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Global Technology

China – AI: The Sleeping Giant Awakens

China is focused on how AI can drive industrial transformation at scale and turn constraints into opportunities. A top-down approach, aligning strategy, ecosystem, standards and industry-specific innovation to an already robust infrastructure, is helping unlock AI's potential in China.

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China – AI: The Sleeping Giant Awakens

China charting a different course for AI. China is developing cutting-edge AI capabilities with significantly less hardware, redefining expectations of computing power requirements. DeepSeek R1 and many newly launched open-source models offer a diversified AI opportunity set in China's efficiency-driven approach instead of the more capital-intensive/high-performance AI models being developed – and a different path to return on investment. China is less concerned about building the most powerful AI capabilities, and more focused on bringing AI to market, impacting the AI ecosystem and influencing AI standards. Whether this is a one-off achievement or a sign of things to come, it is reshaping how we think about China's AI development.

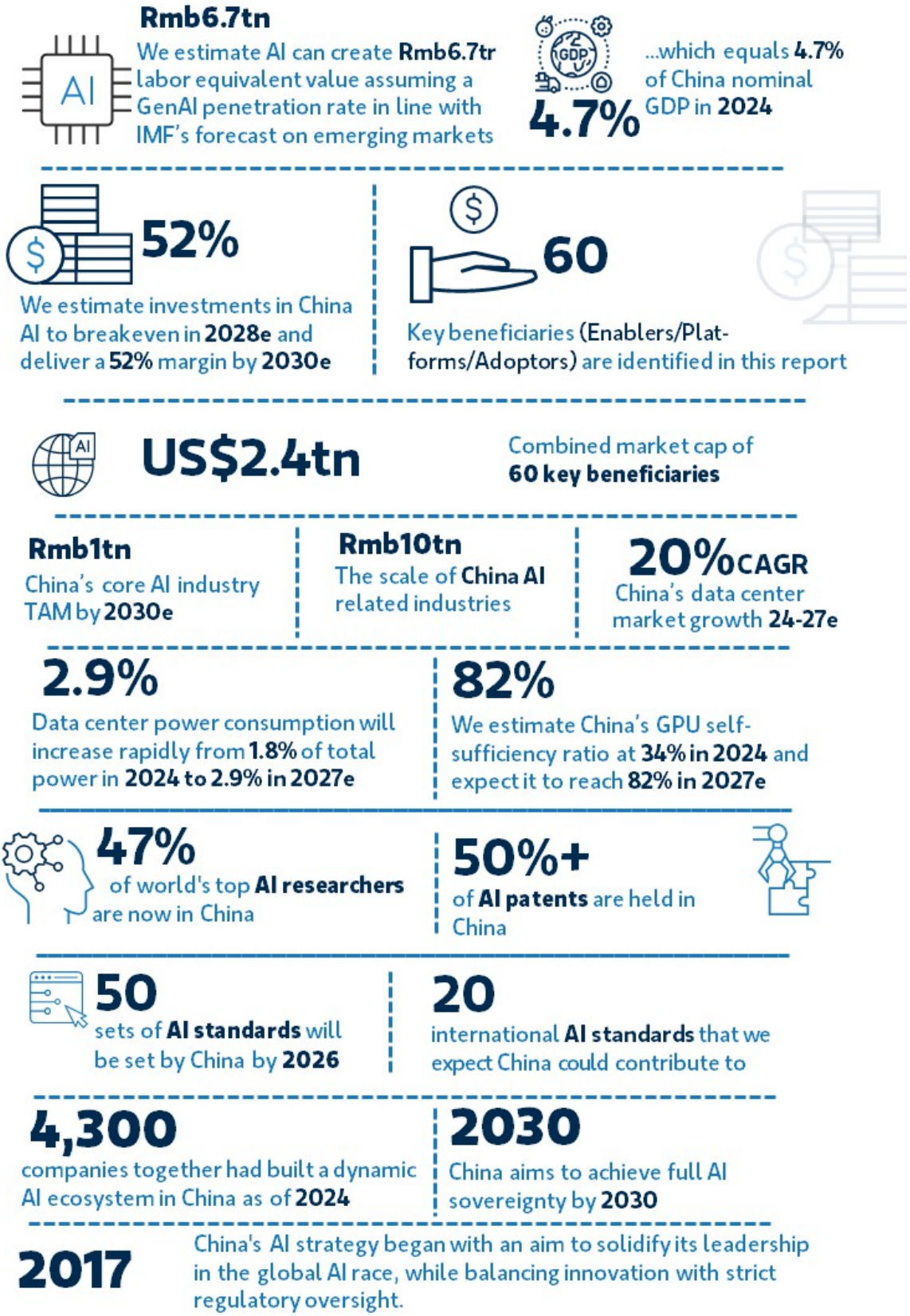
Solid AI foundation. China has been methodically executing a long-term strategy to establish its domestic AI capabilities – its future in AI is supported by a robust ecosystem that integrates infrastructure, data, talent, and innovation. Government support, investments in advanced technologies, expansive AI talent and energy abundance have built a solid foundation for China's AI applications. Its regulatory approach to AI is a balance between fostering innovation and ensuring control by aligning responsibilities across the AI value chain and cultivating a robust open-source community.

