industry may experience overcapacity in the following years. Therefore, it is crucial for the fabless IC design companies to have strong and stable relationship with the semiconductor foundry. With the IPO proceeds, the company focuses on increasing its high-end CIS production capacity. However, its may take more time and capital to complete and operate the 12-inch production lines.

New disruptive technology

The CIS industry is experiencing increasing technology advancement, given the continuous demand for performance upgrade from downstream markets. If the company cannot keep up the pace of market development or upgrade existing products and technologies in a timely manner to maintain their market position, it will have an adverse impact on the company's business.

In addition, the design companies need to maintain a high degree of sensitivity to the trend of mainstream technology advancement based on changes in market demand and technological development.

US-China trade tension

The development of semiconductor industry needs the cooperation from all the global participants. Any further geopolitical relationship changes may hinder the development of CIS development. The design companies have technology cooperation with foreign EDA suppliers and IP licensors. If trade frictions continue to escalate and the scope of the technology ban expands, it may hurt the company's business.

COVID-19 impact

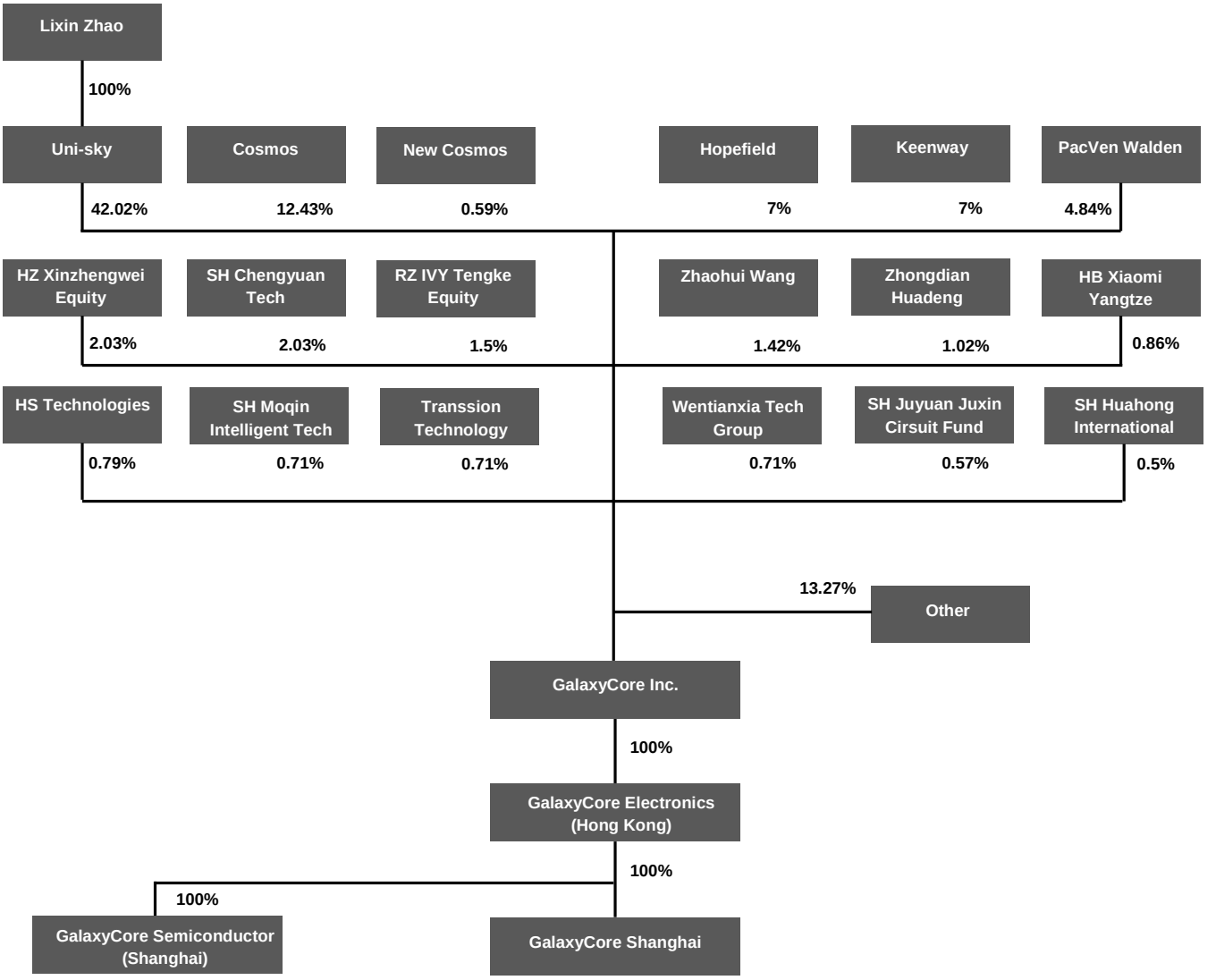
Although the world has suppresses the spread of the pandemic to a great extent, there is risk that the pandemic has a longer impact on our lives. It may negatively affect the supply chain and end market demand, such as decrease in market share of high-ASP products.

