

# Say What You Like, We Are Moving Forward

*“China is a sleeping giant. Let her sleep, for when she wakes she will move the world.”*

*Napoleon Bonaparte*

## Backdrop

Throughout the last half century, the global world order has been shaped and reshaped by a series of nations—British imperial power in the 1800s, US technological prowess in the 1900s, Germany and Japan’s in the 1950s, the rise of South Korea chaebols from the 1960s, and more recently, China’s unprecedented phenomenal economic growth in the last 3 decades.

China’s recent ascendance is causing nervousness in the US as its further progress can threaten American geopolitical dominance. Until recently, China sat relatively low on the technology scale. US companies had a symbiotic and profitable relationship with China, occupying and controlling the more advanced segments of the value chain, and outsourcing low-value added portions to China.

Fast forward to today, China has advanced unexpectedly quick and is able to aim for the technological frontier in many advanced industries. By importing advanced technologies from elsewhere via acquisitions as well as hiring experienced engineers, and increasing its R&D spend, its gap with the US is narrowing fast. In 2016, China’s patent office received a record total of 1.3 million patent applications, more than the US, Japan, South Korea and Europe combined. In 2017, two Chinese tech companies were the top filers of international patent applications, with Huawei in first place and ZTE in second. Intel was in third place.

This has transformed its symbiotic relationship with the US to one of rivalry. The US now sees China not only as a threat to their continued economic dominance, but also views the accelerated pace of China’s technological advancements as a national security threat.

The semiconductor industry remains the most significant area where China needs to catch up quickly, for many other tech industries are dependent on it. Suppressing the rise of China’s semiconductor industry satisfies American aims in both arenas.

## Make America Great Again

As the dominant imperial power since 1945, the US has been able to tolerate the advance of countries that are small and friendly enough to accept US leadership. Alarm bells go off whenever a regional power emerges to challenge American hegemony. Whether dressed as concerns over national security, or unfair

business practices, or outright accusations of theft, the central underlying theme of protectionist policies are the same: we will do all we can to protect our dominance, even if it means stifling your growth.

The US today seems to view China's meteoric rise with grave concern. In the area of technology acquisition, China will now not be able to simply adopt the route taken by Japan, South Korea and Taiwan in the past, where they either bought or formed partnerships with American companies. According to the Wall Street Journal, China has made USD34 billion in bids for US semiconductor companies alone since 2015, yet completed only USD4.4 bn in deals globally in that span. Today, China's efforts to purchase American semiconductor companies are completely blocked for security reasons.

In April 2018, the Trump administration banned US companies from selling chips to Chinese telecom maker ZTE for seven years, citing illegal shipments to Iran and North Korea. Three months later, President Donald Trump lifted the ban. The ban, if it had not been reversed, would have put ZTE out of business. This entire ZTE episode was a wake-up call for China. It made China realise the urgency with which they had to hasten their ascent up the technology value chain, and to be self-sufficient. Referring to the global semiconductor industry, President Xi Jinping has urged for innovation to be the new priority for China's new phase of development and economic growth. Likening a microchip to a human heart, he was quoted as saying:

*"No matter how big a person is, he or she can never be strong without a sound and strong heart."  
President Xi Jinping, April 2018*

The recent actions of the US have shown China that the former will not hesitate to flex its economic muscle to achieve its political or economic goals. Given the heightened risk of a trade war or another ZTE-like embargo, or in the worst case a cold war, China's access to semiconductors - the backbone of its entire tech industry - will be at huge risk.

## The Art of War

The increasing hostility from the US highlights the urgency for China to step up its efforts towards self-sufficiency and minimize its dependence on US as well as other foreign companies that fall within America's sphere of influence. The prospect of a US tech embargo has sparked calls for action to accelerate the development of a Made-in-China IC industry. China has finally learned a hard lesson and recognises the need to build its own expertise. It recognises that the technology gap is large and this could take many years, but China has been left with no choice.