The path forward. Affected by US restrictions, China is avoiding expensive computing resources and is focused on efficiency. US restrictions are a near-term headwind but Chinese companies have focused on developing more efficient, less expensive AI technologies, recognizing that it will take time for China to match the US in high-performance AI compute. The AI value will come from revenue generated by AI-enabled offerings, while in other cases, it will be generated by cost savings through greater efficiency and productivity. A more competitive AI landscape lies ahead with DeepSeek likely prompting competitors (such as ByteDance, Tencent, Alibaba and others) to reduce usage prices for their models and harness AI into their business operations.

Investment implications. The greatest companies get created in times like these, and while still too early to fully assess, we introduce Morgan Stanley's China AI 60 to identify companies leading in AI adoption, innovation, investment, and market presence. With value shifting from AI hardware to the AI application layer, we see China continuing its success in bringing AI applications to market and transforming industries. Companies with proprietary data can make outsized returns, especially if they can build a tokens per second service, while the picks and shovels (enablers) move past peak builds.

Contents

Exhibit 1: China AI Story in Numbers



Source: Morgan Stanley Research

Executive Summary

Artificial intelligence in China – The giant awakens

China's long-term strategy is to be among the global leaders in AI technology. The DeepSeek-R1 open-source large language model that provides a high powered, yet cost-effective AI solution has been a recent key catalyst, but it is China's top-down-driven ecosystem of talent, innovation, data and infrastructure that has created a fertile environment for AI development. In this report, we examine the state of play for AI in China today, and direction of travel to 2030 and beyond. We look at why China has taken a different route than the US, and assess its journey so far. It's a story of AI investment transforming into real life applications at a much faster rate than expected. We dig into which industry segments and companies will most quickly see the benefits and monetization. Accelerated investment by the Chinese hyperscalers will be supported by data center growth and infrastructure. We also consider the implications from US tariffs, and how China continues to progress without access to the most high-powered chips.

Reshaping China's landscape with AI

China is expanding from its traditional presence in manufacturing into the digital realm, with critical AI infrastructure taking center stage. Despite US restrictions, China has achieved cutting-edge AI capabilities with significantly less hardware, surprising conventional expectations of computing power requirements. Government support, a balanced regulatory approach, investment in advanced technologies, expansive AI talent and energy abundance have built a solid foundation for China's AI applications. We think AI value will come from revenue generated by AI-enabled offerings, while in other cases it will be generated by cost savings through greater efficiency and productivity. A more competitive AI landscape lies ahead with DeepSeek likely prompting companies to reduce usage prices for their models and harness AI in their business operations.

Economic implications – What does this mean for China's 3D journey?

We believe the AI revolution will give a boost to China's long-term potential GDP growth by addressing key structural headwinds to the economy – aging demographics and slowing productivity growth. The near-term driver will likely come from the AI capex boom, though its boost to GDP growth could be modest (0.2-0.3ppt annually) considering its relatively small size at the start. Over the longer run, it will translate into a productivity boost by increasing efficiency, optimizing production processes, and unlocking new products, services and jobs. We estimate that AI can create Rmb6.7trn of equivalent labor value using 2024 wages data, assuming a penetration rate in-line with IMF estimates for emerging markets.

We note that the AI revolution could generate stronger labor displacement effects than past technological revolutions during transition, given its breadth (spanning industries and skill levels), speed (exponential growth in technological iterations), and depth (threatening cognitive labor). We think Beijing will need to strengthen social safety nets, increase support for AI-oriented education and career training, and foster job creation in sectors less susceptible to AI displacement (e.g., human interaction-based services).

Exhibit 2: AI could create Rmb6.7tr labor equivalent value assuming a GenAI penetration rate in line with IMF forecasts on emerging markets

High-exposure, low-complementarity Penetration rate	High-Exposure, High-complementarity Penetration Rate						
	0%	5%	11%	16%	21%	27%	32%
0%	-	387	773	1,160	1,546	1,933	2,319
6%	1,388	1,774	2,161	2,547	2,934	3,320	3,707
12%	2,775	3,162	3,548	3,935	4,322	4,708	5,095
18%	4,163	4,549	4,936	5,323	5,709	6,096	6,482
24%	5,550	5,937	6,324	6,710	7,097	7,483	7,870
30%	6,938	7,325	7,711	8,098	8,484	8,871	9,258
36%	8,326	8,712	9,099	9,485	9,872	10,259	10,645

Source: IMF, United Nations, Morgan Stanley Research estimates

AI adoption implications – 2B and 2C

China's priority is to apply AI across the 'real economy', using the rules of the market to get results in terms of commercialized products, while boosting productivity in traditional sectors, such as manufacturing. Hardware constraints have motivated China to focus on engineering efficiency and software/algorithm optimization and, importantly, development of AI applications via commoditization of LLMs. This means much a lower inference cost (i.e., the cost to use trained AI to produce results), which is accelerating AI adoption in mass markets in China.