Appendix 1 – Business milestone

Year	Milestone
2003	Company establishment.
2011	Due to interest in touch control IC business, the company and Alliance creation (Hong Kong) Ltd., a company fully owned by Taiyi Cheng, established Silead (Cayman) Inc. GalaxyCore and Gleeful Treasure Ltd. each owned 50% ownership of Silead. Later, Gigadevice acquired 100% ownership of Silead with cash. Shanghai Suanxin Microelectronics established (CMOS image sensor R&D).
2016	GalaxyCore Microelectronics established (OSAT and sales).
2020	GalaxyCore semiconductor (Shanghai) established (IC chip design and manufacturing).
2021	IPO on Aug. 18.

Source: Company data

Appendix 2 – Shareholding structure



Source: Company data, Bloomberg and CMBIS.

Appendix 3 – Key management

Name	Age	Position Title	Experience
Lixin Zhao	55	Chairman, CEO	Mr. Zhao graduated from Tsinghua University, with a bachelor's degree in electrical engineering and a master's degree in electrical engineering in 1990 and 1995. From 1995 to 1998, he worked as an engineer at Chartered Semiconductor Manufacturing Ltd. (later acquired by Global Foundries). From 1998 to 2001, he served as senior product engineer at ESS Technology International. From 2001 to 2003, he served as design manager in UTSTARCOM. Since 2003, he has served as the Chairman and CEO of the company.
Wenqiang Li	56	COO, Vice President of technology	Mr. Li graduated from Tsinghua University and later obtained a master's degree from the Chinese Academy of Sciences. From 1990 to 1991, he served as a technician in Beijing Shougang Microelectronics Co., Ltd. From 1991 to 1994, he served as an ASIS design engineer of Zhuhai Ruizhi Electronics Co., Ltd. From 1995 to 2001, he served as the Chartered Semiconductor Manufacturing Ltd. (later acquired by Global Foundries). From 2001 to 2004, he served as the chief engineer at WaferTech Limited. From 2004 to 2006, he served as department manager at Shanghai Huahong NEC Electronics Co., Ltd. Since 2006, he has served as vice president of technology and chief operating officer of the company.
Lee Do Sung	58	Vice President	Mr. Sung studied in the Department of Electronics of Korea Aviation University and obtained a bachelor's degree. He served as senior engineer in the applied technology/ marketing department at Samsung Electronics Semiconductor Division (S.LSI), head of sales at S.LSI in Taiwan, head of SOC marketing department of S.LSI and S.LSI at Samsung China. Since 2017, he has served as the Vice President of the company.
Chaoyong Li	56	Vice President	Mr. Li studied in Physics/Semiconductor Device at Sichuan University in from 1983 to 1987 and obtained a bachelor's degree. From 1995 to 1996, and from 1998 to 2004, he studied in the Department of Electrical and Electronic Engineering at Nanyang Technological University and obtained a master's degree and a doctorate degree. From 1987 to 1995, he studied at the Institute of Semiconductors at the Chinese Academy of Sciences and later worked as an assistant engineer and engineer. He served as an engineer at Chartered Semiconductor Manufacturing PTE LTD. From 1998 to 2004, he served as a senior engineer, an academician, Ph.D. student and postdoctoral supervisor at the Singapore Institute of Microelectronics. From 2004 to 2020, he served as director of operations at GlobalFoundries Singapore (12-inch chip factory). Since 2020, he has serviced as Vice President of the company.
Wei Cao	48	Director, Secretary of the Board, Vice President	Ms. Cao graduated from Santa Clara University, USA, with a master's degree in computer engineering. From 2001 to 2004, she served as software engineer at IP Infusion. She joined the company in 2004 and served as digital verification engineer, senior engineer, HR manager. She currently serves as director, secretary of the board of directors, and the Vice President of the company.
Jie Li		Vice President	Mr. Li studied at Tsinghua University majoring in materials science and engineering and obtained a bachelor's and master's degree. Since 2013, he has served as an engineer, manager, director, and vice president of the operation center and the R&D department. Since 2019, he has served as the Vice President of the company.
Fuzhong Wang		Vice President	Mr. Wang studied at the University of Science and Technology of China, majoring in measurement/control technology/instrument and precision instruments/mechanics. From 2006 to 2011, he worked as engineer, manager and technical director in the R&D department of Tianli Semiconductor (Shenzhen) Co., Ltd. Since 2012, he joined the company and currently served as the Vice President.
