

# THE CHINESE CENTURY. The Technology Gap Closes.

*The strategic relationship between China and the USA can be formulated thus: at what point does the qualitative advantages of US industry become so reduced that the quantitative advantages enjoyed by China now becomes dominant. This is one of the key questions addressed by this article. It examines the narrowing gap in Science and Technology between the two countries.*

In 2019, according to World Bank data, the nominal Dollar GDP for the USA, the EU and China was \$21.374 trillion, \$15,593 trillion and \$14.343 trillion, respectively. In other words, the USA's economy was 13% bigger than the EUs and 37% bigger than China's. However, the data is not comparable. For example, in the USA, owner occupied rentals, (a source of valueless income where homeowners' pay themselves an imputed rent) inflates US GDP by 8%. Total imputations (or fictitious sales) in the USA amount to 30% of GDP. Comparable figures are not available for China, and some of the US imputations are necessary.

Taking all this into account, it is likely that in 2019 the USA's nominal economy was less than 25% bigger, rather than the accepted figure of 37%. That said this year it is likely that the Chinese economy will expand by 2% and the US economy will shrink by 5%. However, this figure of 5% must be put into context. The US Treasury has subsidized the economy by over 10% of GDP. Without this subsidy the fall would have been more substantial. Equivalent figures for China are obtainable, especially in the murky world of local government finances. But they are less than 10%. Next year, Chinese growth should exceed that of the USA by around 4%. Therefore, due to the concertinaing effect of the pandemic, the real GDP difference between the two economies should have halved by the end of 2021. That being so, the pandemic therefore has made the world a more dangerous place not only from a health perspective but from a political one as well.

In terms of crude industrial production, therefore a quantitative comparison, China's industrial capacity is three times larger than the USA. And the gap is growing. Comparing industrial production between September 2019 and September 2020, China's grew by 6.4% while it contracted by 6.7% in the USA. [World trade monitor | CPB.nl](#)

## **The Chip Industry, from Design to Fabrication.**

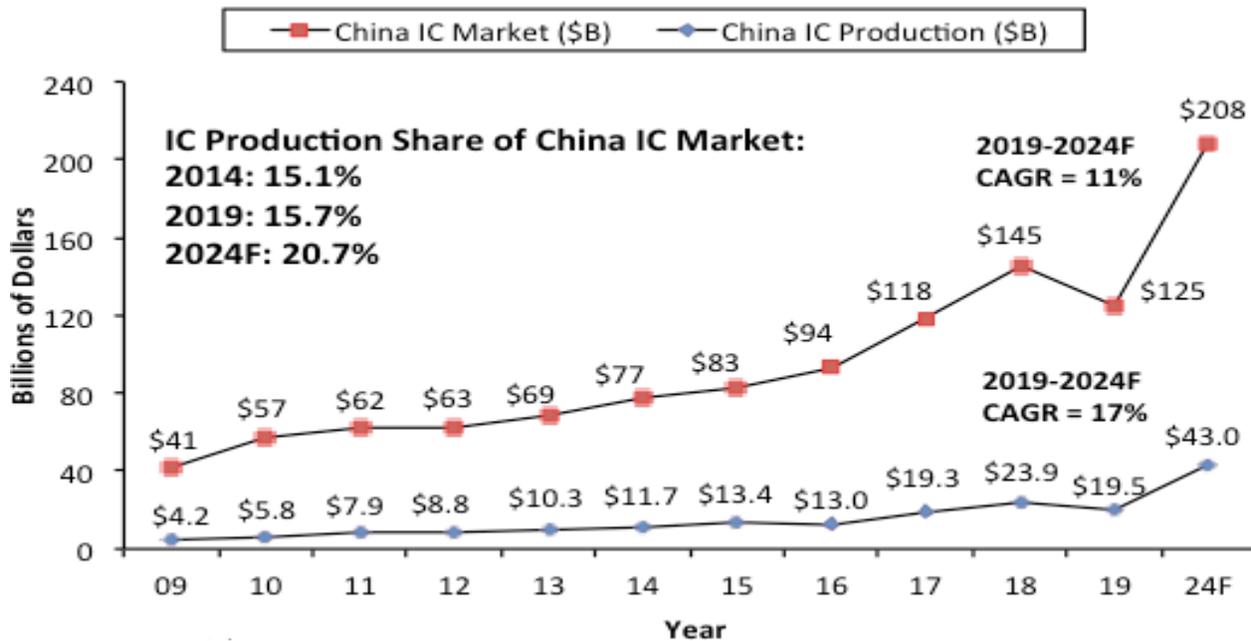
There is no substitute for scholarly research when approaching any subject, particularly by those seeking to build a new world. Debating texts in doors is no substitute for going outside, taking in the view, seeking to comprehend what is being observed, testing these observations against previous theories and tirelessly walking around corners to see what is new. It is called empirical enrichment and verification. It ensures we fit the theory to the facts and not vice versa as all those infantile lefties do by dogmatically clinging fast to the view that China is still socialist at best or state capitalist at worst.