Developing a world-class semiconductor industry is the cornerstone of the "Made in China 2025" strategy. Semiconductors are the enabling technology of many other tech industries, and play a key role in communications, computing, AI, Big Data, robotics, military, transportation, health care, energy, and many other sectors at the forefront of global technological innovation.

From the ZTE experience and President Trump's aggressive stance against China, its technocrats have learned that semiconductors are strategically important for economic and "national security" reasons.

While headline news talks about China's self-sufficiency rate of 70% by 2025, we think this hardly tells us anything about how China will go about executing this important piece of their "Made-In-China 2025" strategy. China has kept the definition of self-sufficiency vague, likely intentionally so. It has already shown too much of its hand way too early for its own good.

Investing in the semiconductor industry is not new to China. In the late 1990s to early 2000s, China focused on the foundry segment. That era saw the birth of new companies like SMIC and Huahong. However, efforts were half-hearted as investments were fragmented. At one point, the government had invested in 130 fabrication sites across more than 15 provinces, none of which made a serious effort to succeed. From the early 2000s onwards, China then embarked on a journey to focus on the fabless industry. This saw the rise of globally competitive companies like HiSilicon, a company wholly owned by Huawei that currently competes head-on with Apple.

China will now need to be smarter and more deliberate, while ramping up efforts to invest in the ecosystem. Having learnt from previous missteps, the government is beginning to adopt a more holistic approach. The government also realises the need for burgeoning local companies to have a strong end-market and have been strongly encouraging domestic tech companies to shift their orders towards domestic firms, even if the current economics do not always warrant it. Users of chips now realize that they need to hedge their bets by helping and ensuring the success of their home grown IC companies.

## The ecosystem

There are certain areas within the ecosystem where China significantly lags foreign players. We are not postulating China will be globally competitive in all aspects with just the passage of time, but rather suggesting that China will endeavour to narrow the gap, as much as they can and as fast as they can.

### *Manufacturing*

The backbone of the semiconductor industry, we believe the foundry segment is crucial for the country. Chinese foundry customers have thus far primarily relied on the more technologically advanced foreign-owned foundries for leading edge chips, not domestic vendors. Additionally, given that China has the inherent scale and end-customer market needed for this segment to flourish, it makes sense for China to support domestic foundries. China's leading and most advanced domestic foundry player, SMIC, is ranked 5th globally. However, its revenues are only less than 10% of TSMC's. This gives us an idea of the leadership position companies in this segment can command, and therein lies the long-term opportunity for China.

The challenge for China is to move beyond trailing-edge capabilities and catch up with advanced technologies sufficient for its own ambitions in emerging industries such as 5G, national security/defence, autonomous driving, IoT, artificial intelligence, as well as augmented and virtual reality, to name a few.

Based on public announcements and our conversations with companies, we expect large R&D investments supporting the long-term strategies to take place over the next several years.

Memory is another segment we expect China to invest heavily in. Global memory revenues of USD132 bn in 2017 accounted for 30% of the semiconductor industry. Within the semiconductor industry, investing in memory is almost necessary. For China to catch up, it needs a competitive memory segment, regardless of near-term economics. The Japanese, South Koreans and Americans, who had attempted to build or support their indigenous semiconductor industries in the past, understand the importance of the memory industry.

In fact, when one studies the history of the segment, its emergence and growth is only possible with the help of government funds. We acknowledge the many failed unprofitable attempts of other government-led investments in the past. We believe this time it will be different for China due to two reasons. Firstly, the industry is highly consolidated today and secondly, China benefits from a huge captive end market.

China accounts for approximately 25% of the global DRAM and NAND industries’ revenues, and this proportion will continue to increase given the continued growth of emerging industries mentioned earlier. The memory market is currently oligopolistic with Samsung Electronics, SK Hynix and Micron controlling the lion’s share. Investing in memory gives China the assurance they will not be at the mercy of others on supply and pricing. By 2020, CICC estimates YMTC’s monthly capacity for 3D NAND to account for 5% of the global total. Meanwhile, Hefei Innotron’s DRAM project is expected to account for 3% of the global total.