Xiuyun Guo		CFO	Mr. Guo studied accounting (auditing) in Jiangxi University of Science and Technology and obtained a bachelor's degree. 2002 to 2005. He worked at Ningbo Chinese Medicine Pharmaceutical Factory and Shanghai Sanjiu Commercial Investment Co., Ltd. From 2005 to 2006, he served as the CFO at various companies. He joined the company in 2010 and he is currently the chief financial officer of the company.
Hing Wong	59	Director	From 1983 to 1989, Mr. Wong received a bachelor's degree in physics, a master's degree and a Ph.D degree in engineering science and engineering from the University of California, Berkeley. From January 1990 to June 1997, he served as technology development engineer at International Business Machines Corporation. From July 1997 to December 1997, he served as engineer at Chromatic Research. From December 1997 to May 2003, he served as head of research and development and senior consultant of Asia business at Silicon Access Networks. From January 2004 to December 2004, he is the senior consultant at Silicon Federation Investment Company. Since 2005, he serves as managing director at Walden Investment Consulting (Beijing) Co., Ltd. Since 2006, he has served as a director of GalaxyCore.
Lei Fu	53	Director	From 1990 to 2001, Mr. Fu obtained a bachelor's degree from Peking University, a master's degree from the Institute of Acoustics of the Chinese Academy of Sciences, a master's degree from the Massachusetts Institute of Technology, and an MBA degree from Stanford University. From 1995 to 1999, he was also the project manager of CIGNA Corporation. From 2001 to 2006, he was a partner at Pond Ventures. Since 2007, he has served as the founding partner of Shanghai Ivy Investment Co., Ltd. Since 2006, he has served as a director of GalaxyCore.
Jian Song	55	Independent director	From 1985 to 1995, Mr. Song received a bachelor's degree, a master's degree, and a doctorate degree from Tsinghua University. Since March 1995, he has served as a teacher, associate professor, and professor in the Department of Electronic Engineering of Tsinghua University. From October 1998 to January 2005, he served as a senior technician of the American Hughes Network System Company. Since 2015, he has served as a director at Sichuan Changhong

			Electronics Holding Group Co., Ltd. Since 2017, he has served as independent director at Jiangsu Zhuosheng Microelectronics Co., Ltd. Since 2019, he has served as independent director at Saites Information Technology Co., Ltd. Since August 2020, he has served as independent director at Zhaoxun Hengda Technology Co., Ltd. and GalaxyCore.
Shaomu Guo	55	Independent director	From 1984 to 1993, Mr. Guo obtained a bachelor's degree from Zhejiang University and a master's degree from the University of Southern California. From 1996 to 1998, he studied at School of Management of Yale University. From 2000 to 2001, he served as the investment banking manager at Salomon Smith Barney's. From 2001 to 2005, he served as the deputy director of the investment banking department of the HSBC Investment Bank (HK). From 2005 to 2007, he served as the executive director at J.P. Morgan Investment Banking Asia. From 2007 to 2013, he served as the managing director of Morgan Stanley Investment Banking Asia. Since 2014, he has served as an independent non-executive director of Yida China Holdings Limited. Since 2015, he has served as an independent non-executive director of Fantasia Holdings Group Co., Ltd. Since July 2020, he has served as an independent director at Dragonair China Real Estate Group Co., Ltd. Since October 2020, he has served as an independent director at Shangkun Real Estate Group Co., Ltd. Since November 2020, he has served as an independent director of Shanghai Xinwei Medical Technology Co., Ltd and GalaxyCore.
Kun Wang	45	Independent director	From 1998 to 2003, Ms. Wang received a bachelor's degree in accounting from Nankai University and a doctoral degree in accounting from the Hong Kong University of Science and Technology. From April 2003 to present, she has served as a lecturer and associate professor in the School of Economics and Management of Tsinghua University. From 2014 to May 2020, he served as independent director at Jiangling Motors Co., Ltd. Since 2017, he has served as independent director at China International Futures Co., Ltd. Since 2019, he has served as independent director at Goertek Co., Ltd. Since 2020, he served as independent director at Huadian Heavy Industry Co., Ltd., and Lingyun Optical Technology Co., Ltd. and GalaxyCore.

