中国：科技： 半导体

证券研究报告

征服设计领域：在新兴和传统市场上齐头并进；买入圣邦股份（摘要）

中国大陆正在半导体设计领域超越台湾

2017 年三季度是中国大陆半导体设计企业的转折点，他们超越了台湾同业成为了全球高科技硅片供应商台积电的第二大出口目的地。新一代中国大陆企业已成为一些新应用领域的领头羊，而其他企业则在传统市场中赢取份额，并保持了盈利增长。我们在本报告中揭示了中国设计公司有可能展翅飞翔的其他新领域。

新应用领域涌现领军企业…

2017 年，**汇顶科技**和比特大陆（未上市）分别成为了指纹传感器和加密货币专用半导体领域的全球领军企业，这两个应用相对新颖且颇具规模，中国和海外企业几乎是同时涌入市场且并无显著技术差异。我们预计人工智能、3D 传感、5G 射频(RF)、5G 光电以及物联网是中国设计公司已然着墨且具有发展前景的新应用领域。我们介绍了几家中国企业，并**探讨了其对我们研究范围内公司的影响**。

…同时，分散的传统市场可为市场份额的攫取者提供盈利增长的空间

在分散的传统市场中，行业领军企业不具备主导地位，同时其他一线生产商也获利丰厚。我们认为中国设计公司在分散的传统市场较有可能在赢得市场份额的同时实现稳定的利润增长。我们的分析显示，模拟芯片、微控制器(MCU)、射频和光电半导体符合这一模式。而我们主要关注的是潜在市场规模庞大的高端及高速增长领域，例如高端模拟（**圣邦科技**）、32 位 MCU、高端光电设备以及 4G 射频等。

首次覆盖汇顶科技和圣邦股份

我们对**圣邦科技的首次评级为买入**（上行空间 23%），因其有望在模拟半导体行业实现稳健的利润增长。**汇顶科技**已成为指纹传感器领域的全球领军企业，但是我们对该股的**首次评级为中性**（上行空间 9%），因为这项技术存在被人脸识别替代的风险。从全球来看，代工、封装和设计服务企业应能受益于中国设计公司所突破的技术边界以及客户基础多元化，同时海外企业将面临来自中国的竞争。

首次评级

Ticker	Company	Rating	TP (Rmb)	up/down side	MV (US$ mn)
300661.SZ	SG Micro	Buy	116	23%	867
603160.SS	Goodix	Neutral	125	9%	7,910

注：股价截至 2017 年 11 月 9 日

资料来源：万得、高华证券研究

相关研究

圣邦股份 (300661.SZ) 买入: 有望实现长期稳定的盈利增长；首次覆盖评为买入；2017 年 11 月 13 日

汇顶科技 (603160.SS): 指纹传感器领军企业，但面临替代风险；首次覆盖评为中性；2017 年 11 月 13 日

全球：科技：中国：传统半导体行业的新前沿；2016 年 4 月 19 日

TSMC (2330.TW): The next 'big things' might not be big enough; stay Neutral；2017 年 5 月 18 日

Global: Technology: 3D sensing: The makings of the next billion dollar industry；2017 年 6 月 13 日

Global Technology: 5G: How 100x faster wireless can shape the future；2016 年 4 月 18 日

**全文翻译随后提供*

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Unless otherwise indicated, pricing in this report is as of the November 9, 2017 close

Exhibit 1: Greater China semiconductor sector coverage comp table

GS semiconductor	Ticker	Ratings	Market Price	Target Price	Market cap US$ mn	Trading P/E		PEG	Trading P/B		ROE	
						2017E	2018E		2017E	2018E	2017E	2018E
SG Micro (Rmb)	300661.SZ	Buy	94	116	867	60.6	46.5	1.5	7.5	6.5	18.2%	14.9%
Goodix (Rmb)	603160.SS	Neutral	115	125	7,910	48.6	37.1	1.1	14.6	11.1	33.6%	33.9%
Hua Hong (HK$)	1347.HK	Buy	14.88	16.90	1,980	14.6	12.7	0.8	1.3	1.2	8.9%	9.6%
MediaTek (NT$)	2454.TW	Buy	331.00	356.00	17,222	27.5	16.5	0.2	2.0	1.9	7.5%	11.5%
Silergy (NT$)	6415.TW	Buy	678.00	636.00	1,723	28.5	22.5	0.9	5.6	4.7	22.0%	22.8%
TSMC (NT$)	2330.TW	Neutral	241.00	213.00	206,811	18.3	17.0	2.3	4.1	3.7	23.5%	22.9%
TSMC-ADR (US$)	TSM	Neutral	41.64	35.10	215,730	19.1	17.8	2.5	4.3	4.3	23.5%	22.9%
UMC (NT$)	2303.TW	Neutral	15.70	14.10	6,747	20.2	18.0	1.5	0.9	0.9	4.4%	4.9%
UMC-ADR(US$)	UMC	Neutral	2.58	2.30	6,694	20.1	18.0	1.5	0.9	0.9	4.4%	4.9%
SMIC (US$)	SMI	Sell	8.76	4.60	7,400	37.0	25	0.6	1.7	1.6	4.9%	6.5%
SMIC-H shares (HK$)	0981.HK	Sell	14.16	7.20	8,463	38.3	26.3	0.6	1.7	1.6	4.9%	6.5%
Parade (NT$)	4966.TWO	Neutral	557.00	515.00	1,408	21.3	19.8	2.6	4.9	4.4	25.5%	24.4%
Average						**29.5**	**23.1**	**1.3**	**4.1**	**3.6**	**15.1%**	**15.5%**
Median						**24.4**	**18.9**	**1.3**	**3.0**	**2.8**	**13.5%**	**13.2%**
STD						**14.1**	**9.7**	**0.8**	**3.9**	**3.0**	**10.4%**	**9.6%**

Note: Target prices are on a 12-month timeframe.

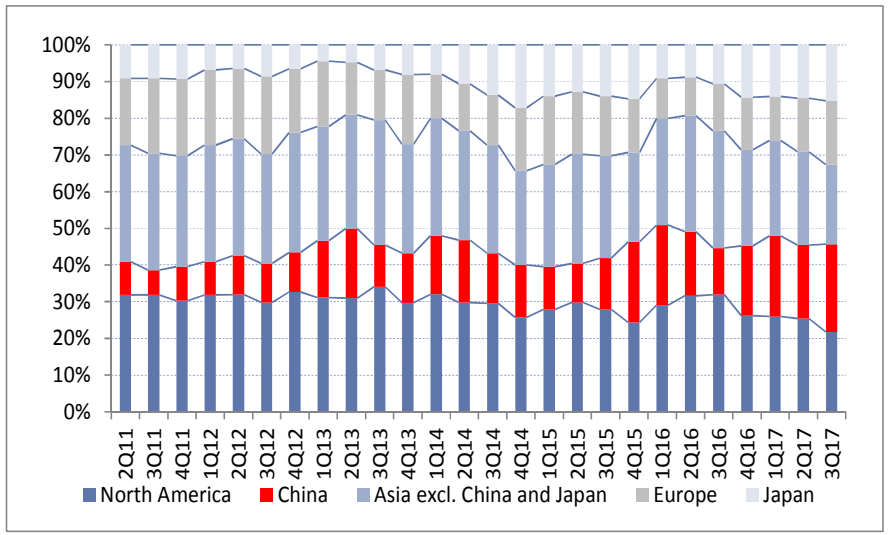
Source: Datastream, Gao Hua Securities Research.

Overview: Chinese design companies to enjoy a second growth spurt

We regard 3Q17 as an inflection point for China's semiconductor design industry as it surpassed Taiwan for the first time as the second largest export destination for **TSMC (Neutral)** after the US (see Exhibit 1, where Taiwan accounts for the bulk of revenues under "Asia excl. China and Japan"). This highlights China's scale and strength in advanced technology, in our view, given that TSMC dominates the leading edge foundry market. While the historical growth of Chinese design companies was mostly driven by market share gains from overseas rivals, the growth spurt in 3Q17 was partially driven by application-specific integrated circuits (ASICs) for cryptocurrency mining, a relatively new application that has been gaining our attention recently.

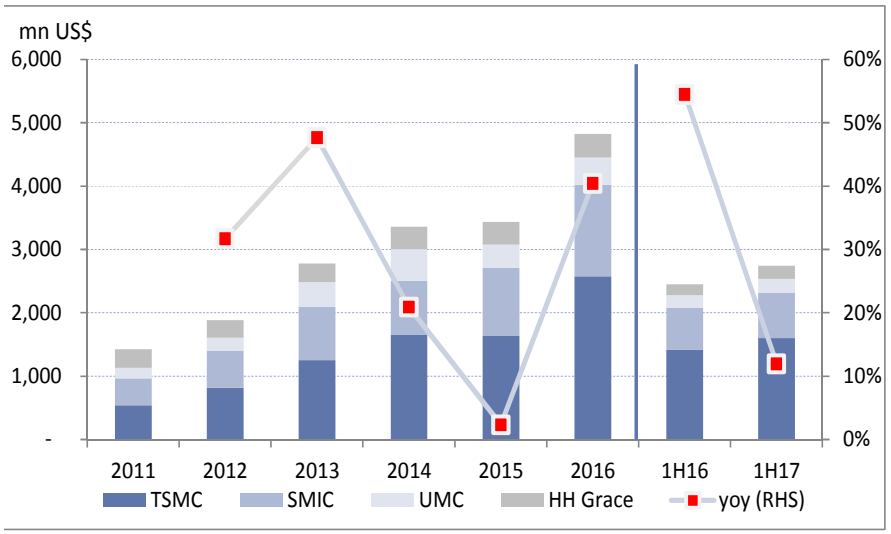
In this report, we identify **other emerging new applications** that could potentially cultivate new Chinese design leaders, and analyze traditional markets offering potential for share gains. Our goal is to draw a differentiated map to identify where industry participants are currently positioned in rapidly growing semiconductor design industry.

