Artisan China Post-Venture Team

China's AI Growth Multiplier

GREATER CHINA
Insights

Key Points

- Artificial intelligence (AI) could be a growth multiplier for China, representing a potential $7 trillion in new economic output by 2030, fueled by a 12% compound annual growth rate (CAGR) in digital activity from 2022 levels.
- Baidu's Ernie Bot, a generative AI program like ChatGPT, exceeded one million users in a single day, surpassing the initial momentum of OpenAI's ChatGPT.
- Large language models provide the foundation for new AI applications and uses.
- The central government's focus on innovation—with constructive policy toward AI—is boosting adoption.
- While geopolitics limit access to advanced AI semiconductors and equipment, Chinese companies have a level playing field within domestic markets.

Introduction

What is Artificial Intelligence?

Artificial intelligence refers to machines performing human tasks, such as understanding ideas, reasoning, learning and decision-making. Generative AI tools, like Ernie Bot and ChatGPT, can create content such as text and images, or write computer code based on a sentence or two of instructions from a programmer.

Globally, venture capital firms have invested $846 billion in AI over the past decade, including $220 billion in China. Looking ahead, we expect China's investments in AI could help its economy generate an additional $7 trillion in GDP by 2030, fueled by a 12% CAGR in digital activity from 2022 levels.

Chinese companies already use AI in areas ranging from health care, consumer recommendation engines and autonomous driving. Large language models are helping new developers create industry-specific applications, making AI tools accessible to companies of all sizes. More importantly, the next generation of use cases for AI is still emerging, setting the stage for entrepreneurs aiming to solve large challenges for China's economy and the broader global community.

In August 2023, China's regulators approved 11 large language models for public use, including Baidu's Ernie Bot, a generative AI program. Ernie Bot was an immediate hit, with over a million users on its first day. The popularity of Ernie Bot and other large language models opens a new chapter of AI in China, as AI tools become increasingly accessible to ordinary people.

China's government has quickly rolled out a constructive policy framework for AI companies. China's Generative AI Law provides guardrails and best practices for industry participants. As we have seen with electric vehicles and solar markets, industrial policy in China can significantly boost new industries.

An obvious challenge facing Chinese AI companies is the evolving geopolitical landscape. The US-led ban on selling advanced semiconductors and quantum computing equipment to China creates bottlenecks in the supply chain. AI also creates industry disruption, as new businesses displace larger competitors.

Over the long run, we expect AI to increase China's economic productivity while expanding the opportunity set for investors. Innovation will continue to come from the bottom up, led by entrepreneurs imagining fresh solutions to unmet market needs and challenges.

The Growth Potential of AI

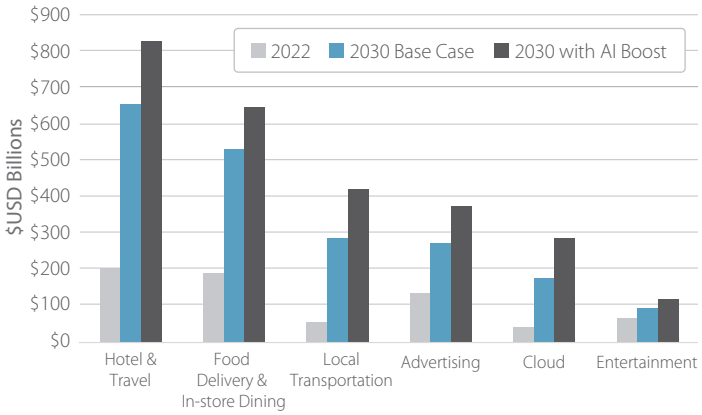
We see three factors that could drive growing AI adoption in China:

- Brick-and-mortar economic activity continues to move online.
- China's long-running IT underinvestment will reverse, as employers look for greater efficiency among rising wages.
- A shrinking workforce also requires employers to fill vacancies via AI and other automation tools.

Growing Online Activity

Some industries in China, like advertising, operate in a digital environment. We expect these industries to gain efficiency using AI tools. Advertisers, for example, can use generative AI to help create ads and marketing campaigns. Other industries have historically low conversion rates to online transactions, but AI should help boost online migration. In addition to higher advertising conversions, we expect better matching of supply and demand with AI recommendation engines. Exhibit 1 illustrates sectors that could double their online sales over the next six years. AI-enabled tools will use smart technology, such as targeted ads and better data analysis for merchants, to drive revenue growth across channels—especially online.