Specifically, the proliferation of super apps (high frequency, multi-use/functionality on a single platform) and the newly launched AI-native apps will likely boost business to consumer (2C) adoption at a faster pace in China in the next 2-3 years, propelled by greater user awareness following the the 'DeepSeek moment' in January. By integrating AI features into existing super apps, they will be able to leverage vast amounts of proprietary data and user engagement, while the proliferation of open-source LLMs will reduce entry barriers for AI adopters.

China's mass adoption cycle of AI in business to business (2B) from this year is likely to be faster than the public cloud adoption cycle in 2013, given an already comprehensive amount of 2B application offerings and enterprises' desire to reduce costs. However, lower IT spending from enterprises, a preference for private cloud deployment, and an immature software industry suggest that 2B adoption will be slower than 2C. China's 2B AI application landscape is also likely to be more fragmented than super-app-dominated 2C, although 2B software names with proprietary data could offer meaningful AI value creation for enterprises.

Exhibit 3: AI Investment Stack – Value Moving From Hardware to Applications

Source: Morgan Stanley Research

Quantifying the AI Impact – ROIC Calculation

We estimate China AI to generate total returns of Rmb806bn and deliver a 52% return on invested capital (ROIC) by 2030e with investments to breakeven by 2028e. This is driven by an AI uplift from consumption at Rmb556bn with the majority of the contribution from e-commerce at Rmb271bn, followed by ads at Rmb95bn, local services at Rmb91bn and enterprise usage of Rmb250bn. We estimate total operating costs from depreciation, power and server rental costs to be Rmb389bn by 2030.

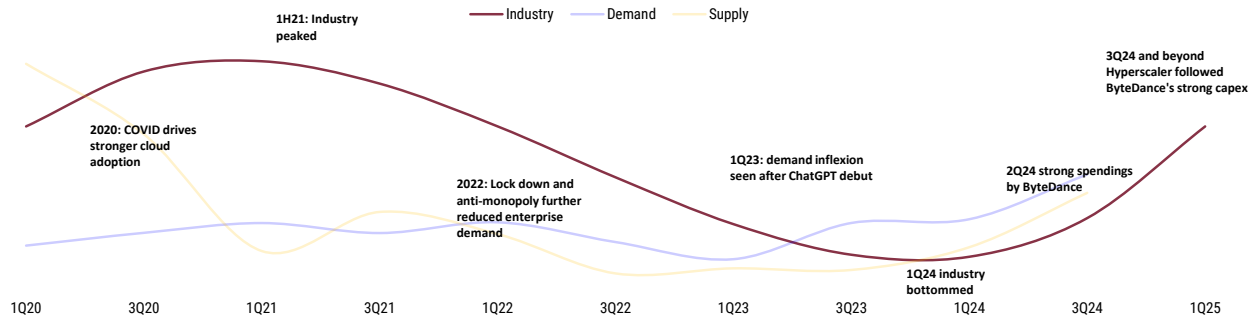
Physical AI – The future is already here

Most companies will make money when autonomous cars or robots are deployed, and while processor and component revenues should come much earlier as their hardware should dominate profits during that investment phase, the opportunity is in the application layer, and if the cost curve keeps dropping physical AI will likely be ubiquitous. We estimate that the global humanoid TAM will reach US$5 trillion in annual revenue and 1 billion in humanoid stock by 2050e, with China representing ~30% of the world humanoid stock. In autonomous cars, we expect partially automated and automated driving penetration to reach 25% in 2025, implying 5.5-6mn units of cars adopting advanced smart driving features this year, and models coming to market faster than expected.

Data center implications – Increasing AI proliferation will need more power

China is home to the world's largest 5G network and the second-largest data center industry, backed by energy-efficient and abundant power grids, which provide a solid foundation for the deployment of high-capacity computing power for future growth and training of large-scale AI models. Since ByteDance started an inflection in big capex spending and data center bookings last year, other internet companies have joined in, and Chinese hyperscalers now appear committed to a secular investment trend. We estimate the top five internet and cloud providers (ByteDance, Alibaba, Tencent, Baidu, and Kuaishou) to spend ~Rmb400bn (~US$60bn) cloud capex per year, with AI contributing close to half. While this is <20% of the top 4 US hyperscalers, we note that China capex is growing at a faster 60%YoY vs. the US at 42% YoY.

Exhibit 4: Where we are in the cycle



Source: Morgan Stanley Research estimates

Hardware – Restrictions prompting innovation

US restrictions mean that advanced GPUs are largely out of reach for Chinese technology companies, however, we believe that Chinese LLM developers currently have access to enough advanced computing power to be able to train most models, based on their accumulated inventory of H20 and legacy GPUs, and a mix of domestic GPUs. In addition, the lack of steady GPU volumes appears to be driving Chinese semiconductor firms to innovate at a faster pace to close the performance gap with their US counterparts, as well as finding more ways to drive AI performance with less hardware. One example is Huawei's 'AI-in-a-box', a supercluster consisting of thousands of Ascend 910 chips that can train foundation models with over 1 trillion parameters, which is intended to compete with similar systems offered by NVIDIA. We estimate China's AI GPU self-sufficiency ratio will rise from 34% in 2024 and to 82% in 2027.