Exhibit 2: China has surpassed Taiwan as the 2nd largest destination of TSMC in 3Q17, a stunning growth from 3Q12 when China was 1/3 of Taiwan
TSMC revenue mix by geography (%)



Source: Company data, Gao Hua Securities Research.

Exhibit 3: China total wafer purchases grew at a 28% CAGR, well above the global average of 13%, during 2011-2016
Total China wafer revenue at TSMC, UMC, SMIC, and Hua Hong



Source: Company data, Gao Hua Securities Research.

Recent surge highlights China's potential in new applications

We use wafer purchases as a proxy to estimate the growth of China's design industry, because top foundries report their revenue by geography and the data are timely and accurate. The wafer purchases of Chinese design companies from TSMC grew 32% yoy in 1Q-3Q17, well above the global average of 8%. In 3Q17, TSMC's China revenue increased 18% qoq to surpass that of Taiwan for the first time. While the historical growth was mostly attributable to share gains from overseas peers, the recent surge since 2017 is driven by emerging leaders in new applications, such as Bitmain Technologies (unlisted) in cryptocurrency mining ASICs and **Goodix (initiate at Neutral)** in fingerprint sensors. **We estimate that Bitmain's wafer purchases from TSMC were nearly 3X those for total AI applications in 2H17.** We forecast that Goodix's fingerprint sensor revenue will increase 43% yoy in 2017. **Whereas our earlier focus was on Chinese market share gainers, we now seek to identify the current Chinese market leaders in emerging new applications.**

Our analysis focuses on local customers and technology barriers

We focus on the design sector within the China semiconductor supply chain because Chinese design companies have **more local customers and lower technology barriers to entry** than equipment, memory, foundry, and packaging sectors. Compared with overseas peers, we believe Chinese design companies have competitive advantages in local customers, long-term vision, valuation premiums, abundant supply of engineers, and an emerging cluster of local foundry, packaging and design service companies. The key competitive disadvantages include **technology barriers** and **rising engineer costs**.

New applications to cultivate more global leaders in China

Reviewing Goodix and Bitmain's progress to date, we summarize the success factors of Chinese leaders in new applications as:

1) A large and rapidly growing TAM (total addressable market) to support R&D,
2) Time-to-market to avoid technology and IP barriers,
3) Full leveraging of China advantages,
4) Continued innovation, and
5) Good execution

Looking forward, we view **AI, 3D sensing, 5G,** and **NarrowBand IoT (NB-IoT)** as emerging new applications that could potentially cultivate successful Chinese design companies.

Identifying fragmented semiconductor product segments offering potential for market share gains

We believe highly concentrated product segments such as central processing units (CPU), graphics processing units (GPU), field-programmable gate arrays (FPGA), and smartphone system-on-chips (SOC) are difficult for a Chinese share gainer to penetrate while generating profit, due to very high and increasing technology barriers especially in software. **Mediatek (Buy)**, as a successful late entrant, is an exception in the smartphone SOC market. We attribute Mediatek's success to its innovation of the total-solution business model that combined chip and software reference design for Chinese emerging handset makers. On the other hand, fragmented segments such as analog, microcontroller units (MCU), radio frequency (RF), and optoelectronics have relatively low and steady technology barriers, potentially enabling Chinese share gainers to achieve solid profitability together with incumbents.

Initiate coverage of two Chinese design companies: Buy SG Micro, Neutral on Goodix

SG Micro (300661.SZ) is a Chinese analog device manufacturer focusing on signal chains and power management integrated circuits (PMIC). The company possesses differentiated technology in low-power, high-current, and high precision design. Referencing the past growth profile of Silergy, the Chinese analog leader by revenue, we believe that SG Micro has potential to enjoy healthy and steady growth in 2017-2020E. Our 12m target price of Rmb116 is based on its A share fabless peers' average 2018E P/E of 40X applied to 2021E EPS and discounted back to 2018E using a peer-average cost of equity of 11.3%. **We initiate SG Micro at Buy** due to its long-term potential for steady growth in the fragmented analog device market and potential premium for an analog name of high quality. We believe the market is not yet fully aware of SG Micro's earnings growth potential, and our TP implies 23% upside, highest in its coverage group. **Key risks** include intensified competition with Chinese peers and delay in new product launches. For details, see our November 13, 2017 report *SG Micro Corp. (300661.SZ): Poised for long term & steady profitable growth; initiate at Buy*.

We believe **Goodix (603160.SS)** has strong technical and execution capability that has enabled it to become the global leader in fingerprint sensors and continue to innovate. We estimate that its revenue will grow 37% yoy in 2018 due to increasing penetration and share gains, but that growth will decelerate to 14% in 2019 due to substitution risk from face recognition adoption and competition in under-display ultrasonic sensors. Long term, we are confident that Goodix will find another new growth driver in light of its track record and strong financial and technical resources. Our 12-month target price of Rmb125 is based on its A-share fabless peers' average 2018E P/E of 40X applied to 2021E EPS and discounted back to 2018E using a peer-average cost of equity of 11.3%. **We initiate Goodix at Neutral** as we expect it to continue gaining market share in the next few years but also face substitution risk from facial recognition and competition from ultrasonic under-display sensors. We believe the stock largely prices in prospects for decelerating growth in 2019E-21E, with our TP implying 9% upside. **Key risks** include: (+) adoption of fingerprint sensors in premium phones together with 3D face recognition; (-) faster-than-expected substitution of fingerprint sensors by facial recognition; intensified competition from local brands and ultrasonic sensors. For details, see our November 13, 2017 report *Goodix (603160.SS): Fingerprint sensor leader, but faces substitution risk; initiate Neutral*.

Implications to coverage stocks: positive to suppliers; potentially negative to competitors

For foundry and packaging service providers in our coverage, such as **TSMC (Neutral)**, **UMC (Neutral)**, **SMIC (Sell)**, **Hua Hong (Buy)**, **ASE (Advanced Semiconductor Engineering)**, and **SPIL (Siliconware Precision Industries)**, Chinese design companies are good customers who push technology boundaries and diversify their customer bases. For example, Bitmain has helped to lower the transaction time and cost of Bitcoin and to stimulate the development of Bitcoin. Bitmain's ASIC has replaced previously used GPU and FPGA and helped TSMC to diversify its customer base. Bitmain and other Chinese companies are key driving forces behind the cryptocurrency industry and will contribute approximately 4% of total revenues at TSMC in 2017, by our estimate.

Chinese design companies have had a meaningful impact on overseas competitors in new markets. For example, Goodix is taking market share from overseas competitors such as Sweden's Fingerprint Cards (Not Covered). We list selected overseas competitors to major Chinese design companies in Exhibit 8, including a number in our global coverage such as **Nvidia**, **Mediatek**, **Qorvo**, **Skyworks**, and **Texas Instruments**, but we note that the Chinese competition is still relatively small especially in concentrated traditional markets. In fragmented markets, China competition will likely take time to materialize from a low base.

China semiconductor design industry appears well poised for growth

In our last China semiconductor thematic report, *Global: Technology: China: A new frontier in the old semiconductor world*, April 19, 2016), we highlighted that semiconductor design companies are more attractive than equipment, foundry, packaging, or memory companies in view of their local customer base and technology barriers in China. At Goldman Sachs' China Investment Conference on September 5, 2017, we invited David Zhang and Yimin Zhu, respective Chairmen of Goodix and GigaDevice (Not Covered), two of China's largest design companies by market cap, to further elaborate on specific competitive advantages versus overseas peers. **Key excerpts from the conference were as follows.**

- China has a **strong and rapidly growing hardware supply chain**, which provides Chinese design companies with ample local customers (Exhibit 4). Local customers are critical for time-to-market, a key success factor in technology. For example, a well-positioned design company knows the needs of the local customer and can prepare and develop a timely and customized product for new design-in. It is also easier for a Chinese design company to send a field engineer to local customers to resolve technical issues on time. China already has a strong 10%-80% market share in many electronics applications, but only up to 13% in semiconductor segments (Exhibit 4). This divergence highlights that Chinese design companies have ample growth potential. A similar story is Taiwan, where the growth of consumer electronics companies and PC original design manufacturers (ODMs) drove the growth of many fabless design companies.
- Most Chinese founders are in their 40s and 50s and plan to run their companies for 25-30 more years. Compared with overseas professional managers, they are more willing to invest for long-term (5- to 10-year) growth at the expense of near-term profitability.
- Chinese A-share semiconductor companies tend to trade at a premium over their global peers and can thus raise low-cost capital for M&A and retain talent. In comparison, overseas semiconductor companies are consolidating.
- Many Chinese design companies have very young teams of engineers in their 20s. Semiconductors are still viewed as a growth space with ample job opportunities for graduates of Chinese universities but a mature opportunity set for graduate from overseas colleges. In 2014, China had 5X the number of engineering graduates than the US. In addition, the average salary of a junior Chinese IT engineer is only 1/5th that of the US, according to the National Bureau of Statistics of China, Bureau of Labor Statistics.
- Many founders of Chinese design companies are returnees of overseas Chinese. They used to be senior technical staff at overseas global companies and are bringing best practices back to China.
- The Chinese government and private companies have been supporting and investing significantly in the entire semiconductor supply chain such that China has now begun to provide decent design, foundry, and packaging services.

