

COVER STORY

China's Bot Boom

Can robot-driven advanced manufacturing be a panacea for China's slowing economy? China sure hopes so.

BY ISABELLA BORSHOFF — SEPTEMBER 18, 2022

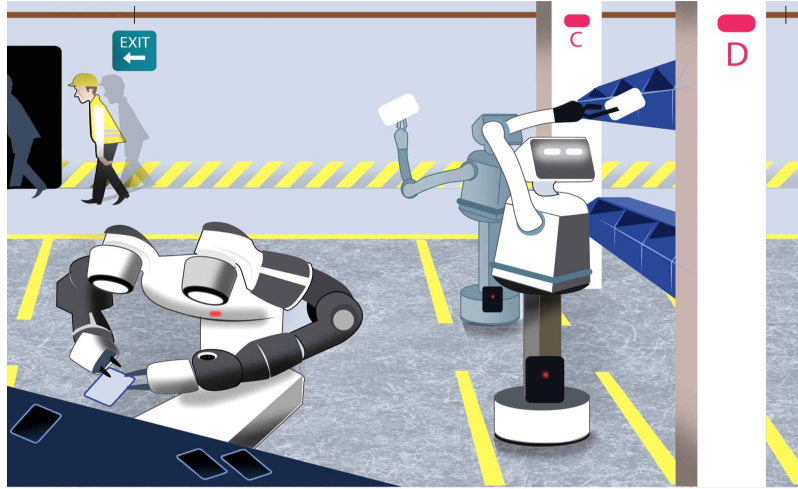


Illustration by Luis Grañena

In the outer reaches of Shanghai, one of the world's most advanced robotics factories is being programmed into existence. By the end of 2022, across an area roughly the size of 12 football fields, humans will work alongside intelligent machines to build China's future robotic workforce.

It sounds like something out of a science fiction film. Instead, it's the culmination of Swiss-Swedish technology giant [ABB](#)'s "in China, for China and the world" strategy: to deliver top-end robots to the world's hungriest automation market via an expanded, fully localized supply chain.



A virtual tour of ABB's 'Factory of the Future' in Shanghai. Credit: [ABB](#)

The fact that ABB, the world's second largest producer of industrial robots after Japanese leader FANUC, chose to build its most advanced production center in Shanghai is a testament to just how central China has become to the robotics industry. This is a relatively recent development — and a surprise even to some in the industry.

"No one believed China would be such a huge market for us, or for robotics," says [Rui Liang](#), ABB's head of robotics in China. There was a perception that "there's no need for people to work in the factory when using robots, and in China, there were people everywhere."

Indeed, China became "the world's factory" in large part due to its demographics. Its manufacturing boom was built on the backs of hundreds of millions of migrant workers, stacked together on assembly lines building fast-moving consumer goods. During the 1990s and early 2000s, labor was readily available, wages were low, and Western consumerist trends

turned on a dime — meaning that robots were hardly front of mind for China's factory owners.

But China's demographics are undergoing a fundamental shift. The late 20th century boom in the country's working age population has given way to demographic collapse, the result of China's strict regulation of family size via the one child policy. Between 1980 and 2015, China's working-age population grew from [594 million to about a billion](#). Now, it's commenced what will become a sharp decline. By one UN estimate, China's working population will lose around 220 million people by 2050, and the country's overall population is set to nearly halve by 2100.

China's aging population is only one piece of the puzzle. The other is rising labor costs. As China has grown wealthier and exhausted its surplus of migrant labor, its workers' salaries have jumped beyond what producers of basic consumer goods are willing to pay.

As those industries move offshore to lower income countries, like Bangladesh and Vietnam, China is undergoing an economic rebalancing. Its days of relying on a tidal wave of young, hungry workers to drive growth by churning out low value goods are over.

This is a normal stage in the development process, but it's also where many countries have seen their economic growth stall. Economists call it the "middle income trap" — where countries deindustrialize before they become rich, and fail to find new ways of increasing economic productivity to bolster ongoing growth. Many more countries languish in middle income territory than have managed to escape it. And for China, which sits tantalizingly close to high income status, the prospect of falling short now is particularly worrying given its aging population, which threatens to burden its economy through high levels of dependency on a dwindling number of young workers.