Multipolar World implications – What are the effects from trade restrictions and tariffs?

In January 2025, the US government announced a new 'Framework for Artificial Intelligence Diffusion', unprecedented in scope and scale. At its core, the new regulation targets to prevent China from accessing AI compute to build frontier models. However, with DeepSeek, we have learnt that computational capabilities aren't the only aspect that drives technology to newer heights. It appears that US restrictions will likely accelerate self-sufficiency in indigenous AI chips usage and reduce the addressable market for HBM, which may accelerate the demand pivot towards cheaper legacy memory. We also think China has a competitive edge from cheaper energy, a vast talent pool (with 535 universities in China currently offering AI-related majors), and an extensive industrial landscape and supply chains. With these unique features, we believe China can effectively compete to offer the rest of the world a compelling AI and tech ecosystem.

Which sectors face a substantial impact from AI?

In this report, we identify energy, autonomous driving and humanoids to proliferate with the rise of China AI. We see data centers contributing ~10% of China's power demand by 2035 with 100% green power achieved by 2032. Accelerated tech iteration and superior LLMs, such as DeepSeek, should expedite L2+ adoption and our auto team now looks for L2+ AD penetration to reach 25% in 2025, up from 15% in 2024, implying 5.5-6mn cars adopting advanced smart driving features this year. We also expect 2025 will be a milestone year in humanoid robot history, marking the start of mass production of humanoid robots. For China, we expect China humanoid stock to reach 252k/61mn/302mn units by 2030e/40e/50e, respectively, representing ~30% of the world humanoid stock by 2050.

According to our AlphaWise survey, AI remains the only bright spot in Chinese enterprises' IT spending outlook, with project adoption accelerating. About 71% of CIOs believe AI will have a significant impact on their IT investments in 2025 and 69% of CIOs have launched or plan to launch their first AI project within the next 12 months (link). Our 'China AI 60' identifies key beneficiaries across industries.

Where could we be wrong?

New US export restrictions designed to control AI's progress globally and ultimately prevent access to the most advanced AI could keep Chinese AI developments in check. US restrictions are not new and export controls do not create absolute barriers for China's AI advancement, but they impose higher costs and complex rules, and unclear compliance conditions could inject considerable uncertainty into the long-term plans for GenAI development in China.

Investment Case

Can China sustain its momentum and translate its research prowess into being an AI leader? The usual predicting variables for AI are data availability, energy, talent, and computing strength. While data, energy and talent are abundant, and outpacing the rest of the world, computing strength turns on the availability of high-end chips, and here China lags. Efforts to restrict China from advanced chips appear to have succeeded temporarily, but are unlikely to work in the long run, as alternatives such as writing more efficient algorithms, outsourcing the training with open source, investing in R&D and building a robust AI ecosystem to close the computing gap are well underway. We believe AI leadership is no longer about cutting-edge models alone, but will require a broader ecosystem that can both develop and adopt these new AI tools at speed in the marketplace – this is the China AI opportunity.

Outbuild, outscale, and outcompete. China is mastering AI by utilizing the same advantages in size, data collection, and strategic determination that have allowed it to close the gap with AI industry leaders. It will clearly have the largest domestic market for AI applications, as well as many times more data and computer scientists advancing AI developments, with impressive speed and focus through a combination of strategic state planning, robust academic output, and increasing private investment. DeepSeek's success will not likely be an isolated event, in our view – it is the product of a deeply embedded state-backed innovation strategy with some 100 LLM models released in 2023 alone, and more than 400 in 2024. Originality may be debatable with many LLM releases modeled on open source, but what matters is that the performance is roughly comparable and has recently exceed in some cases.

Challenging conventional wisdom. China is optimizing AI models to work well with smaller, less powerful chips, vs. reliance on vast amounts of quality data elsewhere. China's low-cost and highly efficient AI platform for global developers also fosters sharing, collaboration and innovation of AI technologies. China is challenging the belief that massive computing resources are essential for AI breakthroughs. China's AI strategy is its open source LLM ecosystem with models that are not only competitive, but also starting to set leading benchmarks in various applications. This is complemented by China's aggressive pursuit of a national data strategy designed to enhance the availability and quality of data, which is crucial for training advanced AI models.

China's approach to AI is intertwined with its broader economic and industrial strategies. AI has become a critical component of its future growth since the Artificial Intelligence Development Plan release in 2017, integrating it into key manufacturing and consumer sectors, and making AI the "main driving force" of industrial transformation. China has already built a formidable AI ecosystem by aligning corporate interests with national priorities, pouring government funding into AI research, and leveraging local competition to drive technological progress. By 2030, China has the stated aim of achieving global leadership in AI, utilizing its resources and initiatives to propel technological and economic progress.