### *Equipment and materials*

Semiconductor equipment and materials are essential enablers for manufacturing semiconductors. This is China’s Achilles heel. The technology gap has caused China to be heavily reliant on foreign suppliers but China now realises they will need to develop their own companies, or risk being hamstrung in just one stroke.

Presently, Chinese companies in these segments account for less than 1% of the global market. We can see from Table 1, foreign companies dominate key pieces of semiconductor equipment. As tough as it may be, China will need to produce its own versions of leading equipment and material companies like Applied Materials, LAM research and KLA-Tencor.

**Table 1: Market share of top 3 manufacturers of semiconductor equipment.**

	Lithography machine	PVD equipment	Etching equipment	Oxidation/diffusion equipment	CVD equipment
Top 3 manufacturers	ASML(75%)	AMAT(85%)	LAM(53%)	Hitachi(43%)	AMAT(30%)
	Nikon	Evatec	TEL	TEL	TEL
	Canon	Vivac	AMAT	ASML	LAM
Market share-top 3 in total	93%	96%	91%	95%	70%

Source: Chyxx.com

## Design

China has made tremendous progress in the area of IC design. In 2009, only one Chinese company featured in the Global Top 50 Fabless IC Design market. In 2017, that number was 10. HiSilicon, for example, founded in 2004, is making baseband chips at roughly the same technology cadence as market-share leaders. China's top state-backed chip maker Tsinghua Unigroup in 2017 was the largest fabless IC supplier domestically, as well as the 9<sup>th</sup> largest globally, with sales of USD2.1 bn.

A key reason for success is because this is one field that is driven mainly by human talent, versus cumulative knowledge and expertise in manufacturing know-how, which takes longer. We think a key reason for success is the large pool of talented engineers that China possesses, and China's ability to pay high salaries to attract its talented natives back from abroad.

## *Outsourced Semiconductor Assembly and Test (OSAT)*

The growth and development of the semiconductor industry over the past decade has benefited China's OSAT industry. Although this segment is not high on the technology scale, it is still nevertheless critical to the ecosystem. The Chinese OSAT industry is not far behind global standards. Currently, 31 of the top 10 companies globally are Chinese companies and we expect China's share of OSAT revenue to continue to grow.

## Conclusion

Looking ahead to the coming decade, it is important to note "Made in China 2025" is China's industrial policy to catapult it into the league of technologically advanced economies – semiconductors are at the heart of the requisite 16 sectors. However, the development of the semiconductor industry will not be without its challenges, as it is estimated that China is probably 10 years behind the West in technology.

Despite this, history has shown that when the Chinese put their mind to developing a certain technology, they will do so. This happened in the mid to late 2000s, when China launched a major policy initiative to promote the high-speed rail industry, and again in the early teens of the 2000s with the solar industry. APS believes there is at least a 50% chance that China will be a major semiconductor country in a decade's time.

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<sup>1</sup> JCET, Huatian Technology and Tongfu Microelectronics

**Deborah Yeo** has 9 years of industry experience as a member of the investment teams at Columbia Threadneedle, First State Stewart, RBC Global Asset Management, and HSBC Global Asset Management. She covers Japanese companies with growth drivers coming from Asia, companies listed in Southeast Asia, as well as Asian companies across the semiconductor and consumer sectors. She graduated with a Bachelors in Electrical Engineering from the National University of Singapore, and has a Masters in Finance from the Imperial College in England.

Tech analysts **Takahiko Nakao** based in Tokyo and **Wang Xinglin** based in Shanghai, as well as Singapore based Portfolio Manager **Hwang Ji-Hwan**, also provided inputs for this paper.

For more information, please contact [cs@aps.com.sg](mailto:cs@aps.com.sg)

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