Were they to examine the chip industry in China in detail they would have to draw the opposite conclusion. China has not developed a comprehensive chip industry for want of trying. Chinese companies and the state wasted tens of billions of Dollars trying to build one. This effort failed for an exquisitely capitalist reason. There was no market for the output of this nascent industry. Chinese corporations elected to buy from overseas suppliers because their components were faster and more suitable. Had Chinese companies relied on Chinese suppliers for advanced components, their products would have been obsolete before they hit the shelves, slower, more energy inefficient and with far fewer features. They

would have bankrupted themselves and China would not have emerged as the workshop or rather assembler to the world.

China was the victim of its own success, it sat at the junction of the global supply chains. The nature of its success was built on this. The ability to source and combine the best components into products under its own label or under a different private label was its strength. The graph below demonstrates the dependency of China on foreign chips.

**Graph 1.**



[China Speeds Up Advanced Chip Development \(semiengineering.com\)](http://semiengineering.com)

In many ways up to this time, China was an assembler rather than a producer of anything bar the more basic components. There was not a hint of state capitalism in this sector until the US in the guise of Trump introduced its embargo. No doubt Biden will continue this process.

Most of its companies saw this pathway as being the most profitable. *“For a long time, research in China has been about getting “short-term, frequent, and fast” results. The focus was on functionality and application, with limited investments in long-term foundational research that had slow returns”*. This quote from an interesting article sums it up. As long as China had unrestricted access to the international supply chain and could exploit it more effectively than any other major economy, such horizons did not impact profits. [Chinese companies drawn to chip-making like bees to honey, Technology News - ThinkChina](#)

It is important to appreciate the stranglehold foreign providers have over China. Until recently China was really a contract manufacturer. This is particularly true for the production of electronic chips, which today is the beating heart of most inedible products. Producing chips requires many steps, and most of these steps are dominated by US companies. *“The manufacturing process relies on equipment, and US firms such as AMAT, LAM, KLA and Teradyne have very high market share in many niche markets,”* says

Everbright's report, "there is no production line in China that uses only equipment made in China, so it is very difficult to make any chipsets without US equipment." [China's chip-making hampered by lack of expertise in using manufacturing equipment \(electronicsweekly.com\)](#) The USA leads in chip design, talent, integrated circuit design, and semiconductor equipment. Indeed, it is estimated that China will require an additional 400,000 skilled technicians to create the necessary pool of talent for an advanced and inclusive chip industry. [How Restrictions to Trade with China Could End US Leadership in Semiconductors \(bcg.com\)](#) To this end a number of specialised universities have and are being set up by the central government to train this pool of talent.

The only area where the US does not dominate, which happens to be the key production stage, is EUV lithography provided by ASML based in Holland using technology originally developed in the US and Japan. [ASML wins SEMI Americas Award for EUV lithography - Stories | ASML](#) (EUV stands for extreme ultraviolet with a wavelength of 32nm) This is the process that actually prints or etches the circuitry on chips. But being outside the USA, does not mean that ASML, the world's only provider of EUV lithography, is immune from US pressure. "An exclusive report by Nikkei Asian Review published on 6 November 2019 said that ASML had delayed its supply of 7nm and below lithography machines to SMIC as 'it does not want to make the US government upset'. The US has been trying to persuade the Netherlands government to cut its supply of lithography machines to SMIC since 2018." This means that China does not have access to this vital piece of equipment.