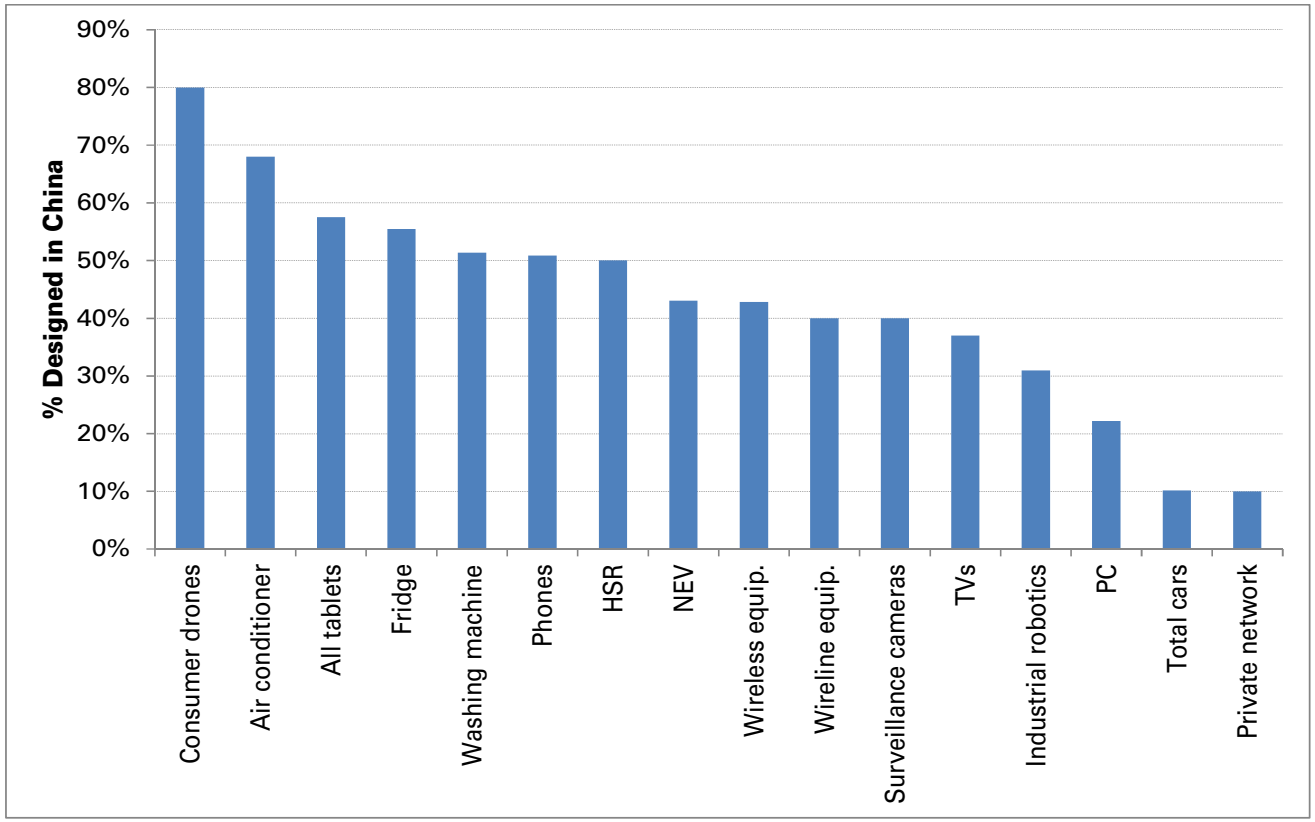
On the other hand, we view technology barriers especially in software, rising labor costs, and certain aspects of government support as competitive disadvantages for Chinese companies, as highlighted below.

- Chinese design companies may have poor profitability in segments requiring process migration, owing to increasingly expensive Moore's Law and sophisticated software foundations, in our view. For example, smartphone SOCs have very high technology barriers in terms of highly technical and sophisticated architecture design, and are challenging even for Mediatek, a global top three fabless design company.
- We believe the cost of experienced engineers in China may now be higher than that in Taiwan, based on our discussions with industry representatives and an increase in professionals from Taiwan who have been recruited into China.

- Chinese companies receive some R&D grants and tax breaks from the Chinese government. Messers Zhang and Zhu indicated their view that some overseas semiconductor companies also receive a lot of government subsidies. In many cases, we believe a flood of government subsidies could potentially cause oversupply and hurt long-term profitability.

Finally, we note that Chinese design companies could thrive on two fronts. Goodix was a new entrant and has emerged as the global leader in a new application – fingerprint sensing, while GigaDevice has taken shares in NOR Flash and in 32bit MCU markets from overseas incumbents. In the next two chapters, we profile **current leaders in new applications** and **fragmented markets** offering the most potential for share gains**, and examine the potential read-across for companies in our coverage.**

Exhibit 4: Local customers are a key competitive advantage for Chinese semiconductor design companies
Market share of Chinese companies in selected electronics applications (as of 2016)



Source: Gartner, Gao Hua Securities Research.

New applications cultivating new global leaders in China

In 2017, two Chinese semiconductor companies, Goodix and Bitmain, have emerged as global leaders in two new applications – fingerprint sensors and cryptocurrency mining ASICs. In this chapter, we review their success and summarize the factors behind it. We believe that new applications offer a great opportunity for Chinese design companies. We identify emerging new applications, and the Chinese companies involved in them to highlight how they can add value in these new areas, as well as examine the implications for our coverage.

Goodix and Bitmain have become global leaders in relatively new applications in 2017

Goodix emerged as the global leader in fingerprint sensors in mid-2017

Fingerprint sensors are a new application that has cultivated a Chinese global leader, **Goodix**. Founded in 2002, Goodix started out making chips for wireline telephone sets. In 2010, it entered the smartphone market with its touch controller chip, and in 2014 it began supplying its first finger sensor to Meizu, a Chinese smartphone maker. Goodix has invested more R&D since 2015 than its main competitor, Sweden-based FPC (Fingerprint Cards). We believe China has lower R&D cost per employee than Sweden due to a lower average income level and more supply of engineers in China; accordingly, Goodix has been able to apply more R&D resources and has led the innovation of live fingerprint sensing, under glass sensing, and potentially under display sensing for high-end full screen OLED smartphones. In 3Q17, Goodix surpassed FPC to become the global leader in merchant fingerprint sensor revenue (around US$130mn vs. US$100mn for FPC). Goodix listed on the A-share market in October 2016 and now has a US$7.9 bn market capitalization as of November 9, 2017.

Bitmain’s cryptocurrency mining ASIC is bigger than Nvidia’s AI GPU in 2017

While AI has captured wide-ranging media attention for some time now, based on wafer purchases we estimate that Bitmain’s cryptocurrency mining ASICs will consume 3X more wafers than AI accelerators in 2017. **TSMC** indicated in its 3Q17 conference call that the cryptocurrency mining ASIC market generated $350-$400mn of revenues in 3Q17. In comparison, we estimate that total AI accelerator wafer revenue will come to only $400mn in 2017.

Founded in 2013, Bitmain is the largest cryptocurrency mining ASIC and service company in the world based on the Bitcoin network’s total hashing power (processing power), of which Antpool, Bitmain’s mining pool, controls 16.5% currently, according to Blockchain.com. Bitmain shipped its first ASIC at 55nm in 2013, a 28nm ASIC in 2014, and a 16nm ASIC in 2016. The company believes that demand for cryptocurrency ASICs is more or less proportional to the price of major cryptocurrencies. In addition to Bitmain, Canaan Creative is another cryptocurrency ASIC company in China, but much smaller than Bitmain from a wafer purchase perspective.

Read-across for our coverage: We view the rise of Bitmain as incrementally positive to its foundry and packaging providers, including **TSMC**, because Bitmain is driving the growth of the cryptocurrency industry and should diversify TSMC’s customer base. We estimate Bitmain will contribute approximately 3% of total revenues at TSMC in 2017. We believe that the demand for cryptocurrency mining ASICs is proportional to the weighted average price of major cryptocurrencies. For example, the Bitcoin price has increased nearly 5X in 2017. If the Bitcoin price continues to increase, we believe that cryptocurrency ASICs could represent 4-5% of total revenues at **TSMC** in 2018. In addition to TSMC, ASIC is replacing other means of cryptocurrency mining such as GPU and FPGA, such that Bitmain’s growth could be incrementally negative to **Nvidia** and **Xilinx** (both covered by Toshiya Hari), the leading GPU and FPGA makers in the world. That said, according to Toshiya Hari, while the emergence of Bitmain and its ASIC solutions poses long-term risk to **Nvidia** and **AMD**, which have both benefited from the sharp rise in Ethereum YTD, he believes the market is ascribing minimal value to revenue tied to mining and therefore this is unlikely to meaningfully impact the stocks.

Three success factors of Chinese semiconductor leaders in new applications

We view both Goodix and Bitmain as successful semiconductor design companies that are now dominating a new application. We summarize their three main factors of success below.

- Both Bitcoin mining and fingerprint sensing are adequately large and growing markets. For example, we estimate the total Android fingerprint sensing market to reach over $1.3bn in 2017E. We estimate that the TAM of cryptocurrency ASICs is approximately $2.0bn-$2.5bn in 2017 and should fluctuate with the trend of major cryptocurrencies (Bitcoin, Litecoin, Ethereum, etc.) going forward, well above Nvidia's AI accelerator market of US$1bn in 2017E (according to Toshiya Hari, our Nvidia coverage analyst).
- Both Goodix and Bitmain were early entrants into their respective markets, at a time when these markets still have a high uncertainty of growth. As early entrants, Goodix and Bitmain have had at least equal time for technology preparation as overseas peers.
- Both companies have leveraged their local advantages. Goodix is situated very close to its local Chinese smartphone makers, especially Huawei, OPPO, VIVO, and Meizu in the greater Shenzhen area. Bitmain has leveraged its China advantage to participate in the entire mining chain – ASICs, modules, and mining services.
- The two companies have invested in and are able to build strong barriers-to-entry in technology innovation, software and ecosystems, just like Intel and Nvidia have done before them. Otherwise, too much competition could undermine the market.
- Like Goodix and Bitmain, we believe Chinese leaders need to execute well to create or maintain time-to-market advantage. While their founders are not necessarily trained overseas, Goodix and Bitmain have adopted the best practices of Silicon Valley, and have issued stock compensation to employees. The founders have control of the companies with a high share of ownership (47.4% for Goodix as of 3Q17), and prefer a flat organization.