Standards influence. AI's progress will also see a contest for control over the global digital AI infrastructure, in our view. As China continues to make advances in AI, many countries and companies could become increasingly dependent on Chinese technology and equipment from AI chips to software. It may seem contradictory at times but coexistence is a reality among countries that compete and cooperate at the same time – for example, Apple and Samsung are competitors in the global smartphone market, yet Samsung has also been Apple's biggest supplier. This may provide China with an advantage in influencing global tech policies by building multilateral efforts to develop an AI governance framework.

Introducing Morgan Stanley's China AI 60. We introduce a broad list under MS coverage for global investors to play the China AI theme across multiple angles. We have worked with our sector teams to help investors 'map' different types of stocks that are exposed to one of the most rapidly developing verticals of China, AI. "China AI 60" is not intended to be an exhaustive list, but rather a starting point for a conversation that will last many years, and is sure to follow some exciting and unpredictable chapters along the way. We invite our clients to challenge our list and offer their own ideas of what should or should not be included, as they become more familiar with the AI theme and its adjacencies.

Exhibit 5: China AI 60

Source: Morgan Stanley Research

What Does AI Mean for China's 3D Journey?

Over the past three years, the market has been concerned about China's slowing growth due to the interplay of "3D challenges" – aging demographics, painful deleveraging by the property sector and local governments, and a deflationary downturn. The AI breakthroughs this year remind the market about China's often-overlooked supply chain and innovation strength, which could mitigate the 3D challenges. A near-term driver could come from an AI capex boom, while it will likely translate into a productivity boost over the longer run. This further demonstrates multipolarization in tech and innovation: on the back of a complete industrial supply chain and rising endogenous innovation capacity, China can effectively compete to offer the rest of the world a compelling AI and tech ecosystem.

AI revolution to boost China's long-term potential growth

AI revolution to provide modest growth boost via capex in the near term… Major tech shifts take time – the launch of iPhone took seven years before smartphones began to achieve widespread adoption. In this AI innovation cycle, we have primarily been in the build-out phase of AI infrastructure in the past two years, similar to the early era of cloud computing, when major technology businesses invested heavily in cloud infrastructure. This means contributions from AI in next 2-3 years will come primarily from the capex boom, aided by increased policy support with multi-channel funding and a more predictable regulatory environment. We estimate that the strong AI-driven capex growth in emerging industries will bring a 0.2-0.3ppt boost to real GDP growth in next 2-3 years, offsetting the drag from continued sluggish property investment.

…while translating into a strong productivity boost over the medium term: We expect rapid AI adoption across China's economy, given its robust AI ecosystem, low-cost while highly efficient AI technologies, and a large domestic market for AI applications. As AI evolves, we expect new industries and market leaders to emerge, in a similar way to previous technological shifts. Over time, AI's impact on labor should become increasingly evident across key areas, such as efficiency and productivity, creation of new roles, transformative human-AI collaboration, systems, and labor redistribution and re-skilling. This could help China address its structural headwind from a shrinking working-age employment pool over the medium term.

Sensitivity Analysis on AI value creation

According to the IMF (Gen-AI: Artificial Intelligence and the Future of Work), about 40% of employment is exposed to AI in emerging markets, with two types of exposure: 1) jobs that are high-exposure, high-complementarity (human input difficult to be replaced, but unit labor productivity would be boosted by AI); and 2) jobs that are high-exposure, low-complementarity (which could be replaced by AI).

As a sensitivity analysis, we present a variety of outcomes of different penetration rates on high-complementarity and low-complementarity labor markets, with 0-7% 2024 China nominal GDP equivalent labor value creation. If we assume 40% of employment in China is highly exposed to AI today, with 16% highly complementarity and 24% highly replaceable, we estimate that AI could generate Rmb6.7tr labor equivalent value (or 4.7% of China's 2024 nominal GDP).

Our key assumptions below:

- **High-exposure, high-complementarity:** For this group, we assume AI creates 30% labor equivalent value, and we take the average urban wage level as our baseline.
- **High-exposure, low-complementarity:** We assume this group is 100% replaced by AI, and we take the national average wage level as our baseline.

Exhibit 6: AI could create Rmb6.7tr labor equivalent value assuming a GenAI penetration rate in line with IMF forecasts on emerging markets...

