



All in on chips

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At \$260 billion, China spends more each year on semiconductor imports than it does on oil. To end the country's reliance on foreign technology and break the dominance of U.S., South Korean, Taiwanese and Japanese chip companies, the government is pouring billions into creating Chinese versions of industry leaders. The potential for market upheaval is enormous -- if these up-and-comers can clear the technical hurdles in their way.

CHENG TING-FANG Nikkei staff writer

SHANGHAI/TAIPEI Business is booming at the Shanghai Integrated Circuit Museum.

For most of its nine-year history, the museum has been mostly a place for school children to learn about the uses of computer chips. But it has become a hot ticket for officials from all over China ever since Beijing declared that creating a world-leading semiconductor industry was a top national priority. On a recent weekday this spring, Lance Long, the museum's director, was hosting a tour for officials from Urumqi, the Xinjiang capital known for being the world's most landlocked city. Before that, Long hosted groups from distant provinces such as

Gansu and Yunnan and even Mongolia. All told, some 200 groups came last year for an education in China's next big thing.

"Many of these representatives knew very little about chips, but they all want to capture this once-in-a-lifetime investment opportunity being led by high-ranked policymakers," Long told the Nikkei Asian Review.

This national enthusiasm reflects China's towering ambitions for its semiconductor industry. China, and its young chipmakers, are clear about their goal: to break the dominance of American, South Korean, Taiwanese and Japanese semiconductor



Courtesy of Tsinghua Unigroup

companies. The government wants to create Chinese versions of most of the industry's leaders, then leapfrog them in the race for advanced chips used in artificial intelligence.

In March, Premier Li Keqiang named semi-conductors as the top priority of the 10 industries China wants to foster in its "Made in China 2025" initiative. But China's ambitions were already clear in 2014 when it launched the National Integrated Circuit Industry Investment Fund -- better known as the Big Fund -- in 2014 with 138 billion yuan (\$21.9 billion) in seed capital, which it hoped would turbocharge investment from local governments and the private sector. The Big Fund is in its second phase of fundraising for at least 150 billion yuan. Credit Suisse estimates China's total investment to be about \$140 billion.

China wants to end its reliance on foreign technology -- its annual imports of \$260 billion worth of semiconductor-related products have recently risen above its spending on oil. And it also wants to move its manufacturing sector to higher-value products.

But there are also national security concerns. Chips serve as the brains for every electronic device

Yangtze Memory Technologies is spending \$24 billion to build one of China's first advanced memory chip factories in the city of Wuhan.

-- from smartphones and PCs to connected cars and data centers -- and therefore have strong implications for intelligence. China wants to defend against the types of national security breaches exposed by Edward Snowden's 2013 leaks, which revealed connections between American technology providers and the U.S. National Security Agency's vast surveillance program.

This position is a mirror-image of the increasingly hard-line U.S. stance toward China. American regulators have cited national security concerns when it has curbed chip and other deals with Chinese groups, and has recently fired the opening shots in a trade war to penalize China for stealing high-tech intellectual property. To Beijing, such moves point to an all-out U.S. effort to slow China's aggressive attempt to become a new semiconductor superpower.

"The U.S. is really feeling the threat," said Jerry Peng, an analyst at research unit IEK of Industrial Technology Research Institute in Taiwan.

There is no guarantee of success for China's chip push, however. The country's previous efforts to build a chip industry, including a major drive in the

1990s, were mostly unsuccessful. Its technology is far behind that of global giants such as **Samsung Electronics** and Intel, making China's goal of producing 75% of the chips it uses domestically by 2025 seem highly ambitious, analysts at Natixis say.

Unlike its previous efforts, when its investments were scattered and ill-placed, China is seeking to bring in expertise from the outside by luring foreign companies to set up advanced production facilities within its territories. This will help create a supply chain and attract talent. The latest move by the U.S. to bar American companies from selling any components to **ZTE**, a Chinese telecom equipment provider and smartphone maker, has only strengthened China's determination to replace as many foreign suppliers as possible, according to multiple industry executives. (See related story on Page 20.)