What other emerging new applications could cultivate leading Chinese design companies?

Looking forward, we view AI, 3D sensing, 5G, and NB-IoT as emerging new applications that could potentially cultivate new global leaders in China. Below we look at each in turn, identifying current key players (based on 2016 revenues, see Exhibit 8) and highlighting the potential implications for companies in our coverage.

AI inference: Awaiting the next killer application

AI is a hot topic – AI semiconductors have attracted both investor attention and VC funding (see *TSMC: The next 'big things' might not be big enough; stay Neutral*, May 18, 2017). In simple terms, AI as we know it today requires two types of chips: a sophisticated accelerator for building the deep learning model, and a powerful, cost-efficient chip for inference. In accelerators, Nvidia dominates the market and has built the CUDA platform representing a strong software barrier-to-entry around its GPU (graphics processing unit). Google and Facebook are also developing their own special AI chips. We believe that Chinese companies have very little chance to succeed in the AI accelerator market due to the high technology barriers especially in software, but that **they may prevail in the inference market**, which is likely more fragmented and does not yet have high technology barriers. That said, we observe that current "typical" AI hardware applications such as surveillance, smart speakers, wearables, and even autonomous driving are much smaller than smartphones and even cryptocurrency mining. We believe the next killer application is needed to underpin more tangible growth in the AI inference semiconductor market.

Key players

HiSilicon Technologies (unlisted) on September 2 this year launched Kirin970, a smartphone SOC with an independent embedded NPU (Neural Processing Unit) licensed from Cambricon for AI applications. According to HiSilicon, compared with the AI functionality of a

quadcore Cortex-A73 ARM core, the NPU can reduce energy consumption by 50X or improve performance by 25X. We believe this launch highlights the current design capability of top Chinese companies such as HiSilicon, the Chinese leader in the smartphone SOC market (based on 2016 revenue and technology).

Horizon Robotics (Hobot) (unlisted), founded in 2015 by Baidu/Facebook alumni and based in Beijing, is a top-tier startup that combines algorithms, software, hardware and chip development capabilities. Hobot mainly develops AI inference ASICs for image and voice recognition, and the main applications are surveillance and autonomous driving. Its ASICs consist of an ARM core and a BPU (Brain Processing Unit) whose architecture is a perfect fit to the AI algorithm of the various applications. On October 20, 2017, Hobot announced an A+ round of funding of nearly $100mn led by Intel. Hobot plans to launch its first ASIC at 40nm in late 2017. **TSMC** and VeriSilicon are foundry and design service suppliers.

DeePhi, founded in 2016 and based in Beijing, is a private company that develops general-purpose chips for deep learning to compete with GPUs. The company compresses and prunes AI algorithms for computing intensive applications such as surveillance and drones. Afterward, DeePhi compiles the modified algorithms and implements them into a semiconductor with efficient architecture. DeePhi currently uses Xilinx's FPGA as the semiconductor, but is developing its own 28nm ASSP (Application Specific Standard Product). **TSMC** and Global Unichip Corp (GUC) are foundry and design service providers. **Mediatek** is an investor in DeePhi and we believe it could potentially become a partner at some stage as it is developing an AI deep learning accelerator.

Read-across for our coverage

We view the rise of Chinese AI-related products and companies as incrementally positive to their foundry and packaging service providers in our coverage such as **TSMC**, **UMC**, and **SMIC** because Chinese AI companies are innovating new applications and should diversify the customer base for their suppliers. The contribution of these Chinese companies is still very small (below 1%) at TSMC and other foundries today, but we expect meaningful growth into 2018-2019 as AI applications take off. In addition, Hobot and DeePhi collaborate with and help **Intel** and **Xilinx** in AI applications in China market. For example, DeePhi is developing its proprietary deep learning algorithm on Xilinx's FPGA and should expand the TAM of FPGA in AI.

5G: New opportunities for optoelectronics and RF semiconductors

The rollout of 5G networks/smartphones should commence in 2019/2020, respectively (see *Global Technology: 5G: How 100x faster wireless can shape the future*, April 18, 2016). We believe that, compared with 4G, 5G will have a greater impact on optoelectronics and RF (Radio Frequency) semiconductors. 5G uses a higher frequency spectrum than 4G and requires more base stations, because each station covers smaller areas at higher frequency. To curb cost, the industry has collectively opted to use small cell base stations, which are cheaper and do not process nearly as much data as macro base stations. The data processing would be handled by a server some distance away. The small cell base station and server would require a high bandwidth optical connection, increasing bandwidth demand for 5G, which is 100X faster than 4G. For RF, a high-frequency spectrum requires far more filters, switches, and power amplifiers (PAs) in each and every smartphone, potentially raising both the RF TAM and technology barriers significantly.

Key players

Accelink Technologies (CL-Buy), founded in 2001 in Wuhan with the Solid-state Device Institute of the Post & Telecom Ministry as its predecessor, which has over 40 years of R&D experience in opto-electronic components. Accelink is the largest optical component company in China (20% market share as of 2016), and fifth largest in the world (6% market share as of 2016). Accelink has a comprehensive product portfolio ranging from active to passive components and sub-systems, and is vertically integrated from semiconductor material growth, optics design and packaging, to software and subsystem development. Pulse-amplitude modulation (PAM) is a form of signal modulation where the message information is encoded in the amplitude of a series of signal pulses. Accelink has already performed its own 25G chip tapeout, and

is currently running internal testing. It targets to start customer sampling in 1Q18 and start commercial production in the second half of 2018, which should be in time for the scale 5G rollout in 2019. We estimate Accelink's 25G module has a c.20% gross margin, with externally purchased chips. Once it achieves internal mass production of 25G chips, we believe Accelink's gross margin could theoretically improve by 10% on the same product. Accelink's largest customers are Huawei, ZTE, and Fiberhome. Currently 25G modules (using outsourced 25G chips) account for 17% of Accelink's earnings. We expect 25G modules (using Accelink's internally-developed 25G chips) will account for close to 50% of earnings by 2019E; as such, **they are one of the key drivers of our Buy thesis (on CL) for Accelink.**

Aluksen Technology, founded in 2016 and based in Shenzhen, is a private company focusing on R&D and production of high-speed semiconductors for optical communications in telecom and enterprise markets. Its core technology is high-speed circuits and integrated photonics. The company has 15 products under development covering a wide range of applications from long-haul transmission and metro/access networks (including 5G back-haul and front-haul) to data center connectivity, emphasizing high performance and low power dissipation. The company has sampled 100G/200G/400G modulator drivers, clock and data recovery (CDR), and TIA (Trans-impedance Amplifier) products since March 2017. Aluksen's key customers include **Fiberhome**, **Accelink**, Huawei, GlobalFoundries, and High Sense. GlobalFoundries provides foundry services.

Vanchip (Tianjin) Technology, a private company founded in 2010 and based in Tianjing, designs RF systems for wireless communication. Its products include power amplifiers (PA), switches, antenna tuners, and front end modules covering 2G, 3G, 4G, and 4G+ platforms. Vanchip is shipping 4G PAs in volume to Chinese smartphone makers. Its customers include **Lenovo,** Gionee, and TCL Corporation. According to EE World, Vanchip is the largest RF semiconductor company in China in terms of sales (as of end-2015). Vanchip is a member of China Mobile's 5G Joint Innovation Center and plans to release its first 5G RF Front End module supporting HPUE (High Power User Equipment) at 3.3GHz-3.6GHz in 2019. In addition to 5G, Vanchip is also developing an RF Front End module for NB-IoT to cover both the low and middle band with optimized efficiency for mass production in 2018. Vanchip's foundry suppliers are Winsemi, **TSMC**, GlobalFoundries, and Jazz; its packaging suppliers are JCET (Jiangsu Changjiang Electronics Technology) and ASEN (Suzhou ASEN Semiconductors).

Read-across for our coverage

Accelink, Aluksen, and Vanchip should help diversify the supplier base and reduce overseas supplier risks at Chinese equipment vendors in our coverage such as **ZTE** and **Fiberhome**. Foundry and packaging suppliers including TSMC should benefit from the growth of these Chinese companies. The rise of Chinese communication semiconductor companies is also a competitive threat to their overseas competitors such as **M/A-COM Technology Solutions** (covered by Mark Delaney), **Acacia** (covered by Doug Clark), **Qorvo** and **Skyworks** (both covered by Toshiya Hari), but we believe that the impact could take years to materialize in these fragmented markets. Mark Delaney believes MACOM currently has well above average margin potential with 25 Gbps lasers, given that the die size is similar to its 2.5G lasers, but the ASP has been more than 10X higher (assuming MACOM's 25G yields improve next year). However, MACOM's 2.5G laser competitor Accelink is planning to sample its own 25G laser in late CY17 and ramp in CY18 (albeit an externally modulated laser vs. MACOM's directly modulated laser approach), and Accelink products could mitigate some of the revenue/margin opportunity for MACOM in the intermediate to longer-term.