However, while some experts believe China is 10 years away from achieving these accuracies, reports also indicate that China can now manufacture 10nm machines. This is a decisive breakthrough being the threshold between steppers and EUV. If this machinery, allegedly cheaper than the ASML equipment it replaces, is reliable and robust, then China has reduced the gap from 10 years to 5 years, given 10 nm chips became widely available only in 2016 (although this chip did not achieve the cost and performance breakthroughs the 7nm chip has achieved). [China created the first independent new lithography machine, which can make 10nm chips in the future. \(tbcoer.com\)](#)

However, ASML is the western exception. The US has now forfeited much of the production of chips to Taiwan and South Korea. Today TSMC based in Taiwan is the undisputed market leader controlling 50% of global production followed by Samsung. Indeed, while Intel the largest US chip manufacturer was struggling to master 7nm chips, TSMC was moving on to 5nm. As a result, Intel gave up the chase and has now contracted out part of its production of these high-end chips to manufacturers in Asia particularly TSMC. In the end raw economics will prevail. It is likely TSMC and ASML will have to choose between an expanding Chinese market or a contracting US market. History has shown that leading companies seldom retain their position if they bet on the wrong markets. (Note 1.)

Huawei is often showcased as the leading Chinese High-Tech company, one feared in the west because of its competitive edge and not because of its links to the Chinese State. However, alongside Huawei is another less well-known Chinese company, but one whose importance cannot be overstated. It is the only Chinese Fabricator of chips likely to become world class and the equal of TSMC and Samsung. Its name is China's Semiconductor Manufacturing International Corporation or SMIC for short. Currently producing 14nm chips it claims to be on the verge of producing elementary 7nm chips. Although it appears confident that it has the ability to jump the 10nm stage, it is likely that due to the lack of domestic EUV machinery capable of achieving this fine detail, it may have to fall back on 10nm for the immediate future. Intel paid a heavy price for attempting to produce 7nm without EUV. For comparison sake, advanced 7nm provides

a 73% higher transistor density compared to 10nm. [Chinese SMIC Finishes Tape Out Of Its First Stage 7nm Equivalent Node \(wccfttech.com\)](#)

In addition, Huawei is effectively merging its manufacturing arm, HiSilicon with SMIC. Together they are likely to provide 7nm chips in the next two years when TSMC may have moved on to 3nm chips. [Huawei chip unit orders up more domestic production as U.S. restrictions loom: sources | Reuters](#) However, it is important to note, that etching is now approaching its physical limits with 2nm being considered the limit using silicon. Moore's law is beginning to falter as this incremental reduction in nm is yielding smaller and smaller gains in speed and energy efficiencies. This deceleration in performance is set against the accelerating cost of producing these chip sets, meaning their cost effectiveness suits only the defense industries and luxury goods where cost is less of a consideration.

In the next field of computing, photonic rather than electronic computing, China appears to have taken the lead. (This field, in my view is misnamed as quantum computing.) Setting aside categorization, this field is free of the minefield of intellectual property patents found within electronic computing, meaning that the only restrictions on China are the technical ones. In other areas China is closing the gap as well. It is now producing its own NAND chips. Yangtze Memory Technologies has launched China's first 128-layer 3D NAND chip. [Chinese Upstart's New Memory Chip Still a Year Behind Industry Leaders \(caixinglobal.com\)](#) Changxin Memory Technology Company is shipping China's first locally produced DRAM chips. Though inferior to market leading chips, they represent a significant achievement for a company only set up in 2016. [Chinese firm begins mass production of first homegrown DRAM chip · TechNode](#)

In summary, it appears quite likely that by 2030 rather than 2025, China will have caught up with the best of the west. By that time China will likely have a homegrown chip industry capable of filling all the steps from design to fabrication and with all the equipment needed. It is likely that it will be able to do so much more cheaply than its competitors because much of its capital costs will have been underwritten by the state. The losers will be the US, Taiwanese, South Korean and Japanese corporations. This decade is likely to see a fundamental pivot towards China, a restructuring of the global chip industry which for so long enabled the US to straddle the pinnacle of the global value chain. In the shorter term China will be disadvantaged, but not for long. [How Restrictions to Trade with China Could End US Leadership in Semiconductors \(bcg.com\)](#)

In the 1980s, when the US was facing the pressure of Japanese technological competition together with the improvement of weaponry in the USSR, the US government sought to weld state and civil research in a programme led by the Pentagon. It's purpose to revive US technical supremacy. (The bind the USA found itself in, was captured by the cheeky riposte the USSR made when accused by the US of espionage: it said there was no need to spy on the USA as all they needed to do was buy a Sony camcorder which contained more advanced technology and miniaturization than found in US weaponry.)