High-exposure, low-complementarity Penetration rate	High-Exposure, High-complementarity Penetration Rate						
	0%	5%	11%	16%	21%	27%	32%
0%	-	387	773	1,160	1,546	1,933	2,319
6%	1,388	1,774	2,161	2,547	2,934	3,320	3,707
12%	2,775	3,162	3,548	3,935	4,322	4,708	5,095
18%	4,163	4,549	4,936	5,323	5,709	6,096	6,482
24%	5,550	5,937	6,324	6,710	7,097	7,483	7,870
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36%	8,326	8,712	9,099	9,485	9,872	10,259	10,645

Source: IMF, United Nations, Morgan Stanley Research estimates

Exhibit 7: ...which equates to 4.7% of China nominal GDP in 2024

High-exposure, low-complementarity Penetration rate	High-Exposure, High-complementarity Penetration Rate						
	0%	5%	11%	16%	21%	27%	32%
0%	0.0%	0.3%	0.6%	0.9%	1.1%	1.4%	1.7%
6%	1.0%	1.3%	1.6%	1.9%	2.1%	2.4%	2.7%
12%	2.0%	2.3%	2.6%	2.8%	3.1%	3.4%	3.6%
18%	3.0%	3.3%	3.5%	3.8%	4.1%	4.3%	4.6%
24%	4.0%	4.2%	4.5%	4.7%	5.0%	5.3%	5.5%
30%	4.9%	5.1%	5.4%	5.7%	5.9%	6.2%	6.4%
36%	5.8%	6.1%	6.3%	6.6%	6.8%	7.1%	7.3%

Source: IMF, United Nations, Morgan Stanley Research estimates

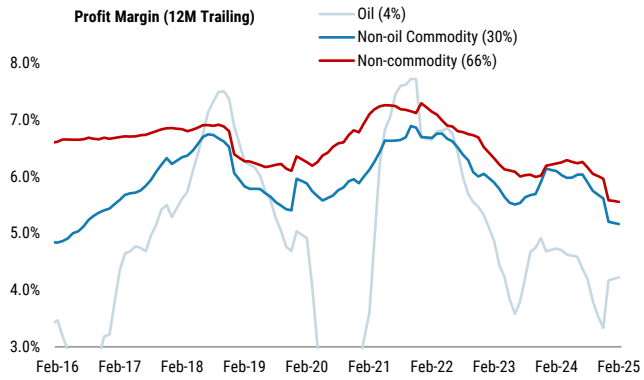
Social welfare reforms to facilitate smooth AI transition

AI labor displacement effect may outweigh complementarity effect during transition... Unlike in previous waves of automation, which had the strongest effect on middle-skilled workers, AI could potentially lead to a broader and deeper labor market transformation, given its breadth (spanning industries and skill levels), speed (exponential growth in technological iterations), and depth (threatening cognitive, higher-wage labor). While AI adoption could generate both labor displacement effects and complementarity effects, the former factor may dominate in the near term, before a rise in AI-induced productivity gains strengthens overall economic demand and creates more new job opportunities.

...exacerbating China's prevailing deflationary pressures: In China, the AI-induced labor market disruption could potentially prove more acute, given that the economy has a weak starting point of high youth unemployment problems and deflation. As a case in point, entry-level wage growth in emerging industries has been on a downtrend over the past three years, given thin industrial profit margins. Given that AI could be capable of taking up junior-level cognitive work, it may encourage corporates to increase capex on AI adoption and thus reduce hiring, leading to more severe wage growth deceleration. The resulting increase in deflationary pressures could weigh on corporate profitability and potentially constrain resources available to support AI innovation.

More policies may be needed to mitigate AI-induced labor market disruption: Although AI may improve China's productivity in the medium to long term, AI-induced labor market disruption and deflationary pressure, if left unaddressed, could exacerbate income inequality and add to social stability risks. To mitigate the pain, we think policymakers may need to take up measures to strengthen social protection for the unemployed, increase support for AI-oriented education and career training, and encourage job creation in sectors less susceptible to AI displacement (e.g., human interaction-based services).

Exhibit 8: Industrial profit margin has been on a downtrend since 2022...



Source: CEIC, Morgan Stanley Research. *Numbers in brackets represent the % share of total industrial profits for each category.

Exhibit 9: ...rendering continued downward pressure on wage growth

Source: Caixin, Morgan Stanley Research

China in the AI Race

China has the most developers of large language models (LLM) and AI applications outside of large US tech platforms, and it maintains a rapidly expanding and evolving AI ecosystem, with many established tech platforms iterating models, new start-ups entering the market, and end-users experimenting with different approaches to deploying applications on enterprise networks. AI is a vibrant industry, driven by a mix of large tech platforms, social media companies, and a slew of well-financed start-ups. The vast majority of AI development and all related innovation in China is led by the private sector, and Chinese companies and researchers remain heavily engaged with global ecosystems, with some Chinese companies leveraging open-source LLMs, such as Meta's Llama-3.

The next six to twelve months will be a critical period for Chinese AI firms, as we expect the industry will see an increasing number of enterprise deployments attempting to solve real-world problems and beginning to show productivity gains.

A sleeping giant in AI… For years, China's presence in manufacturing was defined by physical infrastructure: bridges, railways, and highways under the Belt and Road Initiative (BRI). Today, it is about manufacturing intelligence (via generating tokens) and the arena has shifted to the digital realm with critical AI infrastructure taking center stage. Compute power is only one part of the AI equation – data, energy and talent are equally important to sustain long-term competitiveness. AI is not just about who builds the most powerful chips; it is also about who can impact the global AI ecosystem – and China is well positioned in this area.