Exhibit 1: AI-Driven Expansion of Online Activity in China



Source: Artisan Partners. Estimates are based on the team's analysis and are subject to material revision.

Rising IT Investment

As labor costs trend higher, automation and information technology (IT) investments are becoming more important for Chinese companies. Labor costs in China have gone from 7.7X lower than US labor costs in 2010 to just 3.8X lower today. Given rising labor costs, Chinese employers must invest more in IT to reduce expenses. We estimate that China's IT spending will rise from 2% of GDP in 2022 to 3% in 2030, representing an 11% CAGR. In addition, China's cloud adoption could also rise from 10% in 2022 to 35% in 2030, with a CAGR of 29%, as most AI models reside in either public or private clouds to quickly access and deliver mission-critical data.

Shrinking Workforce

In addition to rising wages, China faces an aging population. Demographers expect China's working-age population to fall from 983 million in 2023 to 767 million in 2050, a decline of 22%. AI alleviates the shrinking workforce problem because employers can use it across lower and higher-skill job categories. AI in lower-skill jobs can assist with anything from warehousing operations to shipping fulfillment. China, which accounted for 30% of global manufacturing output in 2021, already has substantial amounts of manufacturing-related data, which is critical for AI adoption. AI tools could help Chinese manufacturers further improve their global competitiveness. In higher-skill jobs, companies use AI tools for medical diagnosis, software programming, analysis of financial markets, and even predictive models for agriculture and weather forecasting.

Policy Boosts Innovation

China's policymakers were early champions of the AI industry because they recognized its potential to help improve the country's economic output. In 2021, the Chinese Communist Party identified AI as a strategic area of focus as part of its most recent Five-Year Plan. Policymakers identified three areas of critical development for the country—computing power, AI innovation, and AI industry-specific applications.

China is one of the first countries to have formal, transparent rules enacted for generative AI innovation. China's Generative AI Law supports domestic innovation in AI algorithms and frameworks, prioritizing secure and reliable software, tools, and data resources.

On the surface, the rapid passage of China's Generative AI Law could seem counterintuitive to outside observers because China's internet companies play a key role in providing AI infrastructure. China's policymakers previously cracked down on fintech-related areas of the internet sector from 2020 through the first half of 2022. However, at the heart of the government's regulatory actions were antitrust issues, rather than the use and development of AI. China's government has consistently supported innovation in AI.

Key provisions of China's Generative AI Law include:

- **Avoiding misinformation**—Companies are responsible for training and optimizing their models to avoid generating illegal or discriminatory content.
- **Ensuring data privacy**—Businesses must protect user data. App developers cannot share or sell user data to other parties.
- **Maintaining data security**—Consumer-facing companies must complete a data security assessment by regulators to ensure compliance.

Having grown up under strict data privacy laws, China's internet companies are skilled at complying with government regulations. Current AI policies build on existing information privacy frameworks in China, so any companies managing user data have experience in this area. Beyond this, new and existing companies can move forward with a clear set of rules, enabling Chinese companies to move faster than those in other markets that need to self-regulate.

By comparison, the absence of AI regulation in the US has led to legal headaches for OpenAI (the creator of ChatGPT, which has a partnership with Microsoft), now dealing with copyright infringement cases in US courts. Meanwhile, in the EU, draft legislation for governing AI faces a lengthy approval process by EU members. The absence of clear rules in the US and EU means companies operating in these markets must reformulate their products as AI oversight evolves.

AI Has a Wide Range of Practical Applications Across Industries

While AI has been around for decades, the use cases will continue to expand and evolve. To provide a flavor of AI's real-world applications, we will spotlight two industries where companies use AI with increasing sophistication—health care and automobiles.

Health Care

China has enormous health care demands, driven by an aging population and a growing prevalence of health conditions common in the West, including diabetes, heart disease and cancer. Chinese biotech and biopharma companies are moving quickly to unlock the potential of AI, especially in discovering new drugs and therapies. AI is critical in drug discovery because it helps speed up the process and save more lives.

