

# Introducing the World's *New* Technology Leader

BY FRIEDRICH WU

*How China is  
catching up fast.*

**T**he current trade conflict between China and the United States is also a fierce two-country contest to determine whether the former would eventually reach parity with, or even topple, the long-standing number-one “technology hegemon” in the world.

Since the beginning of the Industrial Revolution in Britain, throughout the nineteenth and twentieth centuries, late industrializers like Germany, Japan, and the United States borrowed, copied, and stole technologies first from Britain, and later from each other. As the pioneer industrializer, by 1860, Britain already accounted for nearly 20 percent of world manufacturing output (as a proxy for technological prowess), while Germany and the United States had much smaller shares of 4.9 percent and 7.2 percent respectively. However, after the German unification in 1871 and the end of the Civil War in America in 1865, the two countries embarked on rapid technological races. By 1913, on the eve of the First World War, Germany’s share of world manufacturing output, at 14.8 percent, had surpassed Britain’s 13.6 percent, while the United States, at 32.0 percent, had surged way ahead of both European countries.

Judging from these historical trends, there is no reason to doubt why China will one day be able to beat the United States in the technology domain. In fact, if we examine both input and output indicators, it is highly plausible that China could catch up to the United States’ technology frontiers in perhaps slightly over a decade.

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Let us start with input, which typically includes funding for innovations and the availability of scientific talent. According to OECD statistics, China's total and business research and development expenditures in 2016 (latest available data), at US\$451.9 billion and US\$350.1 billion respectively, were not too far behind the United States' US\$511.1 billion and US\$363.8 billion respectively. Indeed, last year, the U.S. National Science Board had predicted that "China [is likely] to surpass the United States in R&D investments by end of 2018." Besides massive indigenous funding by the Chinese government and corporates, multinationals operating in China are also pouring money into R&D activities, to the significant amount of US\$44.2 billion in 2015. Ironically, notwithstanding frequent complaints about weak intellectual property rights protection and forced technology transfer, American companies spent US\$6.9 billion on research and development in China during 2015–2016.

In terms of research and development brain power, the U.S. National Science Board's latest data reported that universities in America produced 39,834 STEM doctorates (an estimated 25 percent were foreigners) in 2014, while



*According to the Times Higher Education's 2019 World University Rankings, Tsinghua University is now the top university in Asia, after rising eight places to twenty-second, becoming the first Chinese institution to lead the continent. Seven institutions from China are ranked among the top two hundred.*

China's universities churned out 34,103—a very small gap, though some critics might question the quality of Ph.D. graduates from China's academies of higher learning. However, there is evidence to show that the standards of Chinese universities are rising. For instance, in the *Times Higher Education's 2019 World University Rankings*, seven institutions from China are ranked among the top two hundred, with Tsinghua and Peking Universities being conferred the twenty-second and thirty-first positions respectively. With regard to the pool of scientific talent, according to the OECD, by 2016 China already had more R&D researchers (1.7 million) than the United States (1.4 million, but many were foreigners). Again, critics might raise doubt about the quality of China's R&D researchers, but the output indicators suggest that they are a good match to their American counterparts.

Output indicators for technological prowess typically include international patents, the number of papers published in top scientific journals, and country rankings by the Global Innovation Index compiled by the United Nations World Intellectual Property Organization and Cornell University.

In international patent applications filed via UNWIPO, China toppled Japan in 2017 to reach the number two spot just behind the United States. With a growth rate of over 10 percent every year since 2003, the UNWIPO projected in 2018 that "China is to overtake the United States within three years as the largest source of international patent applications." Already in 2017, Chinese companies Huawei and ZTE were the top two

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corporations that had filed the largest numbers of international patent applications, surpassing Intel and Qualcomm from the United States (numbers three and five).

As for leadership in scientific research, which underpins technological advancements and innovations, the Nature Index—compiled by *Nature*, the premier international journal of sciences—which includes every paper published in the world’s eighty-two top-tier scientific journals by country of origin, reveals that scientists from China had contributed the second-largest number of papers (13,434), just behind contributions by U.S.-based scientists (26,623) during the mid-2017 to mid-2018 period. While the gap seems to be large, one should point out that a considerable number of these U.S.-based scientists are not American citizens. Hence, stripping off the paper contributions from non-American scientists working in America, the gulf between China and the United States would close considerably.

Finally, since 2007, the UNWIPO, in collaboration with Cornell University and INSEAD, has compiled a Global Innovation Index that measures 127 countries’ relative innovation capacities based on seven input and output variables. In the first year of its publication, the United States was conferred the top position among nations, while China was ranked a lowly twenty-ninth, even behind India (23) and Malaysia (26). By 2018 (the latest), however, the United States’ position had slipped to 6th, while that of China had shot up to seventeenth, even beating Canada (18) and Australia (20). Should these downward and upward trajectories continue, it would not

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be impossible for China to converge with, or even outrank, the United States on the Global Innovation Index within a short decade.

The current trade war waged by the Trump administration against China is in reality a campaign to contain China’s challenge to the United States’ “technology hegemony.” But as my analysis of input and output indicators reveals, Washington is fighting a rear-guard battle. My bet is that it will not succeed in pushing back China’s ambition to emerge as a technological powerhouse. Over the past millenniums, as the eminent historian Paul Kennedy has elucidated, empires come and go, great powers rise and fall. No single nation can claim permanent hegemony forever, including that in the technology realm. ◆