Analysts also say China has learned from its past mistakes.

"It's totally different from decades ago when China suffered through a frustrating experience to build semiconductors out of nowhere," Mark Li, an analyst at Bernstein Research said. "This time, it's a totally different story as the country has all the right ingredients, including a massive market and strong local makers of smartphones, TVs, PCs, and automobiles ... It could be just a matter of time for them to bear fruit."

MEMORY CHIP PUSH The first fruits of Beijing's big investment in chips could come as soon as the end of next year, when it will begin shipping its

first batch of memory chips. Right now, China has yet to produce such chips in substantial volumes. But industry executives say Chinese memory chips could cause a major disruption in the market once its manufacturers are able to produce them in sufficient quantities, which they expect to happen in three to five years.

When that happens, it could have an impact on two markets: NAND flash memory and DRAM memory chips.

Production of global NAND flash memory -- a \$58 billion market annually -- is controlled by only six companies: Samsung Electronics, Toshiba, Western Digital, **SK Hynix**, Micron Technology and Intel.

DRAMs are dominated by an even smaller group of companies: Samsung, SK Hynix and Micron, which together held 95% of the \$71 billion global market in 2017, according to Taipei-based research company TrendForce.

Helped by strong demand and tight supplies, Samsung and SK Hynix generated some \$85 billion in memory chip

sales in 2017, higher than the gross domestic product of Luxembourg. The combined semiconductor operating profit from both companies -- about \$46 billion -- would be 1.6 times higher than what the two biggest Japanese companies, Toyota Motor and SoftBank Group, earned together in fiscal 2017.

"It's so unhealthy about the recent memory price hike, and it's so unfair that such important components are controlled by very few companies," a Chinese chip industry executive told the Nikkei

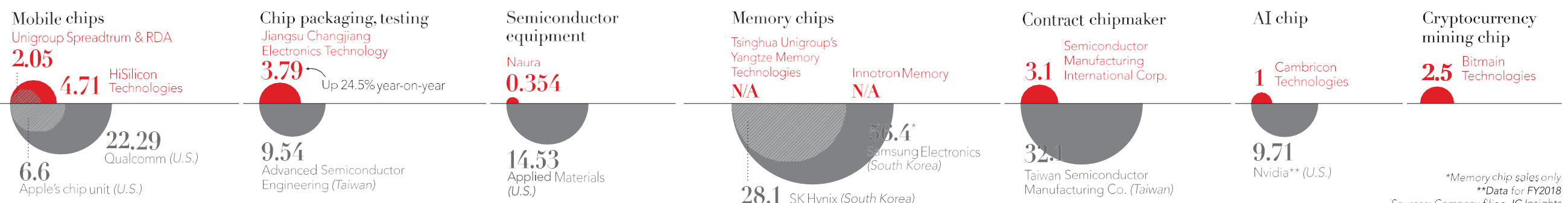
We wouldn't care at first whether we could make a profit or whether we cause a price crash in the market

CHINESE CHIP INDUSTRY EXECUTIVE

China's champions vs. global leaders

(by revenue, in billions of dollars)

Chinese company
Foreign company



*Memory chip sales only

**Data for FY2018

Sources: Company filing, IC Insights

Asian Review. “The road could be bumpy, but we need to have our domestic memory chips for sure, and we wouldn’t care at first whether we could make a profit or whether we cause a price crash in the market.”

A little-known state-backed conglomerate called Tsinghua Unigroup will play a key role in determining whether Chinese chipmakers can successfully challenge the dominance of Samsung, SK Hynix and Toshiba in the memory market.

Tsinghua initially tried to buy its way into the market, but its \$23 billion bid to acquire Micron and a separate attempt to become the largest shareholder of Western Digital were blocked by the U.S. government. At the same time, the industry’s dominant players were reluctant to license their technology to the aggressive latecomer. But those setbacks did not dampen Tsinghua’s enthusiasm.