The Pentagon's effort was successful, bringing forward the era of information technology that ultimately led to the dominance of the internet and the eventual emergence of smartphones. Where no industry existed before, a new industry emerged rivalling that of the largest industry of all, motor vehicles, and it was to richly reward US corporations. Had it not been successful, then inter-imperialist rivalries could have intensified, and the world would now be a different place.

Today China is embarking on the same course of action. It is seeking to fuse state companies with private companies in a \$1.4 trillion plan, and integrate both state financed research with private R&D. To those who claim that China was and is a state capitalist, the initiatives put in place over the last few years shows just how discordant Chinese industry actually was. State investment went primarily into the upstream investments needed to fertilise private downstream investments, where the bulk of manufacturing took place. In the field of downstream investments, it was more like the Wild West than the Endowed East as the articles above show.

Paradoxically the best evaluation of the changes taking place in China is to be found in the Pentagon's 2020 assessment of the structural changes being implemented in China. This report is more about Chinese intentions rather than its capabilities, indicating a certain confidence on the part of the Pentagon that China is yet to challenge it technically. This is a must read for all those who categorise China as state capitalist. Only now is China replicating the US industrial military complex. [2020 China Military Power Report \(defense.gov\)](#)

It is likely that China is engaged in this effort because it recognises that military conflict of one kind or another with the US is inescapable. The US economic war with China has been very costly for the US, hurting thousands of corporations. 3500 of these corporations including some of the largest multi-nationals wrote to Trump requesting the end to tariffs on Chinese goods. [Thousands of companies sue US over China tariffs | Financial Times \(ft.com\)](#) The US state in the form of the state department, truly a global department, would not embark on such moves if it did not consider there was more at stake than short term profits. They recognise the US is experiencing its first existential challenge to its economic and financial hegemony. The US dominates the world economy, not because of the dollar but through the dollar, and the dollar is able to exert leverage only because of US technical supremacy which allows it to monopolise the commanding heights of value chains. Once that goes everything goes, which is why the drums of war beat ever louder. The embargo on China has merely delayed the outcome not reversed it. The US has everything to lose and everything to gain by means of war, which is what is making the next 5 years so dangerous.

#### **Of Jet Engines and intellectual property theft.**

The Chinese have been accused of stealing Intellectual Product data and reverse engineering Western and Russian products. In this they have followed the well-worn path of previous economies seeking to catch up to their more advanced economic rivals. The only difference is that as technology advances, this catch up is more difficulty, slower and extremely expensive.

Contrary to popular belief, the West has never shared its High-Tech secrets with China. *"Equipment vendors are all under NDA with TSMC. If SMIC asks a vendor for instructions, the vendor will only disclose very basic information about the instructions, just to show good faith."* [China's chip-making hampered by lack of expertise in using manufacturing equipment \(electronicsweekly.com\)](#) This article is referring to the equipment vendors in the electronic chip industry. NDA stands for Non-Disclosure Agreements where operating instructions are kept away from the user. Thus, even were Chinese companies to replicate the physical side of the equipment, they would be stymied by the lack of software to operate the equipment efficiently.

Nor is it true that China does not have robust protections for Intellectual Property (I.P.). It does have these laws and it does enforce them. The likely reason for this transition coincides with developments in China

itself. As China has moved from being a predominantly contract manufacturer to developing its own world class Science and Technology capacity, it makes sense to now protect its own intellectual conquests as well. The problem with I.P. really lies in the USA where patent law is now beginning to hamper scientific research because it has become so obstructive.

In the field of military aviation, it is not stealth but jet engines that is the key component. Jet engines arguably are the most complex and difficult pieces of equipment to engineer. This is especially true of super cruise jet engines which do not require after-burners to fly faster than Mach 1. Since 2000 China has been seeking to catch up. It is only now succeeding.

China's C919 designed to compete with the Airbus 320 and Boeing 737 is a case in point. It typifies the Chinese stage of industrial development. It is really a plane built with western parts including and especially the engines. China has only contributed the less advanced components. However, it must be recognised for what it is, and intermediate stage. The huge travel market in the country has already guaranteed enough orders for this plane to allow China to cross this intermediate stage. China will build a world class aviation industry, and the next plane it designs and builds, will not rely on western parts and expertise. Within ten years there will be three major aviation corporations not the current duopoly of Boeing and Airbus.