That's where robots come in.

"China's aggressive push for automation comes from the biggest existential threat that China and the CCP faces right now," says [Dominic Jacobson](#), an investment analyst who looks into emerging markets at VanEck, the New York-based investment manager. "At the current rate the population is going to contract over the next decade. That presents some significant challenges, including a rising dependency ratio, and so puts greater pressure on the working population to produce."



Chinese workers sit around a table during lunch break in front of a VW Polo car body at Volkswagen's Shanghai plant, 12 October 2004. Credit: Carsten Rehder/[AP Images](#)

“Going to a 10,000 foot level, promoting manufacturing really fits into the new China policy paradigm. They [China] want to re-establish themselves as the global industrial powerhouse that they've been known to be — the manufacturing center of the world.”

— [Dominic Jacobson](#), an investment analyst at VanEck

By adopting robots in its factories at scale and transforming into a new kind of manufacturing giant, China hopes to follow the lead of industrial powerhouses like Japan, Korea and Germany, all of which avoided the middle income trap.

In 2011, China's manufacturing sector accounted for 32 percent of GDP; in 2021, it had fallen to [about 27 percent](#), according to the World Bank. For many economies, like the U.S. and UK, it's normal for GDP to shift in favor of services and away from manufacturing as incomes rise and factories follow cheaper labor offshore. But Beijing wants to keep manufacturing's share steady going forward. Productivity tends to be lower in services; plus, recent supply chain challenges created by geopolitical tensions, the COVID-19 pandemic, and now Russia's invasion of Ukraine have reinforced the value of being able to *make* things.

"Going to a 10,000 foot level, promoting manufacturing really fits into the new China policy paradigm. They [China] want to re-establish themselves as the global industrial powerhouse that they've been known to be — the manufacturing center of the world," says Jacobson, from VanEck. "But that also ties into some of their political ambitions, such as common prosperity. The idea is that the manufacturing sector has traditionally been an area of the economy that has employed a lot of the working class people."



Workers in Xpeng Motor's EV factory in Zhaoqing, Guangdong Province. June 9, 2020.

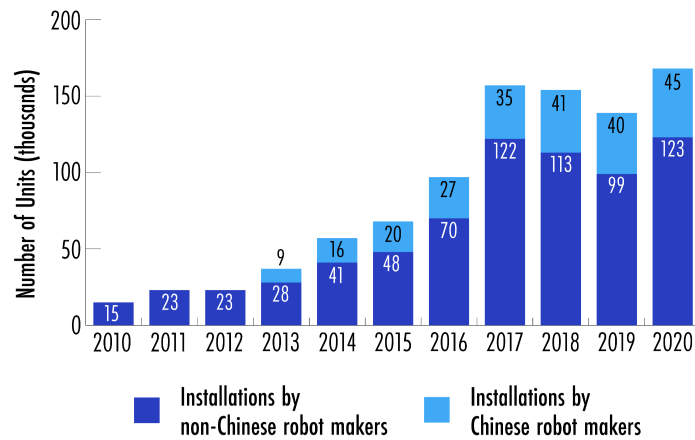
Credit: [Xpeng Motors](#)

For China, making the transition requires moving into the kind of advanced, big bang-for-buck manufacturing that economies like Germany excel in — think electric vehicles rather than plastic toys. And in high-end manufacturing, robots, alongside other digital innovations like artificial intelligence and cyber-physical systems, are central.

With a series of government plans, including [Made in China 2025](#), that seek to accelerate China's robotic development and deployment, factory floors across China have started to change.

In China today, the most menial and labor-intensive work — such as routine testing of a hot-of-the-press cell phone, or lifting the metal frame of a car into place — is more frequently done by robots than migrant workers. Far from the androids of science fiction fame, these automatons look more like bulked up versions of the Pixar lamp mascot: a multi-jointed metallic limb that ducks and weaves its way through whatever tasks it's been programmed to do. But as robots grow more flexible — backed by improvements in machine learning — they are increasingly taking on more sophisticated challenges.