3D sensing: Takeoff at the same pace of dual cameras and fingerprint sensing?

While 3D sensing technology is not brand new, the excitement and scope of its applications could grow exponentially if smartphones adopt 3D sensing, given the sheer size of this application market (over 1.5bn units in 2017) (see *Global: Technology: 3D sensing: the makings of the next billion dollar industry*, June 13, 2017). The iPhone X is the first smartphone to adopt 3D sensing and may stimulate the penetration of 3D sensing in Android smartphones and the development of related applications. We estimate smartphone 3D camera shipments will increase from 60mn in 2017 to 850mn in 2021. 3D sensing requires an ASIC to interpret and integrate 3D sensing signals with the regular 2D

color picture. Assuming $3 ASP, the typical price for a large volume and simple signal processing ASIC, we calculate the 3D sensing ASIC TAM could reach $2.55bn in 2021.

Key players

Shenzhen Orbbec, founded in 2013 and based in Shenzhen, is a private company focusing on R&D and production of 3D sensors, ASICs, and modules. The company taped out its first ASIC in 2015, becoming the fourth to produce 3D sensors after Apple, Microsoft, and Intel. Its products are used in gaming, gesture control, and cloth fitting. On July 2017, the company launched its 2nd generation 28nm ASIC and completed its development of a 3D sensing module for smartphones. In our discussion with the company in September post our China conference trip, Shenzhen Orbbec said that it is the first company to sample 3D sensing modules in the Android smartphone camp. TSMC is the foundry supplier. Its investors include Mediatek and CITIC Securities.

Read-across for our coverage: This newly created ASIC TAM should benefit foundry and packaging suppliers such as **TSMC**. A reliable source of local supply may also help Chinese smartphone makers such as **ZTE** to narrow their gap with Apple in 3D sensing smartphones. **Mediatek**, as an investor and potential collaborator, should benefit from any success achieved by Orbbec.

NB-IoT is taking off in China

IoT (Internet of Things) is a rapidly growing market (see *TSMC (2330.TW): The next 'big things' might not be big enough; stay Neutral*, May 18, 2017). We estimate China IoT adds to reach 160mn and 320mn in 2017 and 2018, respectively. As a new IoT standard, NB-IoT (narrow band IoT) is a wide area connection with only 180KHz bandwidth and can be implemented in GSM, UMTS, or LTE networks. Compared to its predecessors, NB-IoT has a low network upgrade cost, low terminal hardware cost, improved data security, and long battery life. Huawei has led the development of NB-IoT, which is adopted in China and Europe. In China, key players are HiSilicon, which launched the first NB-IoT chip in 1H17, followed by RDA Microelectronics. Since NB-IoT is open source and has relatively low barriers to entry, we expect fierce price competition in NB-IoT chips starting in 2H18.

Read-across for our coverage

The volume of IoT applications is very high in the billions, but the die size is very small. Therefore, we predict that IoT will contribute more revenue to packaging companies such as **ASE** and **SPIL** (covered by Wei Chen) on a unit-driven basis than to foundries such as TSMC, UMC and SMIC, because foundry revenue is proportional to die size. We believe the competition and technology leadership of HiSilicon could be incrementally negative to **Mediatek**, which generates 2-3% of its total revenues from IoT and counts NB-IoT as a growth driver.

Exhibit 5: Bitcoin mining and fingerprint sensing have cultivated two global semiconductor design leaders in China. We believe 3D sensing, AI, 5G, and NB-IoT are other promising new applications for Chinese design companies
Selected new applications and participating Chinese design companies

New Applications	Cryptocurrency	Finger print	3D sensing	AI	5G	NB-IoT
Chinese participants	Bitmain	**Goodix**	Orbbec	Horizon Robotics	Vanchip	HiSilicon
	Canaan Creative			DeePhi	Aluksen	RDA
				Cambricon	**Accelink**	

Note: Companies in bold are part of our coverage universe.

Source: Gao Hua Securities Research.

Fragmented markets offer better potential for share gains than concentrated ones

When identifying the potential for share gains, we seek out fragmented markets where high technology barriers to entry can be avoided. In semiconductors, the main technology barriers include the evolving Moore's Law, architectural software, and new standards. As Moore's Law steps into 7nm, in addition to the technology challenges the design cost (chip design, IP, and masks) can be substantial (as much as $300mn for a smartphone SOC, for instance), which would be a significant burden even for a large company before volume manufacturing. A failed leading-edge product could therefore greatly impact earnings. For example, **Mediatek** is one of the earliest adopters of TSMC's 10nm process with its Helio X30 product, but the adoption of X30 has been extremely poor so far. The high cost of X30 is partially responsible for Mediatek's poor smartphone margin in 1H17, in our view.

In MLCCs (Multi-layer Ceramic Capacitors), the technology roadmap has continued similar to Moore's Law at lower capital intensity, serving as a barrier to entry. Intel's X86, Nvidia's CUDA, and Qualcomm's royalty model are good examples of architectural software and industry standards that are accumulative and evolving as an effective barrier to entry. For example, since most customers have adopted Nvidia's CUDA, AMD had to develop a Heterogeneous-Compute Interface for Portability (HIP) to enable developers to port CUDA applications to its GPU platform. Comparatively, some semiconductor segments such as analog and discrete devices have relatively steady technology and no software involvement; thus they are friendly to new entrants. Among these segments, some (analog and RF) have higher initial barriers in technology and foundry processes than others (diodes and most discrete devices).

In addition to technology barriers, we believe that product fragmentation is an important factor for competitive dynamics. In a market with thousands of products, a new entrant can often operate "under the radar" and avoid direct fierce competition with the incumbents, at least in the early stage; it can also easily avoid direct competition with its Chinese local competitors. For example, Yangjie Tech, a Chinese transistor maker has had limited direct competition with Suzhou Good-Ark Electronics and Jilin Sino-Micro, its main Chinese competitors, in the past. Rather, these Chinese companies are gradually taking share from their competitors in Taiwan and Europe. In comparison, in a single-product market where differentiation is merely low- to high-end, the incumbents can defend their position more easily leveraging pricing and marketing strategy. We view **CPUs, GPUs, and smartphone SOCs** as such markets.

What semiconductor segment could benefit a young Chinese semiconductor company? We believe that leader's market share is an easy way to delineate the technology barrier and product fragmentation in each semiconductor segment (Exhibit 6). If a leader can sustainably maintain high market share, we conclude that the segment likely has high technology barriers to entry and concentrated product lines so that the leader can build a good base from which to fend off competitors. For example, Intel now has over 90% market share in the CPU segment where AMD has struggled as a distant second for over a decade because CPUs depend on Moore's Law for performance and on software (operating systems, middleware, security software, etc.) to function. If a Chinese company were to enter the CPU segment, we believe it would likely face even more challenges than AMD due to a lack of technology accumulation.

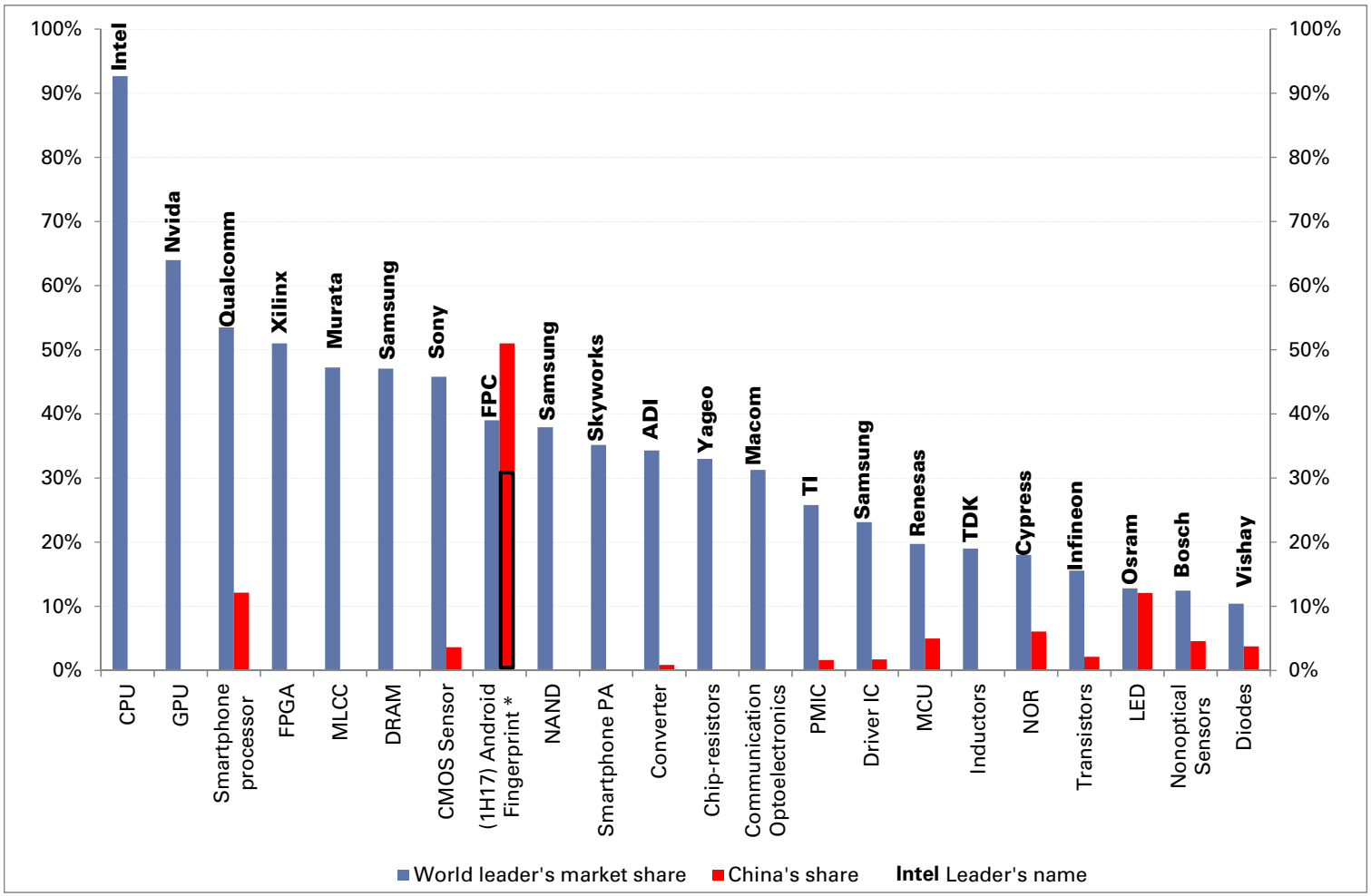
Comparatively, in the PMIC (power management IC; a kind of analog semiconductor) segment, the leader **Texas Instruments** (TI) has 26% market share (2016) and high profitability due to its cost leadership and strong hold on high-end analog devices through the acquisition of Burr-Brown Corporation in 2000. However, other analog vendors such as **Analog Devices, Maxim, Silergy, SG Micro** and MPS (Monolithic Power Systems) also have had robust profitability and good growth over the past few years. We attribute analog's revenue and profit fragmentation to its slow pace of technology change (not following Moore's Law), high product fragmentation (thousands of SKUs), and wide diversity of applications (in every electronic device).