A handful of health care companies in China already use innovative AI to improve efficiency in the global drug discovery and development value chain. From a productivity standpoint, AI tools can reduce the time needed to conduct clinical trials. For example, for every 2.5% improvement in preclinical trial results, we could see thirty new drug approvals by the FDA over the next 10 years. This potential for saving time has led to a 7-fold increase in AI adoption in clinical trials. In 2021, more than 100 drug applications to the FDA included an AI component, compared to just 14 in 2020.

Exhibit 2: AI Applications

Health Care	Auto	Digital Content	Financials	Business Productivity
Drug discovery	3-D vision	Generating pictures and videos	AI portfolio management	Automating back office tasks
Diagnosis and detection	Intelligent cockpits integrating large language models	Gaming graphics	Risk assessment tools	Accelerating data analysis
Analyzing complex data sets	Driver assistance via autonomous driving features	Search and shopping recommendations	AI thematic fund offerings	Predictive modeling
MedTech and glucose monitoring	Independent wheel suspension	Enhanced ad conversions	Automated trade execution	Smart enterprise software suites
Smart implants for knees and hips	Smart charging stations for EVs	Greater marketing efficiencies	Fraud detection and prevention	Presentation development
Physician service tools	EV battery optimization	Enhanced algorithms for content promotion	Replicating indicies	Automated personal assistants

Source: Artisan Partners. For illustrative purposes only.

AI is also used in health care services, such as early diagnosis and disease detection, to improve patient outcomes. Life sciences tools could incorporate AI to better analyze complex health care data sets. In addition, MedTech could incorporate AI into continuous glucose monitoring, cardiac monitoring and robotics.

Automobiles and EVs

China's government has banned the sale of internal combustion engine cars by 2035. Over the past decade, the number of EVs on the road in China has increased at an 85% CAGR, with EV makers expected to sell 8.5 million units in 2023. Chinese automakers have demonstrated a strong, pioneering spirit in incorporating AI driver assistance into their EV models. China permits SAE Level 2++ of autonomous driving, a form of co-piloting with humans that allows continuous assistance with acceleration, braking and steering.

AI applications in cars include:

- **Independent wheel suspension**—Uses cameras under the car to scan the road for bumps, allowing each wheel to adapt to road conditions independently.
- **Three-dimensional vision**—Combines a bird's-eye view (view from above) with deep-learning models (transformers that follow a complex set of rules) to enable autonomous driving features.
- **Corner cases**—Solves hard-to-predict road hazards, such as running a stop light or an animal in the road. Combining AI tools, including machine vision and machine learning, can help improve safety features.

AI relies on the quality and quantity of input data, and Chinese automakers have enviable data to train their models on. While Chinese domestic auto companies are currently 6 to 18 months behind global EV leader Tesla in collecting autonomous driving data, they are quickly narrowing the gap. Domestic EV makers in China are winning market share from foreign car brands and have larger fleets of cars in service to collect data.

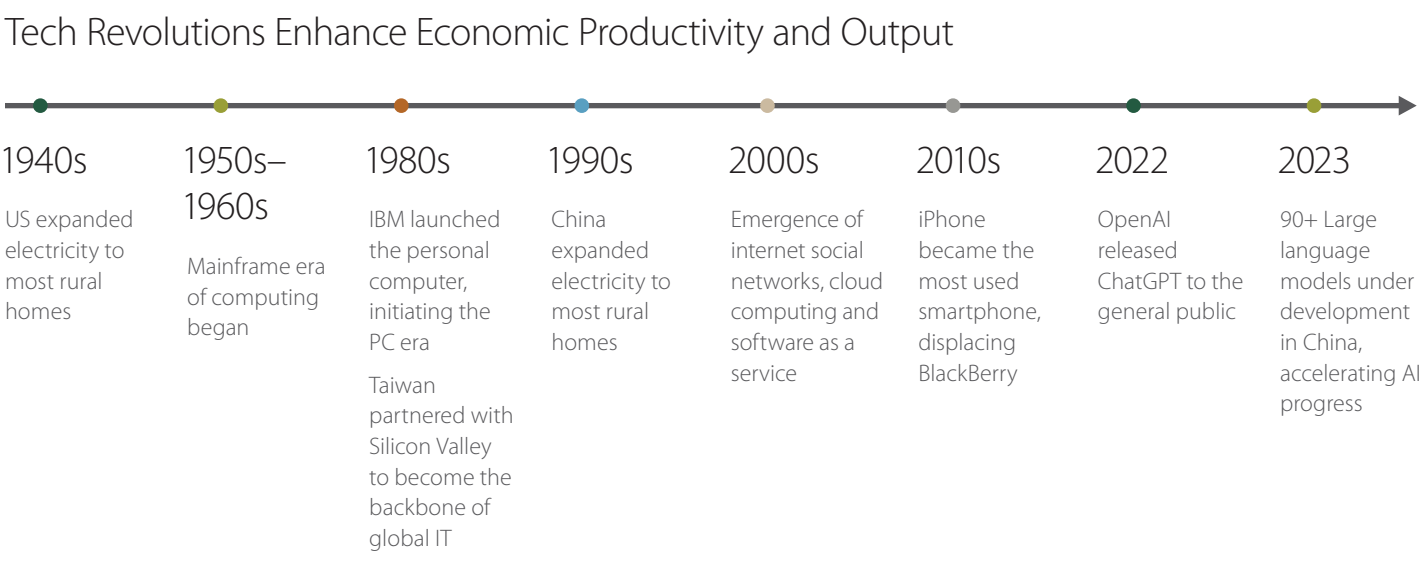
Large Language Models Make Applications More Scalable