Source: Company data, CMBIS

Financial Summary

Income statement

YE 31 Dec (RMB mn)	FY19A	FY20A	FY21E	FY22E	FY23E
Revenue	**3,690**	**6,456**	**8,787**	**14,275**	**19,491**
COGS	-2,729	-4,617	-5,995	-9,696	-13,626
Gross Profit	**961**	**1,839**	**2,792**	**4,579**	**5,865**
SG&A	-165	-228	-287	-452	-598
R&D exp.	-357	-595	-703	-1,213	-1,754
Financing exp.	-19	-103	-144	-195	-226
Other opex	-36	-28	-33	-27	-12
Operating profit	**384**	**885**	**1,625**	**2,691**	**3,276**
Non-operating income	0	0	0	1	1
Non-operating exp.	-0	-13	-10	-16	-21
Pre-tax profit	**384**	**872**	**1,615**	**2,676**	**3,255**
Income tax expenses	-25	-99	-162	-268	-326
Net profit	**359**	**773**	**1,454**	**2,408**	**2,930**
Non-controlling interests	0	0	0	0	0
Net profit to shareholders	**359**	**773**	**1,454**	**2,408**	**2,930**
Adj. EBITDA	**406**	**924**	**1,677**	**2,782**	**3,423**

Cash flow summary

YE 31 Dec (RMB mn)	FY19A	FY20A	FY21E	FY22E	FY23E
Pretax profit	**359**	**773**	**1,454**	**2,408**	**2,930**
D&A	22	39	52	91	147
Change in working capital	-143	-1,295	-845	-1,341	-1,441
Others	115	177	145	170	164
Net cash from operating	**353**	**-306**	**807**	**1,328**	**1,799**
Capex	-104	-405	-884	-1,434	-1,845
Purchase/sale of	-15	-8	-54	0	0
Purchase/sale of subs	0	0	0	0	0
Other	66	29	4	18	18
Net cash from investing	**-53**	**-384**	**-934**	**-1,417**	**-1,828**
Change in shares	0	0	2,036	100	100
Change in debt	512	983	1,250	877	212
Dividend/interests paid	-128	-83	-101	-125	-127
Other	-558	866	0	0	0
Net cash from financing	**-174**	**1,765**	**3,184**	**852**	**185**
Net change in cash	**126**	**1,076**	**3,057**	**763**	**156**
Cash, beginning	202	329	1,374	4,431	5,194
Exchange difference	2	-31	0	0	0
Cash, end	**329**	**1,374**	**4,431**	**5,194**	**5,350**

Balance sheet

YE 31 Dec (RMB mn)	FY19A	FY20A	FY21E	FY22E	FY23E
Current assets	**2,506**	**4,815**	**9,060**	**12,277**	**13,644**
Cash & equivalents	484	1,470	4,536	5,299	5,455
Trade & other receivables	594	1,026	828	1,875	1,816
Inventories	1,180	2,077	3,416	4,653	5,940
Other current assets	249	242	281	451	433
Non-current assets	**455**	**902**	**1,800**	**3,143**	**4,842**
PPE	182	248	489	974	1,619
Intangibles	74	201	266	377	527
Goodwill	0	0	0	0	0
Other non-current assets	199	452	1,045	1,793	2,696
Total assets	**2,961**	**5,716**	**10,860**	**15,421**	**18,486**
Current liabilities	**2,599**	**2,785**	**3,439**	**4,978**	**4,716**
ST debt & LT debt to	687	1,568	2,239	2,603	2,518
Trade & other payables	1,814	1,030	941	2,075	1,859
Other current liabilities	98	188	259	301	340
Non-current liabilities	**96**	**212**	**1,212**	**1,726**	**2,023**
LT debt	84	201	779	1,292	1,590
Bonds payables	0	0	0	0	0
Other non-current liabilities	11	11	433	433	433
Total liabilities	**2,695**	**2,997**	**4,652**	**6,704**	**6,740**
Total equity	**266**	**2,719**	**6,209**	**8,717**	**11,747**
Share capital	0	0	2,499	2,499	2,499
Reserves	59	1,712	1,762	1,862	1,962
Retained earnings	267	1,041	2,349	4,517	7,153
Other equities	-60	-33	-401	-160	133
Minority interests	0	0	0	0	0
Total liabilities and equity	**2,961**	**5,716**	**10,860**	**15,421**	**18,486**