Annual Installations of Industrial Robots in China

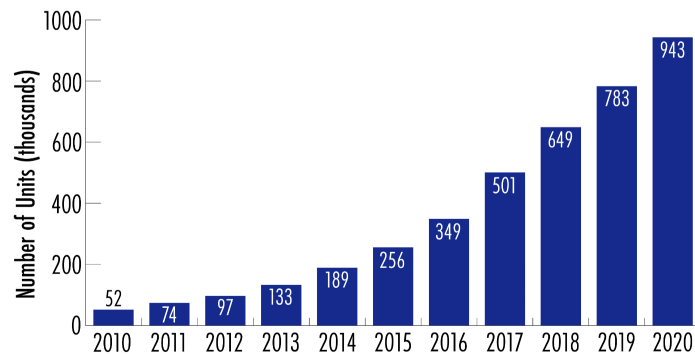


Data: International Federation of Robotics

“The whole robotics industry is going crazy in China,” says [Elon Choo](#), who works in sales for a second-hand robot distributor in Dongguan, in southern China. “Our company started ten years ago, and it was quite small. We’ve been growing very quickly for the last five, six years.”

China still lags on so-called “robot density” — a measure of the number of robots per 10,000 workers. In 2020, it came in ninth, after countries like South Korea, Japan, Germany and even the United States. But its robotics rise has been unprecedented, and it’s now the fastest growing robot market in the world. From operating a mere fraction of the world’s industrial robots in 2005, China overtook Japan as the world’s largest robot buyer in 2013. By 2016, it was home to more robots than any other country; and in 2020, it installed almost half the world’s total.

Number of Robots Deployed in Chinese Factories



Data: International Federation of Robotics

Indeed, unlike in the West — where, politically, robots are viewed with suspicion for their potential to supplant unskilled manufacturing workers — in China, the rise of automation is seen as central to the country’s future growth. China’s leaders, in other words, aren’t worried about replacing humans with robots; they know they need to, to survive.

In many ways, China is well-positioned to make the productivity leap. With its existing, strong industrial base, and STEM-focused workforce, it’s an attractive place for robotics companies to make, test and deploy their creations. As ABB’s Liang says, it’s no big coincidence that “China is the biggest manufacturing center in the world, and it’s the biggest market for robots.”

But can robot-driven advanced manufacturing be a panacea for China’s slowing economy?

Experts agree a successful push in robotics will be a boon, even if it won't solve all of China's economic woes. At the same time, a robotic revolution will come with its own challenges, including managing the hundreds of millions of workers who might get left behind.

MADE IN CHINA, VERSION 2.0

Since the 1959 introduction of “[Unimate](#),” the world's first industrial robot, to a General Motors assembly line in New Jersey, the automotive sector has been the chief driver of robot development and deployment worldwide. This meant vehicle manufacturing powerhouses like Japan and Germany gave rise to the world's premier robotics companies, which largely focused on relatively simple, giant arms that could lift and place heavy and dangerous things like steel sheets and car engines.



The Kawasaki Unimate. A licensing agreement was signed in 1969 between Unimation Inc. and Kawasaki Heavy Industries (which now controls Kawasaki Robotics) to allow Kawasaki to manufacture and market the Unimate robots in Japan. Credit: [Kawasaki Robotics](#)

Until recently, China was hardly a world-leading auto center and, as a result, was largely ignored by the world's robot-makers. In the year 2000, less than 400 robots were sold in China, compared to almost 100,000 worldwide.

That didn't deter ABB, which began selling robots to Volkswagen in Shanghai in 1994. Compared to the scale of its global business, ABB's robotics operations in China were initially tiny.

“We sold six welding robots to Volkswagen that year,” Liang says. “But we kept thinking about the population. There's one billion people there, and there are no cars. Maybe you think there's no market. Or maybe you think there's a huge market!”