Should we follow common sense to chase large TAM? In semiconductors, TAM often increases with greater market concentration (Exhibit 7). We view this as partially a self-fulfilling prophecy because a concentrated market offers its leaders higher pricing power than a fragmented market. In addition, the leader with a large TAM has more resources to build a good wall of defense than that with a small TAM.

For example, the DRAM price was highly volatile when the market was fragmented, but has remained healthy since almost all the Japanese and Taiwanese players have exited the market. For a Chinese new entrant, we believe the ideal market should have low concentration and large TAM. We believe that PMICs, MCUs, inductors, and transistors are markets that meet these criteria.

Our analysis so far applies to Chinese new entrants but not to Chinese industry leaders. We count **Goodix** and HiSilicon as two global leaders in China (based on revenue and technology). HiSilicon leads in communication ICs, surveillance ICs, and high-end smartphone SOCs, but is a private company. **Goodix** has surpassed Fingerprint Cards to become the global leader in fingerprint sensor revenue. We believe ideal conditions for Goodix today would be high technology barriers to entry and a highly concentrated market. Goodix's rapid rise is partially due to its early adoption of a brand new product in fingerprint sensors.

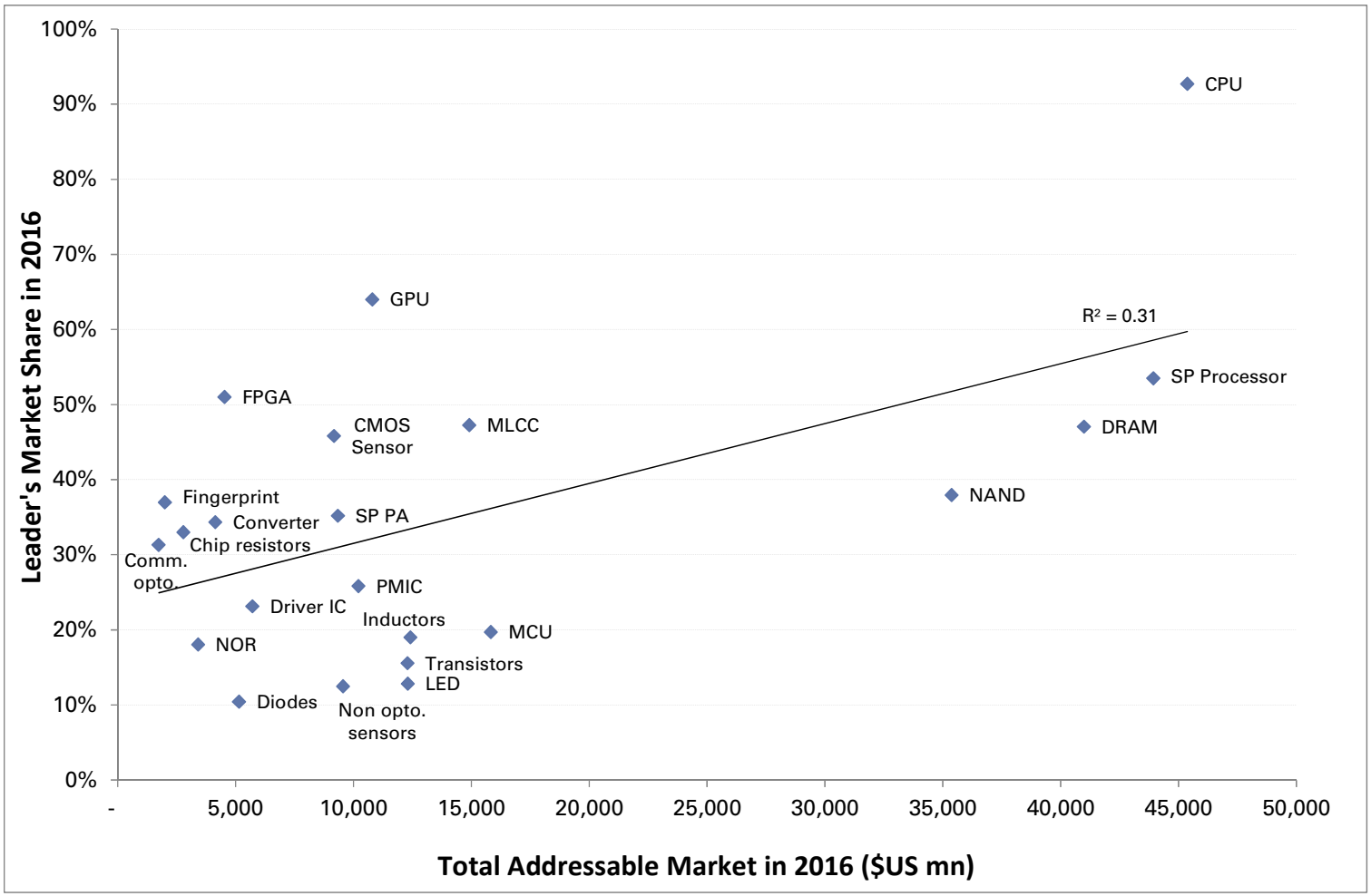
Exhibit 6: Chinese design companies are more likely to gain share in a more fragmented market
Market shares of market leader and total Chinese companies in selected semiconductor segments in 2016



* Notes: 1) Above data are from Gartner in 2016 except for fingerprint sensors, which was from SunRise Big Data in 1H17, in order to better capture the significant change in this market for the past few months. 2) We exclude Apple (AuthenTec) from this segment, only counting Android fingerprint sensor shipments. 3) Chinese fingerprint sensor companies include: Goodix (leader), Silead, Microarray, Betterlife, Cdfinger, Chipone, Sunwave, Chipsailing. 4) Goodix had a 31% share in 1H17 vs. 23% in 2016 and 5% in 2015. It has surpassed FPC in terms of revenue to become the global leader since 3Q17.

Source: Gartner, SunRise Big Data, Gao Hua Securities Research.

Exhibit 7: A Chinese new entrant may have a better chance of sustained growth in a highly fragmented segment with large TAM
Leader's market share and TAM of selected semiconductor segments in 2016



Source: Gartner, Gao Hua Securities Research.

A closer look at Chinese public and private design companies

We have categorized 46 leading Chinese design companies by their revenue size and technology process in Exhibit 8. Public and private companies represent 54% and 46% of this list, respectively. In advanced processes, HiSilicon is a global leader in telecom ASICs, surveillance SOCs, modems, and STB chips and is a top three supplier of high-end smartphone SOCs after Apple and Qualcomm. HiSilicon is the top Chinese design company by a large margin in terms of advanced design capability. In light of the challenging smartphone SOC margin at **Mediatek** (we estimate around 20.6% vs. 36.4% for the company as a whole in 3Q17), we believe other Chinese design companies with advanced nodes may be under margin pressure. In the mature process category, **Goodix** surpassed Fingerprint Cards to become the global leader in fingerprint sensor revenue in mid-2017. Goodix has won its title through technology differentiation and service. For example, Goodix is the first supplier of under-glass finger print sensors in the world. Other noteworthy companies in the mature process category are Omnivision and ISSI, both of which used to be US listed companies but have since been taken private by Chinese private equity firms.

GigaDevice focuses on NOR Flash and 32-bit MCUs, two fragmented markets. In the analog space, **Silergy** is the Chinese leader and focuses on DC/DC PMICs. On Bright focuses on AC/DC PMIC. SG Micro and 3PEAK strive to develop high-end signal-chain products. **SG Micro** is also rapidly expanding its PMIC business. Fine Made makes PMICs for LED and battery applications. In RF, Vanchip and HunterSun are veterans of power amplifiers in China. RDA, now part of Spreadtrum, is also a player. In optoelectronics, **Accelink** makes lasers for internal use. Aluksen is a start-up focusing on high-end modulator drivers, clock and data recovery (CDR), and transimpedance amplifiers (TIA). The company is entering mass production of a 4X32G Hz liner drivers for long-haul communications.