Key ratios

YE 31 Dec (RMB mn)	FY19A	FY20A	FY21E	FY22E	FY23E
Revenue by segment					
CMOS	3,194	5,864	7,798	12,843	17,713
TDDI	486	591	989	1,431	1,778
Others	10	0	0	0	0
Total	**3,690**	**6,456**	**8,787**	**14,275**	**19,491**
CMOS %	*87%*	*91%*	*89%*	*90%*	*91%*
Growth (%)					
Revenue	68.2%	74.9%	36.1%	62.5%	36.5%
Adj. EBITDA	-21.0%	127.6%	81.5%	65.9%	23.0%
Net profit	-28.1%	115.2%	88.0%	65.7%	21.6%
Profit & loss ratio (%)					
Gross margin	26.0%	28.5%	31.8%	32.1%	30.1%
EBITDA margin	11.0%	14.3%	19.1%	19.5%	17.6%
Net profit margin	9.7%	12.0%	16.5%	16.9%	15.0%
Balance sheet ratio					
Net debt/total equity (%)	108.0%	11.0%	net cash	net cash	net cash
Debt/EBITDA	1.9	1.9	1.8	1.4	1.2
Interest coverage	26.3	17.4	16.6	22.2	26.8
Cash conversion cycle (days)	20.1	43.6	123.0	105.0	98.0
Profitability (%)					
ROE	135.0%	28.4%	23.4%	27.6%	24.9%
ROA	12.1%	13.5%	13.4%	15.6%	15.8%
Per share data (RMB)					
EPS	0.19	0.37	0.58	0.96	1.17
BVPS	0.14	1.30	2.48	3.49	4.70

Source: Company data, CMBIS estimates

Disclosures & Disclaimers

Analyst Certification

The research analyst who is primary responsible for the content of this research report, in whole or in part, certifies that with respect to the securities or issuer that the analyst covered in this report: (1) all of the views expressed accurately reflect his or her personal views about the subject securities or issuer; and (2) no part of his or her compensation was, is, or will be, directly or indirectly, related to the specific views expressed by that analyst in this report.

Besides, the analyst confirms that neither the analyst nor his/her associates (as defined in the code of conduct issued by The Hong Kong Securities and Futures Commission) (1) have dealt in or traded in the stock(s) covered in this research report within 30 calendar days prior to the date of issue of this report; (2) will deal in or trade in the stock(s) covered in this research report 3 business days after the date of issue of this report; (3) serve as an officer of any of the Hong Kong listed companies covered in this report; and (4) have any financial interests in the Hong Kong listed companies covered in this report.

CMBIS Ratings

BUY	: Stock with potential return of over 15% over next 12 months
HOLD	: Stock with potential return of +15% to -10% over next 12 months
SELL	: Stock with potential loss of over 10% over next 12 months
NOT RATED	: Stock is not rated by CMBIS
OUTPERFORM	: Industry expected to outperform the relevant broad market benchmark over next 12 months
MARKET-PERFORM	: Industry expected to perform in-line with the relevant broad market benchmark over next 12 months
UNDERPERFORM	: Industry expected to underperform the relevant broad market benchmark over next 12 months

CMB International Securities Limited

Address: 45/F, Champion Tower, 3 Garden Road, Hong Kong, Tel: (852) 3900 0888 Fax: (852) 3900 0800

CMB International Securities Limited ("CMBIS") is a wholly owned subsidiary of CMB International Capital Corporation Limited (a wholly owned subsidiary of China Merchants Bank)

Important Disclosures

There are risks involved in transacting in any securities. The information contained in this report may not be suitable for the purposes of all investors. CMBIS does not provide individually tailored investment advice. This report has been prepared without regard to the individual investment objectives, financial position or special requirements. Past performance has no indication of future performance, and actual events may differ materially from that which is contained in the report. The value of, and returns from, any investments are uncertain and are not guaranteed and may fluctuate as a result of their dependence on the performance of underlying assets or other variable market factors. CMBIS recommends that investors should independently evaluate particular investments and strategies, and encourages investors to consult with a professional financial advisor in order to make their own investment decisions.