ABB doubled down: By 2005, it had launched an R&D base in China; and in 2006, it relocated its robotics headquarters to Shanghai. It was the first international robotics company to establish a full value chain in China.

The bet paid off. In the wake of the Global Financial Crisis, things began to change. As car markets in the West stalled, China boomed thanks to a large government stimulus and an increasingly wealthy population. Foreign carmakers turned to the Chinese market to bolster their bottom lines, and in 2009, China became the world's largest car market.

[Georg Stieler](#), who manages the China office of technology advisory Stieler Technologie- & Marketing-Beratung (STM), says the change in China's robotics appetite happened almost overnight. In 2011, he remembers a local manufacturer telling him he had no interest in robots “because look at all the unskilled and uneducated labor we have.” Just two years later, though, thanks to the growing, robot-hungry contingent of car manufacturers, China became the largest market for robots in the world.



Shanghai Mayor Gong Zheng (left) and Rui Liang (right) at the Recognition Ceremony for ABB's technological innovation and R&D capabilities, May 24, 2021. Credit: [ABB](#)

The arrival of a car industry in China coincided with the beginning of major demographic and developmental shifts in China — ones that would likewise boost the fortunes of robot-

makers.

First, factory owners started to feel the bite of rising wages. Between 2003 and 2013, real wages in manufacturing almost tripled. When wages are low, businesses are unlikely to make large upfront capital investments in robots and other automation equipment. As they rise, however, robot economics starts to make more sense.

Second, China's working age population growth slowed dramatically, peaking around the middle of last decade. Businesses soon faced a double dilemma: workers were both increasingly scarce and more expensive. As a result, lower-end manufacturing started shifting elsewhere in Asia, where wages are significantly lower. Nike and Adidas, for example, were both manufacturing more shoes in Vietnam than China by 2013.

“**A big way you generate productivity is getting people off farms and into factories. That's what China's done. That's China's story. But eventually that peters out...**”

— [Roland Rajah](#), lead economist at the Lowy Institute in Sydney

China's economic model needed a refresh. Its main driver of growth — the deep well of young, migrant workers willing to move to cities and take up menial, sometimes dangerous factory work for low pay — was stalling.

“A big way you generate productivity is getting people off farms and into factories,” says [Roland Rajah](#), lead economist at the Lowy Institute in Sydney. “That's what China's done. That's China's story. But eventually that peters out, and you can't generate that kind of productivity growth easily going forward.”

When that demographic advantage reverses, and wages rise in line with normal development patterns, countries need to find other ways to stimulate growth. Otherwise they risk falling into the “middle income trap” — a phenomenon that has ensnared dozens of countries including Mexico, Turkey and South Africa.

Since the rise of Xi Jinping in 2012, China's leadership has been focused on avoiding the middle income trap by driving productivity growth through advanced manufacturing, including increased robot use — à la industrial powerhouses like Japan, Korea and Germany. In 2013, China's Ministry of Industry and Information Technology (MIIT) released its first “Guidance on the Promotion and Development of the Robot Industry,” which included goals like increasing robot usage to 100 per 10,000 human workers, from 25 per 10,000 workers that year.



A factory making industrial robots in Jiangsu province, September 11, 2019. Credit: FeatureChina via [AP Images](#)

By that point, China's robot deployment was skyrocketing, but the robots themselves were largely made by foreign companies, like ABB.

Beijing announced the [Made in China 2025](#) initiative in 2015, with the goal of ensuring the enabling technologies of future-facing manufacturing were built at home, not abroad. Made in China 2025 identified robots as one of ten key future technologies, and a follow-up plan, the Robotics Industry Development Program (2016–2020), set a target for robot density of 150 robots for every 10,000 workers by 2020, which China soared past — hitting 246 per 10,000 in 2020.

Government plans and policies were backed up by a comprehensive subsidy regime at both the national and provincial levels. For example, in 2015, Guangdong Province made \$150 billion available to businesses for robotics development.

But Stielor says subsidies for domestic companies were largely ineffectual, especially in the early days.