We compared the historical profitability growth of the top 16 public companies in Exhibit 9 in terms of advanced technology. Three companies in our coverage – **Goodix, Silergy, and SG Micro** – lead in profit growth and ROE. Here we used gross profit growth instead of revenue growth to emphasize the healthy gross margin trend. ROE is a good check on whether growth is being driven by M&A. We note that the most profitable companies are analog companies or global leaders in new applications. In addition, most public companies are in a fragmented market because the China A-share market has a strict listing requirement for profitability. This is consistent with the investment framework for semiconductor design companies in China that we introduced in our April 19, 2016 report, *China: A new frontier in the old semiconductor world.*

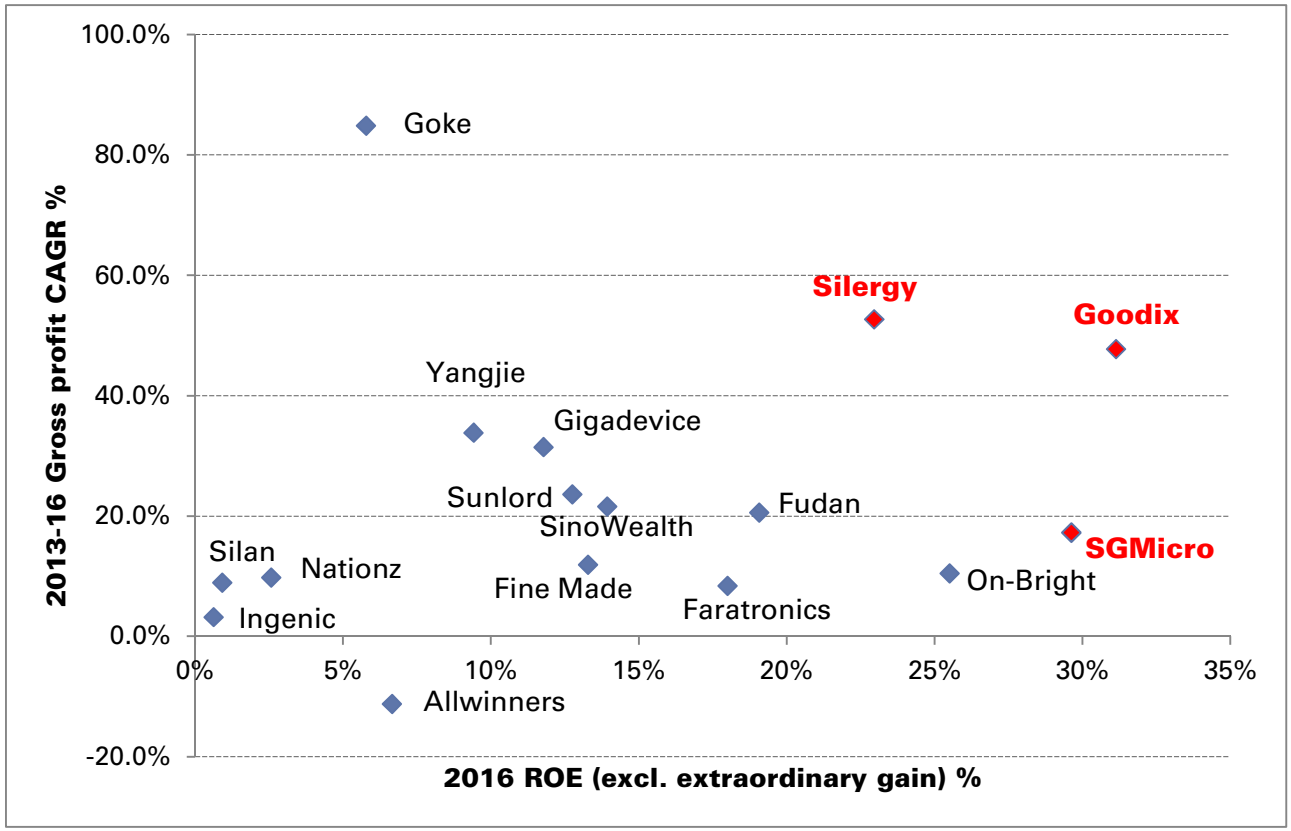
Exhibit 8: Most Chinese design companies are still in the early stages
46 Chinese design companies by IC design revenue and technology process as of 2016

	> $500mn	$200mn-$500mn	$100mn-$200mn	< $100mn or n.a.	Overseas competitors
Advanced	HiSilicon Spreadtrum Bitmain	Datang (Leadcore)	Allwinners	Ingenic ASR Microelectronics ZTE Microelectronics Rockchip	**Mediatek** **Nvidia** **Qualcomm** **AMD**
Mature		**Goodix** Silan GigaDevice Unigroup Guoxin Omnivision	Fudan Microelectronics Nationz	SinoWealth Navinfo (AutoChip) Goke Microelectronics Solomen Superpix Awinic Galaxycore Hua Hong IC Montage Hobot DeePhi ORBBEC	**Xilinx** **Microchip** **Sony** Cypress FPC Egis Macronix Synaptics
Analog		**Silergy**	On Bright	**SG Micro** FineMade 3Peaks	**Maxim** **ADI** TI MPS
Passive Discrete		Sunlord Faratronics Jilin Sino-Microelectronics	Suzhou Goodark Yangjie Tech	Techsem Huajing Zhonghuan Semi	**Murata** Taiwan Semiconductor Yageo
RF				Vanchip HunterSun RDA	**Qorvo** **Skyworks** Airoha Technology
Opto-electronics		**Accelink***		Aluksen	**MACOM** **Acacia**

Note: 1) Accelink refers to our 2017E laser segment revenue estimate; 2) Bold names are our covered companies.

Source: Company data, Gao Hua Securities Research.

Exhibit 9: Goodix, Silergy, and SG Micro lead among Chinese design companies in growth and profitability
2016 ROE and 2013-2016 gross profit growth CAGR of 16 Chinese semiconductor design companies



Note: Red names are our covered companies.

Source: Bloomberg, Datastream, Wind.

Exhibit 10: Summary of target price methodologies and risks for coverage stocks discussed in this report

Company	Ticker	Rating	Currency	Market Price	TP	TP methodology	Risks
SG Micro	300661.SZ	Buy	Rmb	94.0	116.0	40X long term discounted P/E on 2021E EPS discounted to 2018E by COE	Intensified competition and delayed new products launch.
Mediatek	2454.TW	Buy	NT$	331.0	356.0	SOTP: 16X NTM P/B-ROE implied valuation plus market value per share for Mediatek's 20.9% stake in Goodix.	Intensifying competition from Qualcomm on Helio products and Spreadtrum on low-end SOC
Hua Hong	1347.HK	Buy	HK$	14.9	16.9	85% fundamental value (1.14X FY18E P/B to NTM BVPS) and 15% M&A value (23.7X NTM P/E, derived from historical Greater China semiconductor deals).	intensifying competition from overcapacity in China due to strong local government funding
Silergy	6415.TW	Buy	NT$	678.0	636.0	85%/15% weighting of our fundamental valuation (based on historical NTM P/E of 21.3X) and M&A value (31X P/E)	Slower than expected adoption of Silergy's smart meter SOC in China.
SMIC	0981.HK	Sell	HK$	14.2	7.2	4.8x 2019E EV/DACF	Higher-than-expected govt. subsidy; faster-than-expected 28nm HKMG ramp
SMIC(ADR)	SMI		US$	8.8	4.6		
Goodix	603160.SS	Neutral	Rmb	114.9	125.0	40X long term discounted P/E on 2021E EPS discounted to 2018E by COE	(+) Positive progress in Under Display optical sensor development; (-) subtitution risks from facial recognition and delayed Under Display development.
Parade	4966.TWO	Neutral	NT$	557.0	515.0	70% fundamental value (15X NTM P/E) and 30% M&A value (23.7X P/E).	(+) New applications for high speed products; (-) muted demand for iPad/PC.
TSMC	2330.TW	Neutral	NT$	241.0	213.0	15X NTM P/E	(+) Strong iPhoneX sales; (+/-) FX fluctuation and poor iPhone8 sales.
TSMC(ADR)	TSM		US$	41.6	35.1		
UMC	2303.TW	Neutral	NT$	15.7	14.1	16X NTM P/B-ROE	(+) Faster-than-expected HKMG recovery; (-) 28nm market loss.
UMC(ADR)	UMC		US$	2.6	2.3		
Accelink	002281.SZ	CL-Buy	Rmb	28.0	28.0	36X 2018E P/E	Competition, product delays, customer inventory reduction.
ZTE	0763.HK 000063.SZ	Buy(H) Neutral(A)	HK$ Rmb	28.3 34.9	29.0 28.0	15X/17X 2019E P/E multiple for H/A	(+) Faster-than-expected overseas market share gain. (-) Continued telco capex cut, further margin pressure, higher SG&A spending.
Fiberhome	600498.SS	Neutral	Rmb	35.9	26.0	26X 2018E P/E	(1) Faster/slower-than-expected telco optical capex decline; (2) Faster/slower-than-expected fiber network upgrade progress; (3) More/less-than-expected competition intensity in domestic and overseas markets.
NVIDIA	NVDA	CL-Buy	US$	205.3	228.0	38x normalized (FY19) EPS of $6.00	Increased competition in Datacenter, quarter-to-quarter volatility, timing/magnitude of GPU adoption in the Automotive end-market.
AMD	AMD	Sell	US$	11.1	11.4	2.2x 2018E EV/sales	Traction with new products, magnitude/nature of competitive responses, and monetization of IP.
MACOM	MTSI	Neutral	US$	36.6	42.0	1) 85% fundamental weight of $39, using 16X applied to normalized EPS of $2.45; 2) 15% M&A weight of $58 using 18X applied to CY18E EBITDA.	Risks relate to revenue trends (especially in optical, GaN and datacenter), margin trends, and M&A.
Qorvo	QRVO	Neutral	US$	79.5	70.0	12x normalized EPS of $5.80	Smartphone demand/mix, cost synergy execution, and competition.
Skyworks	SWKS	Neutral	US$	111.1	108.0	14x normalized EPS	Smartphone demand (particularly, Apple, Samsung and Huawei), changes in the competitive landscape, and GM execution
TI	TXN	Sell	US$	97.1	85.0	18x normalized EPS	Growth in automotive/industrial, share gains, and GM execution.
ASE	2311.TW	Neutral	NT$	37.1	38.9	10% premium to 2017E sector average P/B-ROE of 11X	Market share loss/gains; lower-/higher-than-expected SiP penetration.
SPIL	2325.TW	Neutral	NT$	47.9	50.0	50% weighting to an M&A valuation which applies 18.4X NTM P/E and 50% fundamental valuation weighting which applies 14.7X NTM P/B-ROE	Market share at key customers; weaker-/stronger-than-expected smartphone demand; pricing pressure.
Intel	INTC	Neutral	US$	46.3	42.0	14X normalized EPS	PC demand, Enterprise/Cloud spending, competition and technology transitions.
Acacia	ACIA	Neutral	US$	36.0	37.0	70% on fundamental valuation and 30% on an M&A value (26X NTM P/E). Our fundamental valuation is based on an equal-weighted EV/S and P/E methodology. We use a 3.0X EV/S and as well as a 14X P/E	(+) A recovery in China as well as new customer and product adoption. (-) Downside risks include end market weakness, competition, higher spending.
Xilinx	XLNX	Neutral	US$	70.8	72.0	85% on a fundamental valuation of $71 (24x normalized EPS of $2.95) and 15% on our $78 M&A valuation (20x normalized EBITDA)	Comms order trajectory, competition vis a vis Intel, R&D intensity