This report or any information contained herein, have been prepared by the CMBIS, solely for the purpose of supplying information to the clients of CMBIS or its affiliate(s) to whom it is distributed. This report is not and should not be construed as an offer or solicitation to buy or sell any security or any interest in securities or enter into any transaction. Neither CMBIS nor any of its affiliates, shareholders, agents, consultants, directors, officers or employees shall be liable for any loss, damage or expense whatsoever, whether direct or consequential, incurred in relying on the information contained in this report. Anyone making use of the information contained in this report does so entirely at their own risk.

The information and contents contained in this report are based on the analyses and interpretations of information believed to be publicly available and reliable. CMBIS has exerted every effort in its capacity to ensure, but not to guarantee, their accuracy, completeness, timeliness or correctness. CMBIS provides the information, advices and forecasts on an "AS IS" basis. The information and contents are subject to change without notice. CMBIS may issue other publications having information and/ or conclusions different from this report. These publications reflect different assumption, point-of-view and analytical methods when compiling. CMBIS may make investment decisions or take proprietary positions that are inconsistent with the recommendations or views in this report.

CMBIS may have a position, make markets or act as principal or engage in transactions in securities of companies referred to in this report for itself and/or on behalf of its clients from time to time. Investors should assume that CMBIS does or seeks to have investment banking or other business relationships with the companies in this report. As a result, recipients should be aware that CMBIS may have a conflict of interest that could affect the objectivity of this report and CMBIS will not assume any responsibility in respect thereof. This report is for the use of intended recipients only and this publication, may not be reproduced, reprinted, sold, redistributed or published in whole or in part for any purpose without prior written consent of CMBIS.

Additional information on recommended securities is available upon request.

For recipients of this document in the United Kingdom

This report has been provided only to persons (I)falling within Article 19(5) of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005 (as amended from time to time)("The Order") or (II) are persons falling within Article 49(2) (a) to (d) ("High Net Worth Companies, Unincorporated Associations, etc.,) of the Order, and may not be provided to any other person without the prior written consent of CMBIS.

For recipients of this document in the United States

CMBIS is not a registered broker-dealer in the United States. As a result, CMBIS is not subject to U.S. rules regarding the preparation of research reports and the independence of research analysts. The research analyst who is primary responsible for the content of this research report is not registered or qualified as a research analyst with the Financial Industry Regulatory Authority ("FINRA"). The analyst is not subject to applicable restrictions under FINRA Rules intended to ensure that the analyst is not affected by potential conflicts of interest that could bear upon the reliability of the research report. This report is intended for distribution in the United States solely to "major US institutional investors", as defined in Rule 15a-6under the US, Securities Exchange Act of 1934, as amended, and may not be furnished to any other person in the United States. Each major US institutional investor that receives a copy of this report by its acceptance hereof represents and agrees that it shall not distribute or provide this report to any other person. Any U.S. recipient of this report wishing to effect any transaction to buy or sell securities based on the information provided in this report should do so only through a U.S.-registered broker-dealer.

For recipients of this document in Singapore

This report is distributed in Singapore by CMBI (Singapore) Pte. Limited (CMBISG) (Company Regn. No. 201731928D), an Exempt Financial Adviser as defined in the Financial Advisers Act (Cap. 110) of Singapore and regulated by the Monetary Authority of Singapore. CMBISG may distribute reports produced by its respective foreign entities, affiliates or other foreign research houses pursuant to an arrangement under Regulation 32C of the Financial Advisers Regulations. Where the report is distributed in Singapore to a person who is not an Accredited Investor, Expert Investor or an Institutional Investor, as defined in the Securities and Futures Act (Cap. 289) of Singapore, CMBISG accepts legal responsibility for the contents of the report to such persons only to the extent required by law. Singapore recipients should contact CMBISG at +65 6350 4400 for matters arising from, or in connection with the report.