Turning to the more demanding technical requirements of military jet engines, it can be said that China is now less than a generation behind the West. Reverse engineering rolls easily off the tongue. The reality is different. Any competent mechanic can disassemble an engine into its various components. But being able to replicate these components to the standards required is another matter altogether. Here we are talking of precision engineering, of high temperature materials and in particular single crystal alloys.

These are skills that China has only mastered in the last few years. For example, it was only in 2017 that China finally produced the ball that goes into ball point pen. So, although China dominates ball point pen production, producing over 40 billion pens annually, it had to import the bearing from Switzerland at great cost. [China finally figured out how to make ballpoint pens | Business Insider](#) Ball bearings are a case in point because they are at the heart of all complex machinery and the more precise their tolerances, the more durable and efficient is that piece of machinery.

This is particularly true for jet engines where the shaft speed can approach 20,000 revolutions per minute. The faster the rotation the more air that can be sucked in, expanded and expelled. To achieve these revolutions, the combustion chamber needs to run hotter. Today's modern jet engines run up to 1700 degrees Celsius, which requires complex blades based on single crystal alloys with ceramic coatings and complex channels. These blades have to withstand the huge centrifugal forces being generated by rotation while not being weakened by the heat being generated. Converting heat into motion will always be one of the fundamental challenges facing engineers. [Rolls-Royce single-crystal turbine blade casting foundry](#) [The Engineer](#)

China is today mass producing its WS10 engine. This engine has been thirty years in development, which attests the difficulties facing advance engineering. One of the stumbling blocks in this development again flies in the face of the state capitalists. It was China's fragmented aerospace industry that held it back. In particular, the fact that its many vendors could not provide quality components. This was a problem encountered last century in the US and European supply chains as well. This problem has now been

addressed in China through state intervention and support, resulting in the assembly of more durable engines. [Procurement: China Finally Masters Jet Engines \(strategypage.com\)](https://strategypage.com/Procurement/China-Finally-Masters-Jet-Engines)

More importantly, China has finally mastered the production of a super cruise fighter engine, the WS-15. Once this goes into mass production, the Chinese air force will have caught up with the West. [J-20 to have strongest heart: chief of WS-15 awarded for breakthrough \(china-arms.com\)](https://china-arms.com/j-20-to-have-strongest-heart-chief-of-ws-15-awarded-for-breakthrough)

In the history of inter-imperialist rivalries, the newer and often more nimble economies typically leapfrog the dominant economies by adopting emerging technologies. This left the older economies saddled with investments representing more traditional technologies. For example, this was the case with Germany and the UK before WW1 when German industry began to overtake Britain. This could be the case with China as well. Just as with photonic computers, it appears that China has overcome the difficulty in building a hypersonic jet engine called the *Sodramjet*. More advanced than scramjets it can achieve speeds of 15,000 km per hour, putting any part of the planet in reach within 2 hours. If true, and if production hurdles are overcome, this engine bridges the divide between space and air warfare, between jet and rocket, thus heralding a new paradigm in military tactics. A decisive advantage. [Chinese Develop Hypersonic Jet Engine That Can Go 16 Times The Speed Of Sound \(wonderfulengineering.com\)](https://wonderfulengineering.com/chinese-develop-hypersonic-jet-engine-that-can-go-16-times-the-speed-of-sound)

## **Conclusion.**

This article has examined the technological gap between the world's top two economies through the prism of two strategic sectors. It sought to and answered the question: at what point does China's quantitative advantages outweigh the diminished qualitative advantages enjoyed by the USA. The answer is that by the close of this decade China will have the upper hand. In all ways the 2020s is likely to be the most decisive and eventful decade in the history of our species.

One event can slow this down, the win by the Democrats of the final two seats for the Upper House being held in Georgia. This will streamline decision making between Congress and the White House and end the dysfunctional politics that has made America Break and which has advantaged China.

The era of the domination of the Anglo-Saxons appears to be at an end as Australia is now discovering to its cost. But Anglo-Saxons may be able to redeem themselves for the last time through building a global anti-war movement. Once the pandemic is over and once the vaccines have proved to be effective, the drums of war will be unmistakable.

(Note 1.) While the US leads in hardware, China leads in consumer software with the exception of an operating system for smartphones to rival Android. This gap will be rectified within the next two years in the likely form of Huawei's Harmony Operating system. In retail, on-line banking and connectivity, China is the world leader, and vendors to China need to take account that China, with few exceptions, is now the world's largest consumer market and the gap will only grow.

Brian Green, 15<sup>th</sup> December 2020.