Note: Target prices on are a 12-month timeframe, with the exception of ACIA (6 months).

Source: Wind, Goldman Sachs Global Investment Research, Gao Hua Securities Research.

A list of 40 semiconductor design companies in China and their products

Exhibit 11: A list of 40 semiconductor design companies in China and their products

Company	Ticker	Main Products	Main Competitors	Types	2016 Revenue mn US$	Market Cap mn US$
Fabless						
HiSilicon	Private	4G smartphone SOC, Comm IC, surveilance IC, ASIC	Qualcomm, Mediatek	Advanced	3,978	n.a.
Bitmain	Private	Consumer-grade 16nm ASIC for cryptocurrency miner	Canaan	Advanced	3,000	n.a.
Spreadtrum	Private	4G smartphone SOC	Novatek Microelectronics, Himax	Advanced	1,912	n.a.
Datang (Leadcore)	600198.SS	Leadcore supplies 4G smartphone SOC	Spreadtrum, Mediatek	Advanced	340	1,882
Allwinners	300458.SZ	Tablet, OTT, IP camera, & auto entertainment SOC	Rockchip, Mediatek	Advanced	187	1,547
Ingenic	300223.SZ	MIPS processor		Advanced	17	861
ASR Microelectronics	Private	Smartphone SOC, baseband	Spreadtrum, Mediatek	Advanced	13	n.a.
ZTE Microelectronics	Private	Modem, Comm IC, ASIC		Advanced	n.a.	n.a.
Rockchip	Private	Tablet, smartphone, smart TV, & speaker SOC	Allwinner, Mediatek	Advanced	n.a.	n.a.
Goodix	603160.SH	Touch controller, finger print sensor and IC	Focaltech, FPC, Synaptics, Egis Technology	Mature	460	7,910
Silan	600460.SS	LED driver & controller, MOSFET, Diode, IGBT, MCU, MEMS sensor		Mature	356	2,091
GigaDevice	603986.SH	SPI NOR and NAND flash, 32-bit MCU	Marconix, Fudan Micro, STMicroelectronics	Mature	223	4,978
Unigroup Guoxin	002049.SZ	Smart card, oscilator, ASIC, FPGA	Fudan Micro, Hua Hong IC, Nationz	Mature	211	3,727
Fudan Microelectronics	1385.HK	Smart card, smart meter IC, SPI NOR & NAND Flash, FPGA	Tongfang, Hua Hong IC, Gigadevice, Nationz	Mature	179	684
Ninestar	002180.SZ	Printer consumable IC		Mature	135	4,796
Nationz	300077.SZ	Smart and security IC	Tongfang, Fudan Micro, Hua Hong IC	Mature	106	1,191
SinoWealth	300327.SZ	8-bit MCU		Mature	78	1,125
Navinfo (AutoChips)	002405.SZ	Automotive infotainment system, connectivity, body control SOC	NXP, Renesas	Mature	73	5,727
Goke Microelectronics	300672.SZ	STB & surveilance IC, NAND controller, Comm IC	Hi-Silicon, Silicon Motion, Mstar, STM	Mature	73	1,156
Solomen	2878.HK	LCD and OLED drivers, LCD controller	Novatek Microelectronics, Himax	Mature	68	130
Superpix	833220.OC	CMOS image sensor	Omnivision, Superpix	Mature	68	91
Awinic	Private	Audio IC, LED driver, power PMIC, MEMS Mic	On-Bright, Silergy	Mature	n.a.	n.a.
Galaxycore	Private	CMOS image sensor	Omnivision, Superpix	Mature	n.a.	n.a.
Hua Hong IC	Private	Smart card	Tongfang, Fudan Micro, Nationz	Mature	n.a.	n.a.
Montage Technology	Private	STB, TV, and memory interface IC	Goke, Mstar	Mature	n.a.	n.a.
Silergy	6415.TW	PMIC, smart meter IC	Maxim, Monolithic Power System (MPS), TI	Analog	222	1,966
SG Micro	300661.SZ	OPAMP, comparator, PMIC, analog switch, audio/video drivers		Analog	68	867
FineMade	300671.SZ	PMIC, LED drivers, MOSFET		Analog	49	652
On-Bright	4947.TW	LED driver and controller		Analog	114	410
Vanchip	Private	PA	Qorvo (RFMD), Skyworks, HunterSun	RF	n.a.	n.a.
HunterSun	Private	CMOS and GaAs PA, Bluetooth and Wi-Fi chips	Qorvo (RFMD), Skyworks	RF	n.a.	n.a.
RDA	Private	Cellular PA, transceiver, & switch; WiFi, Bluetooth, FM, & STB tranceiver	Qorvo (RFMD), Skyworks, HunterSun	RF	n.a.	n.a.
Suzhou Goodark	002079.SZ	Diodes, rectifiers, protection devices, MOSFETS, MEMS sensors		Discrete	178	989
Techsem	300046.SZ	Rectifier, power module, heatsink		Discrete	36	495
Sunlord	002138.SZ	Various passive components (inductors, resistance etc)	TDK-EPC, Murata, Taiyo Yuden, Fenghua Advanced Tech	Passive	260	2,488
Faratronics	600563.SH	Filmite capacitors, transformers	Panasonic, EPCOS, KEMET, Vishay	Passive	226	1,751
Jilin Sino-Microelectronics	600360.SS	Diode, transistor, LED driver, power discrete		Passive	207	920
Yangjie Tech	300373.SZ	Bridge rectifiers, diode, power discrete		Passive	178	2,009
Zhonghuan Semi	002129.SZ	Solar silicon material, wafer, & cell; diode, MOSFET		Passive	95	3,280
Huajing	Private	Rectifier, diode, heatsink		Passive	n.a.	n.a.

Note: For Navinfo (AutoChips), Datang (Leadcore), Ninestar and Zhonghuan Semi, 2016 revenue refers to IC design segment only.

Source: Bloomberg, Company data, Gao Hua Securities Research.

Company-specific disclosures for Not Covered companies

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Goldman Sachs expects to receive or intends to seek compensation for investment banking services in the next 3 months: Horizon Robotics Inc., Gigadevice Semiconductor (Beijing) Inc.

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信息披露附录

申明

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每项指标的准确计算方式可能随着财务年度、行业和所属地区的不同而有所变化，但标准方法如下：

增长是下一年预测与当前年度预测的综合比较，如每股盈利、EBITDA 和收入等。 **回报**是各项资本回报指标一年预测的加总，如 CROCI、平均运用资本回报率和净资产回报率。 **估值倍数**根据一年预期估值比率综合计算，如市盈率、股息收益率、EV/FCF、EV/EBITDA、EV/DACF、市净率。 **波动性**根据 12 个月的历史波动性计算并经股息调整。

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在我们的全球覆盖范围中，我们使用并购框架来分析股票，综合考虑定性和定量因素（各行业和地区可能会有所不同）以计入某些公司被收购的可能性。然后我们按照从 1 到 3 对公司进行并购评分，其中 1 分代表公司成为并购标的的概率较高(30%-50%)，2 分代表概率为中等(15%-30%)，3 分代表概率较低(0%-15%)。对于评分为 1 或 2 的公司，我们按照研究部统一标准将并购因素体现在我们的目标价格当中。并购评分为 3 被认为意义不大，因此不予体现在我们的目标价格当中，分析师在研究报告中可以予以讨论或不予讨论。

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GS SUSTAIN 是一项侧重于通过发现优质行业领先企业而实现长期超额收益的全球投资策略。GS SUSTAIN 50 关注名单列出了我们认为凭借出色的资本回报、具有可持续性的竞争优势和对 ESG（环境、社会和企业治理）风险的有效管理而有望在长期内相对于全球同业表现出色的行业领军企业。候选企业主要基于对企业在这三方面表现的综合量化分析筛选而出。

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