The group’s affiliate, Yangtze Memory Technologies, is spending \$24 billion to build the country’s first advanced memory chip factories in the city of Wuhan. It has poached thousands of engineers from Samsung, SK Hynix, Micron and **Nanya Technology** (see sidebar on Page 15), and on April 11, it began moving equipment into the factory.

Tsinghua Unigroup Chairman Zhao Weiguo announced that the company should begin producing its first batch of 32-layer NAND flash memory chips this year. But Avril Wu, a longtime market watcher at TrendForce, said it is likely that Yangtze Memory will not be ready to ship the more advanced 64-layer chips, currently the industry standard, until the end of 2019 at the earliest.

Apple, the world’s biggest consumer of NAND flash memory, recently visited Yangtze Memory to learn about its development status, according to people familiar with the matter. It is not clear whether the iPhone maker received pressure from China to evaluate a potential supply deal, but Apple will undoubtedly want to continue diversifying its memory chip suppliers in order to reduce its reliance on Samsung, multiple industry sources

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JERRY PENG Analyst at IEK

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and analysts have said.

Roger Sheng, an analyst at Gartner, said Chinese memory chipmakers still have a long way to go before they make a dent in the market. Still, his company expects that in the NAND flash memory segment, Yangtze Memory could come to replace some low-end providers in three years and compete with first-tier players in five years.

Samsung Electronics CEO Kim Ki-nam and Micron CEO Sanjay Mehrotra are aware of China’s offensive, but both say Chinese chipmakers face high technological barriers to entering the market. “We recognize that the Chinese government is supporting [these emerging players] actively ... but it’s difficult to narrow technological gaps in the short

term solely through big investments,” Samsung’s Kim said at the company’s annual general meeting in March.

The memory chip market is notoriously volatile, swinging between periods of supply shortages and serious gluts. Despite China’s technological hurdles, executives from top memory chipmakers worry that Chinese companies could flood the market with cheap semiconductors, leading to a repeat of the massive oversupply that hit the industry a decade ago.

There may be good reason for such concern -- the planned capacity from China is huge. Yangtze Memory has set out

to make 300,000 NAND flash wafers a month in years to come, equivalent to some 20% of current global output. “Even if only some one-third or even less of [planned production] is realized in three to five years, it could cause a major price drop for memory chips and hurt the profitability of current suppliers,” said Sean Yang, an analyst at Shanghai-based CINNO.

Chinese chipmakers will have the advantage of a vast end market of local gadget makers eager to use more domestic chips. Chinese brands controlled roughly 50% of the global smartphone market and 36% of the PC and tablet computer market in 2017, according to Gartner. Government agencies would also be first-wave adopters.

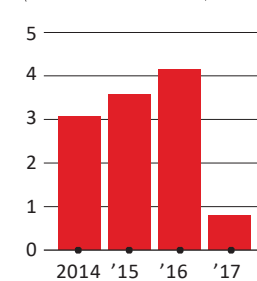


China’s targets for domestic chip production (as percent of domestic demand)



Source: Natixis

Cross-border semiconductor M&As by Chinese companies (in billions of dollars)



Sources: Natixis, Bloomberg

Another potential hurdle -- intellectual property, including chip design and production techniques -- is not a worry for Chinese chipmakers, analysts say. “Intellectual property issues would never be a roadblock for these newcomers,” said IEK’s Peng. “The most important task is to deliver the results, and even if there is any concerns with IPs, they can always later come back to negotiate with these big guys to settle the case with a certain license fee.”

A DILEMMA FOR FOREIGN CHIPMAKERS While IP may not be a worry for the Chinese companies, it is a very real concern for foreign chip giants such as Intel, Samsung, **Taiwan Semiconductor Manufacturing Co. (TSMC)** and SK Hynix. Like companies in other sectors, high-tech groups are eager to have access to the Chinese market, but wary of handing over valuable technology secrets to state-sponsored competitors.