…long in the making. China's stated ambition to be become a world innovation leader in AI by 2030 dates back to its 2017 announced AI technology development program. This plan was to expand AI in a wide range of targeted areas, such as production, defense and governance. Today, China ranks #1 globally in AI patents and technology clusters, according to WIPO and R&D World, overcoming technological challenges. China was first to enter into the 'ranks of innovative countries' and is now expected to reach 'world-leading level' by (as defined by major breakthroughs in AI by European Parliamentary Research Service) and to become the 'major AI innovation centre in the world' by 2030, according to EPRS. This puts China on track to achieve its 2017 'New Gen AI Development Plan' to make AI 'the main driving force of China's industrial upgrading and economic transformation'.

Opportunities. We think China's AI opportunity lies more in AI applications – services built on top of AI – rather than solely trying to make models larger to improve performance. With AI spreading to virtually every sector of the economy utilizing available AI models, we expect to see the emergence of Chinese leading companies globally in many downstream industries beyond the large cloud early adopters. (*China – AI: Sector Preference – Energy, Autonomous Driving, Humanoids* .)

Strategic focus – AI leadership by 2030

China's strategic focus has long been on "self-reliance and self-improvement". Competitiveness in AI can be assessed by the size of models and processing speeds and/or the rate at which it can leverage AI to deliver the most tangible economic benefits in terms of revenue growth and returns. Taking a holistic view of the AI stack, the focus on models is that the biggest and fastest matter, but equally important is the broader innovation of AI ecosystems, compute infrastructure, and regulatory landscape. China's AI model development ecosystem differs significantly in scale and structure from that of the US. China has a much larger number of AI companies developing models, which contrasts with the US's small number of dominant big players in partnerships with hyperscalers that have access to the compute needed to power their AI development and deployment.

China's priority is to apply AI across the 'real economy', using the rules of the market to get results in terms of commercialized products, and boosting productivity in traditional sectors such as manufacturing. This means the results of the AI research should be closely tied to AI products that the market wants, with the reason being the interconnection between education, research, investment and building enterprises. For example, compared with the US's current AI concentration in the broader consumer applications, such as Claude+, GPT, and Gemini, Chinese AI research tends to be focused on business apps, such as autonomous driving, smart manufacturing, intelligent customer service, and digital humans.

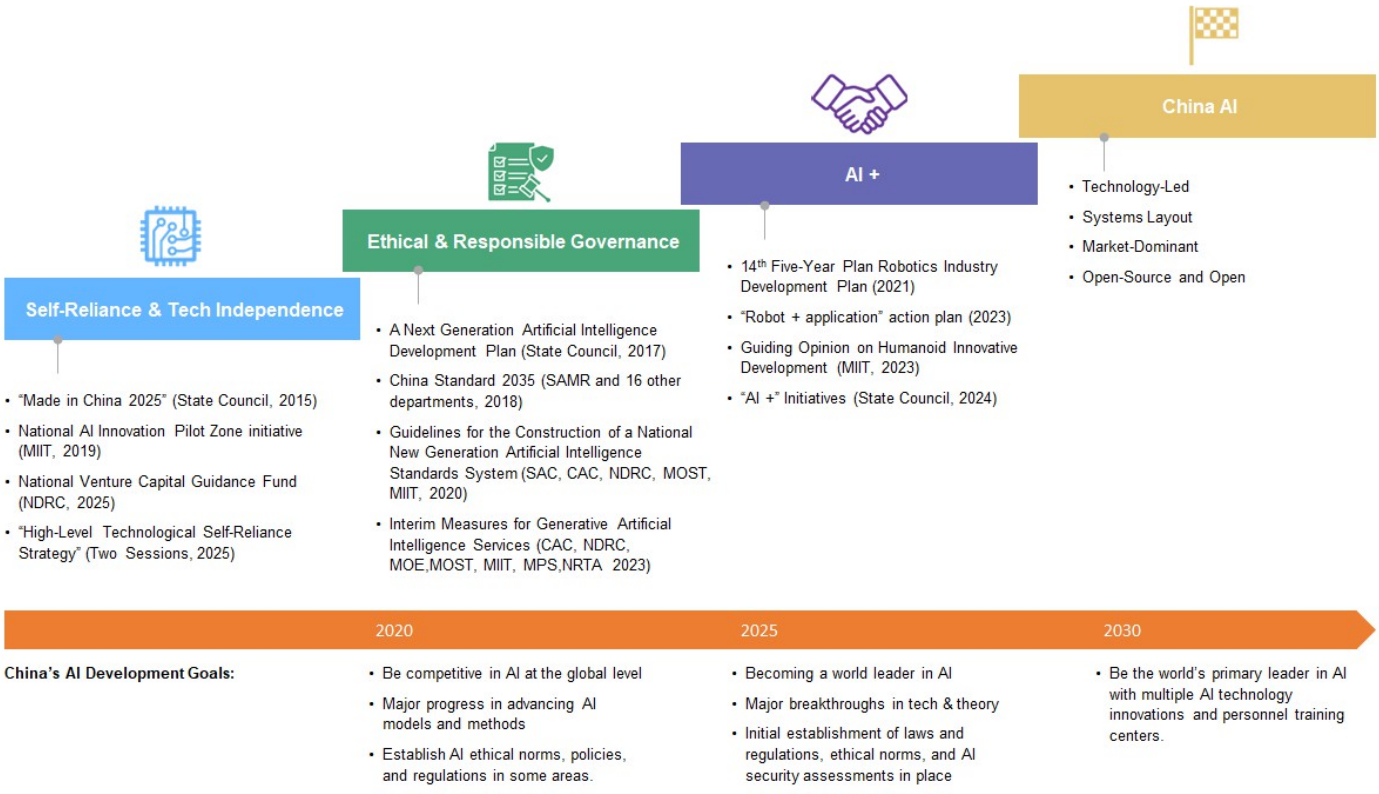
- **Technology innovation:** China continues to build on its investment in AI infrastructure and research with significant advances in facial recognition, natural language processing, and machine learning applications. China's ability to collect and utilize large-scale data sets, combined with strong government backing, drives further AI progress. However, China's limited access to advanced computing resources, and domestically designed and manufactured alternative chips that lag in performance, imposes constraints on both AI training and inference capabilities.