AI applications require significant computing power, or infrastructure, to work. AI infrastructure refers to the data, chips, and storage powering applications in the background. Fortunately, app developers in China can leverage large language models that major internet companies provide to access the underlying computing power needed to run and customize their applications for business uses.

Large language models are AI that uses deep learning to analyze human language at scale. Engineers train the models on massive amounts of data, including text and code, to generate coherent and fluent responses. In China, over 90 companies—including startups, academics, and established firms—are building their own large language models. These large language models form the foundation for specific use cases targeting industry and business needs.

To run a large language model, organizations require a "full stack" of AI infrastructure—meaning they have the data, chips and servers to power the algorithms. A handful of companies in China have the full stack, most notably Baidu, Alibaba, Tencent and ByteDance. These companies offer foundation models, which are sophisticated, general-purpose algorithms that can be adapted to a wide range of downstream tasks.

Exhibit 3: Major Technology Advances Over the Past Century

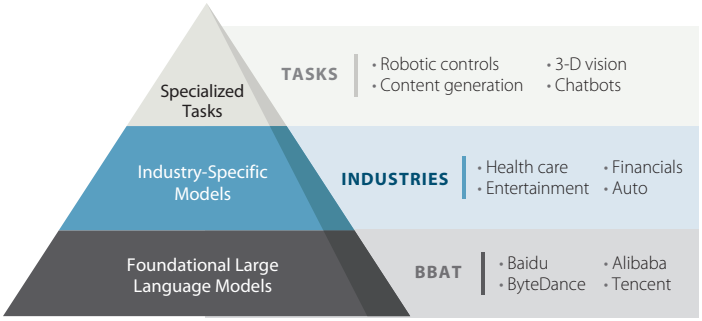


Source: Artisan Partners. For illustrative purposes only.

Here is an overview of the companies providing foundation models to app developers:

- **Baidu** is China's largest search engine. The company is the current frontrunner in foundation models. Baidu has embedded Ernie Bot, a generative AI program, into its search engine. Ernie Bot is also available to the public via China's iOS app store.
- **Alibaba** is a diversified consumer online marketplace. The company has its own large language model called Tongyi Qianwen, a pre-trained foundation model that Alibaba's merchants can use to improve the customer experience.
- **Tencent** is China's largest internet company, which operates social networking platforms, mobile gaming, and payment systems. The company also has large language models, including its Huanyuan AI project.
- **ByteDance** developed the video-sharing apps TikTok and Douyin (the Chinese version of TikTok). The company's approach to AI has been to build an open ecosystem that leverages large language models from third parties.

Exhibit 4: Large Language Models Form the Base of Industry-Specific Models and Tasks



Access to foundational large language models makes current and future applications more scalable. Through these models, app developers have access to similar computing power.

Source: Artisan Partners. For illustrative purposes only.

With cash-generative businesses, Baidu, Alibaba, Tencent and ByteDance play a crucial role in China's domestic ecosystem because they can invest considerable resources in AI infrastructure. These resources include large company balance sheets, large teams of engineers, and the ability to add headcount. Jobs in China related to artificial intelligence-generated content (AIGC) have skyrocketed since early 2023. In January 2023, there were 200 AIGC jobs listed on China's major recruitment platforms. By July 2023, close to 1,600 AIGC jobs were posted, of which Baidu, Alibaba, Tencent, and ByteDance accounted for 20% of open positions. Like Microsoft having the cash to invest $13 billion since 2019 into its partnership with OpenAI, China's internet companies enjoy scale advantages.