“Many of these companies didn't actually own any quality technology. Some of them even bought foreign robot arms and just repainted them to get subsidies.”

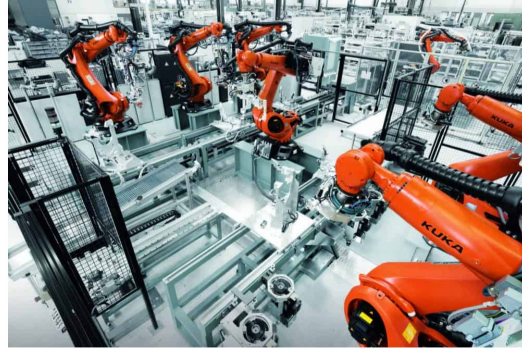
— [Georg Stielor](#), manager of *Stielor Technologie- & Marketing-Beratung's* China office

“There were all kinds of crazy reasons to start robotics companies, and the funds were not distributed according to the skills of the management, or an original idea for a new technology or protocol,” he says. “Many of these companies didn't actually own any quality technology. Some of them even bought foreign robot arms and just repainted them to get subsidies.”

Indeed, despite its rapid growth in robot deployment, China has struggled to increase its share of domestic robot production.¹ The so-called “big four” in global robotics — which includes the Japanese firms [FANUC](#) and [Yaskawa](#), Germany's [KUKA](#) (now Chinese controlled)² and ABB — still sell [over 70 percent](#) of the robots in China, although some in the industry say local companies have managed to increase their profile during the pandemic and through COVID lockdowns.

Regardless, Beijing's efforts — as well as the raw appeal of the Chinese market — have succeeded in localizing some of the value chain. Today, a large number of ABB's robots are being manufactured in Shanghai and sold domestically. As ABB's then-head of China sales, Tim Deng, said in a company [blog post](#), ABB is “well positioned to help the Chinese government meet the ambitious goals of its Made in China 2025 plan.”

Some of ABB's key rivals have also been building aggressively in China. In June 2018, Yaskawa, a Japanese company, rolled out a new robotics [factory](#) in China. ABB's main rival, FANUC, the Japanese automation powerhouse that has a hold on the global industrial robot market, has also been increasing its investments in China. Although it still produces its core components in Japan, it announced plans last year to pour \$240 million into the expansion of its



The 'KR QUANTEC pro'. Credit: [KUKA Group](#)

factory in Shanghai. And KUKA, a German robotics giant that China's Midea Group purchased in 2016 (to some [outcry](#)) has gradually expanded its manufacturing presence in its new home country, and now develops some robot models, as well as makes them, in China.

ABB's new, \$150 million Shanghai megafactory, which was announced in 2018 and has faced successive delays due to the COVID-19 pandemic and this year's Shanghai lockdowns, is just another boon for Made in China 2025. It is projected to spit out 100,000 new robots every year, making it ABB's largest single robot manufacturing center.

For ABB, the opening of a new facility will help the firm regain its footing in China, after a sales slowdown in the first half of this year caused the firm to lose ground to FANUC, the global leader. The new megafactory could also help ensure that China is well-equipped to rise in the ranks of the world's robotic nations.

A PRODUCTIVITY MIRACLE?

Although the robotization of manufacturing has long been promised — or threatened, depending on your vantage point — experts say COVID-19 marks a turning point.

Despite its initial dampener effect on sales in most major markets — China, by contrast, saw a 20 percent increase in robot sales in 2020 — the pandemic is likely to kickstart another round of factory automation around the world. Robots can work through lockdowns, after all, and they don't get sick. Supply chain bottlenecks have also demonstrated the value of producing things close to where they're needed.

“We've visited a couple hundred manufacturers [in Australia] over the last two years, and all of them are trying to de-risk their businesses by not relying on people overseas too much,” says [Jonathan Roberts](#), a professor in robotics at Queensland University of Technology, in Australia. “Maybe even four or five years ago that didn't enter people's thinking. There's been a massive switch.”