For China, bringing in as many world-class foreign chip producers as possible is the easiest way to achieve its goal of cultivating a supply chain ecosystem to support its new industry.

“For the longer term, expanding advanced production sites in China could be a trade-off for the existing players because they are potentially helping their competitors,” said a Taiwanese chip



Getty Images

industry executive who asked not to be named. "It's like these newcomers can go to Harvard or MIT near their home rather than going abroad."

TSMC, for instance, has spent \$3 billion on an advanced 12-inch chip facility in the Chinese city of Nanjing, which began production ahead of schedule in April. The world's No. 1 contract chipmaker relies on Apple, Qualcomm, Nvidia and other U.S. clients for 60% of its revenue, but Chinese customers are its fastest growing, making up some 11% of sales in 2017, up from 9% the previous year.

Not far away from TSMC's Nanjing facility, Tsinghua Unigroup is planning to build a \$30 billion megasite the size of 2,380 basketball courts to produce memory chips. The Tsinghua project would benefit from any suppliers that TSMC brings to the community.

"It's very difficult for emerging players to secure good support from best-in-class chip equipment and material suppliers, but foreign chipmakers would bring a whole cluster of them even to some

81%

fall in cross-border semiconductor M&A deals by China from 2016 to 2017

Effective tax rates on semiconductor companies:

U.S. **35%**
South Korea **23%**
China **11%**

Sources: Natixis, Bloomberg

Chinese companies like Semiconductor Manufacturing International Corp. are counting on massive domestic demand for their chips.

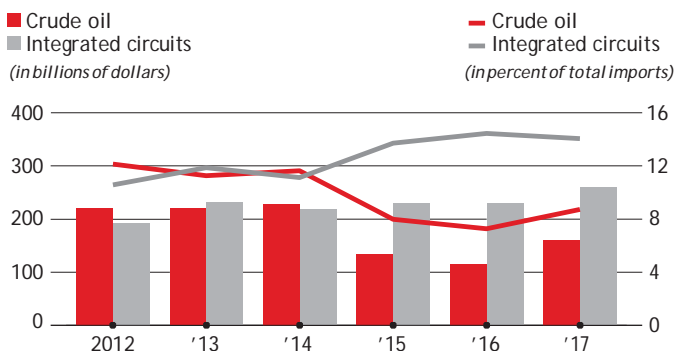
distant cities should they have a facility there," said Gartner's Sheng. "And these foreign chipmakers could help us train a huge group of engineers that could later work for local Chinese companies."

This complicated dynamic will only be exacerbated once homegrown Chinese chipmakers make it to the global stage.

"We will see more and more conflicts of interests later -- between countries and also between local and foreign suppliers later," said CINNO's Yang. "This ongoing trade friction between the U.S. and China is just one example." **N**

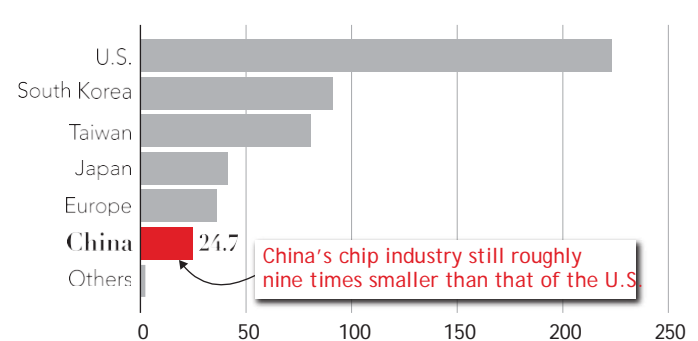
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Semiconductors top oil as China's No. 1 import



Sources: Natixis, CEIC

Chip industry revenue by country/region (in billions of dollars)



China's chip industry still roughly nine times smaller than that of the U.S.

As of 2017

Source: IEK