Risks for China's AI Ecosystem

While China's AI capabilities are developing rapidly, challenges and risks are still ahead, including geopolitics and industry disruption. We expect AI to be a growth multiplier for China's economy, but progress will not be linear. US trade restrictions on advanced semiconductors require Chinese entrepreneurs to find creative workarounds.

Geopolitics

China, which imports all its advanced semiconductors, has a vast appetite for chips. In 2022, China imported $415.6 billion of integrated circuits, representing 538.4 billion units. This dependency on imports for key technologies has left it vulnerable to the ebbs and flows of geopolitics.

In 2022, the US prohibited the sale of supercomputing equipment to China, specifically restricting the sale of high-end AI graphics processing units (GPUs) to Chinese buyers. These include the world's most powerful chips, the Nvidia A-100 and H-100 integrated circuits, which have become critical tools in the AI industry. With 54 billion transistors packed on a single chip, the Nvidia A-100 is favored by global tech giants outside China. The US chip ban also prohibits the sale of logic chips of 14-16 nm or smaller, DRAM memory chips of 18nm half-pitch or less, and NAND flash memory chips with 128 layers or more to Chinese companies.

By some estimates, Chinese companies procured more than 200,000 A100 chips before the US chip ban, so companies have existing stock to work with. In response to the US chip ban, Nvidia introduced the A800, a lower-powered chip that it can sell to Chinese companies under US guidelines. Baidu, Alibaba, Tencent, and ByteDance placed orders with Nvidia for A800 chips totaling $5 billion for 2023 and 2024, demonstrating that China's tech giants continue to invest in AI-related tech at scale.

US restrictions mean Chinese companies must use double the number of lower-power chips to train their AI models, and training those models will take more time than global competitors. However, geopolitics is not necessarily a disadvantage for Chinese companies in their home markets. All Chinese companies use the same AI infrastructure, so they have a level playing field domestically.

Industry Disruption and Shifting Supply Chains

New businesses launching AI-powered apps will reshape corporate and consumer spending patterns, creating disruption across industries. Like the iPhone displacing the BlackBerry, future applications are hard to predict in the present.

We also expect a reshuffling and reimagination of supply chains, spurred by geopolitical issues. Due to US trade restrictions and chip bans, industries that cannot operate in China could migrate to Southeast Asia over time. Economies in Southeast Asia have young workforces, affordable land, and governments actively courting foreign investment. That is a winning formula for fostering new industries.

Taiwan has been a notable beneficiary of surging AI demand. Taiwanese companies excel in hardware design, software integration and customer relationships, creating a strong competitive moat in their areas of expertise. Chinese companies will progress in their capabilities to produce smaller integrated circuits over time, but they must start with producing larger, less efficient chips.

With AI still in the early innings, we simply do not know who the winners and losers will be across various applications and industries. However, we are optimistic about the long-term impacts of AI in China and excited about the early infrastructure leaders in AI.

AI Opportunities Primed to Grow

Chinese companies are progressing faster than expected in AI initiatives, including developing large language models and business-specific applications.

Businesses are leveraging:

- Large proprietary data sets
- A deep bench of engineering talent
- Strong demand from a large domestic market
- Policy support from a laser-focused central government

Given this edge, we expect app developers to continue building on China's large language models to expand the opportunity set. Chinese companies are well-positioned to develop their AI models with speed and efficiency.

Rising labor costs and a shrinking workforce are reshaping IT spending, as employers look to automate and enhance operations. An aging population also necessitates more investment in health care, an area where AI can help provide better care at a greater scale and lower costs. The migration to electric cars will also foster use cases for AI in renewable energy and expand China's smart energy grid.

AI's cumulative effect in China is likely to compound over time. AI will be a growth multiplier for China, increasing economic output through enhanced productivity and creating new categories of products and services. Bottom-up innovation in China remains driven by entrepreneurs. Chinese companies are designing novel solutions to problems that people previously thought unsolvable. The creativity and imagination of China's innovators are improving the lives of generations to come.

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