On the one hand, this trend and the so-called “reshoring” movement could be seen as a threat to China's manufacturing future. But experts tend to agree that China's existing giant market — both in terms of factories and consumers — make it a logical hub for advanced manufacturing.

“It's an attractive place to produce because of the size of the market, and because supply chains are so dense within China,” says [Alexander Brown](#), an analyst at MERICS, the German think tank.



ABB robots at work in Xpeng's Smart EV Factory, June 9, 2020. Credit: [Xpeng Motors](#)

Many economists also think China is poised to capitalize on the boom in advanced manufacturing. "China is well advanced in terms of many of the key technologies [in this sector], like renewables, electric cars, use of AI and robotics, and manufacturing processes. And there's a lot of government support for it," says [John Hawksworth](#), an independent macroeconomist who was formerly the chief economist at PwC in the UK.

But China's robotic rise won't be without headwinds. In a world where geopolitical tensions are threatening both foreign investment in China and Beijing's access to overseas technologies, China's continued reliance on outside companies in its robotics rollout leaves it vulnerable.

"After two-and-a-half years of the zero-Covid policy, Beijing's unclear position in the Ukraine war, and the perception of a looming Taiwan conflict are making many foreign companies rethink their supply chains," says Stieler, from STM.

Meanwhile, China's domestic robotics firms' market share has remained stubbornly low, at around 30 percent for the past five years.

"Right now, China can produce robots by itself, but the quality isn't as good as those produced in Japan or Germany, in terms of chips and software," says [Hongbin Li](#), a co-director of the Stanford Center on China's Economy and Institutions. "It's just not something China is as good at. So if China is cut off from the rest of the world, this will be an issue."

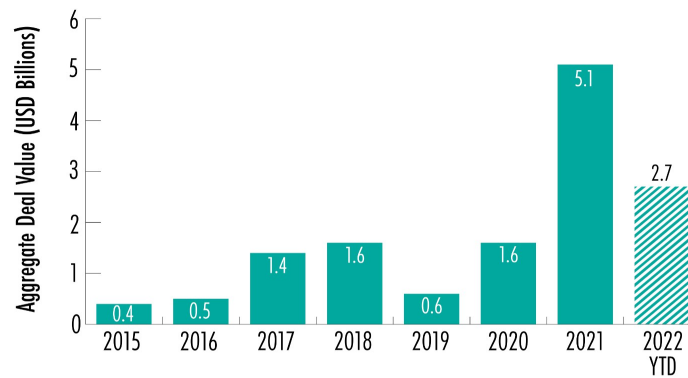


An industrial robot from Chinese firm SANY displayed at the World Robot Conference in Beijing, August 18, 2022. Credit: Andy Wong/ [AP Photo](#)

Moreover, Chinese robotics companies have often relied on acquiring European intellectual property to make up for their own technological gaps. But "decoupling" is making that more difficult, too, as European leaders grow more aware of the risks associated with technology transfer. In May 2022, for example, the Italian government used its foreign investment screening powers [to prevent](#) Chinese robotics firm Efort — which has previously acquired Italian companies — from increasing its stake in Italian industrial robot component maker Robox.

Many analysts expect China will eventually achieve greater self-sufficiency and be able to hedge against geopolitical risks. Investment from venture capital firms, for instance, is pouring into the Chinese robotics sector at unprecedented rates, and in recent years, increasingly sophisticated technology is emerging from the country's technology hubs.

Robotics Venture Capital Investments in China



Data: Preqin Pro

But even if China can manage to keep up its rapid development and deployment of robots, the country's hunger for advanced manufacturing is really just a means to an end — increasing productivity — and economists say that boosting productivity is a lot harder than just installing more robots in factories.

“China's [economic] growth has been unprecedented,” says Rajah, from the Lowy Institute. “But on the productivity front they're not a miracle in the same way [as Japan and Korea]. They'd need to become one.”

Indeed, as a high-middle income country, China is on the cusp of making it out of the middle income trap. But China faces a host of other productivity challenges, including the fact that its population is, on average, less educated than Japan's or Germany's was at the same development stage. Human capital development, economists say, is central to sustained economic growth.

[Linda Glawe](#), an economist at the University of Hagen, in Germany, argues that China is in a “relatively good position” when it comes to building an advanced manufacturing economy, but says “it really depends on China's investment in human capital and education quality all over the country. That will be decisive.”



A staggering [70 percent of China's workforce](#) doesn't have a high school degree, yet the jobs that complement advanced manufacturing require higher education levels. The question for China, many warn, is how to manage those unskilled workers through such a transition.

When people “do not possess the necessary human capital, like non-routine cognitive skills, then it's difficult for them to take jobs that are complemented by automation,” including productive service sector jobs, Glawe says. Not only could that ultimately hamper China's ability to innovate, it would also drive a wedge between China's haves and have-nots.

[Scott Rozelle](#), a development economist who co-directs the Stanford Center on China's Economy and Institutions with Li and has worked in China on-and-off for the last 40 years, sees the stakes as even higher when it comes to China's education levels.

"If you look at the countries that have been in the middle income trap for the last 50 years ... only 35 to 40 percent of their labor force has been to high school," says Rozelle,³ who is the co-author of a recent book on the subject, [Invisible China: How the Urban-Rural Divide Threatens China's Rise](#). "Big parts of their labor force can't participate in this new economy. Can China become a high income country when 500 million people haven't been to one day of high school? What do [those workers] do?"

“When you have that large a population, trying to raise everyone up to middle class is quite challenging. It’s not an overnight thing. It’s probably something they’ll be working on for the next 30 years.”

— [John Hawksworth](#), macroeconomist

[Lauren Johnston](#), an associate professor at the University of Sydney and expert in China's economic demography, doesn't see this as such an issue. "If you take Shanghai, Tianjin, Beijing, their education statistics are safely within range of the OECD standards. If you take the national ones, no, of course they're not," she says. "The question is, do Beijing, Tianjin, Guangzhou have enough qualified scientists to push China's frontier. And then, what they generate in growth, they can share and continue the steady catch up of the poorer parts."

China's aging population might soften the blow of a potential unemployment crisis, but it won't mitigate it entirely, especially in the short term. Most experts agree that the next phase of China's growth is going to require building a social safety net — which is largely nonexistent at the moment — and managing the spread of wealth across the population.

[Click here to read a Big Picture by Eliot Chen on unemployment in China.](#)

"When you have that large a population, trying to raise everyone up to middle class is quite challenging," says Hawksworth, the independent economist. "It's not an overnight thing. It's probably something they'll be working on for the next 30 years."

With ABB's new robotics factory about to come online, however, China's long sought-after goal of increasing robot density could get a boost overnight. "We are going to build up a beautiful megafactory to fulfill the demand in the biggest market in the world," says Liang, from ABB. "There's a lot of new things coming [in China] ... It's very exciting."



Isabella Borshoff is a staff writer based in London. Previously, she worked as a climate policy adviser in Australia's federal public service. She earned her Master's in Public Policy at Harvard's Kennedy School. Her writing has been published in *POLITICO Europe*.

● COVER STORY

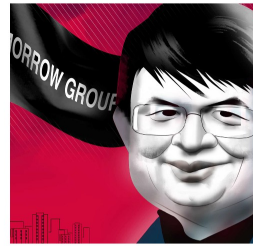


The 5G Fracture

BY LUKE PATEY

It is business gospel in the West that for a corporation to be globally competitive, it must be competitive in China. But what happens when an international company loses the chance to compete in the world's second largest economy? The Swedish telecommunications giant Ericsson shows a possible post-China future may not be as bleak as imagined.

● THE BIG PICTURE



Xiao Jianhua's Lost Empire

BY ELIOT CHEN

A look at Xiao Jianhua's financial empire: the companies involved, what's happened to them, and what, if anything, remains.

● Q & A



Aaron Friedberg on What the U.S. Got Wrong About China

BY DAVID BARBOZA

The professor talks about his latest book; why engagement was a gamble, not a blunder; what changed after Tiananmen; and why the U.S. should take a stronger line against China.



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