- **Global standards:** Leaders in AI development will most likely shape how these technologies are implemented worldwide. China's approach to AI ethics and governance is materially different from Western frameworks, which could influence everything from privacy standards to how AI is used in public spaces. While China's censorship standards on AI development could hinder its ability to develop competitive AI models by imposing strict controls on the outputs of models, it is also likely that by navigating these challenges effectively, Chinese AI developers might gain valuable insights into how to make AI models safer.
- **Economic impact:** There are disruptions across multiple sectors already, and China's integration of AI into manufacturing and supply chains could reshape global trade dynamics. Its digital economy initiatives, powered by advanced AI, could establish new standards for everything from mobile payments to smart city infrastructure. China is taking an alternative approach by embracing open-source AI, while the US appears to be moving toward closed, tightly controlled AI systems. For example, China's DeepSeek-R1 model rivals OpenAI's o1 model while being more efficient, open-source, and freely available. Manus agentic is another recent example of how fast Chinese companies can adopt and deploy new technologies.
- **National security:** Advanced AI capabilities could revolutionize military strategy, cybersecurity, and intelligence gathering. As of August 2024, the Cyberspace Administration of China had approved a list of more than 180 LLMs for general use. Consolidation and competition is underway, but only a few will advance, given the funding and hardware constraints on Chinese AI developers.

Not a sprint but a marathon

A development plan to become the world's major AI innovation center by 2030. China's AI strategy began in 2017, which it has developed by balancing innovation with strict regulatory oversight. While China may temporarily achieve cost efficiencies in AI production, long-term success in this field will ultimately depend on foundational innovation with lasting superiority rooted in original intellectual contributions. By 2030, China aims to achieve full AI sovereignty, with AI embedded into every major industry, optimizing productivity, sustainability, economic growth, and global trade, with the scale of its AI core industry exceeding Rmb1tn (~US$141bn), and the scale of related industries exceeding Rmb10tn (US$1.4tr).

Exhibit 10: China's AI development plan



Source: The State Council of the People's Republic of China (released July 20, 2017), Morgan Stanley Research

Progress so far has been impressive. China's success in AI is not solely dependent on big data but on better algorithms, hardware innovation, talent development, and strategic government backing. Its focus on efficiency, AI computing power, and industrial application gives it a competitive edge in catching up with the US in AI development. China has already built a dynamic AI ecosystem of over 4,300 companies aligned to harness AI's transformative potential via a common top-down vision, innovation, and ecosystem development. We estimate its AI industry was valued at over US$3.2bn as of 2024, and it is already the top ranked globally in terms of the number of research papers on AI and the largest owner of AI patents worldwide since 2020 (especially in areas of voice and image recognition, robotics, and machine learning).

The New Generation Artificial Intelligence Development Plan of 2017 stated that, "By 2025, China will achieve major breakthroughs in basic theories for AI, such that some technologies and applications achieve a world-leading level, and AI becomes the main driving force for China's industrial upgrading and economic transformation." We are starting to see the results with the recent achievements in DeepSeek and numerous world-class advanced LLMs.

China's AI ecosystem has made impressive strides with strong government support and close ties between industry and state-backed academic labs. This has led to increasing amounts and quality of its AI research, a very large and rapidly expanding talent pool, significant state and private-sector investment, and the mass adoption of AI in enterprises, cloud and consumer end-markets.

Breakthroughs…

DeepSeek a pivotal moment, reshaping the AI race… Alibaba, Tencent, and Baidu, along with newcomers like Manus AI, have since released their own advanced models. Many of these are available for free as open-source software, unlike the subscription models of OpenAI and others. The most impressive breakthrough has been DeepSeek, which has shifted the global AI narrative (*Tech Bytes: DeepSeek – AI Bifurcation February 11, 2025*) – not by putting China ahead (which it does not), but by challenging the US's perceived AI dominance. DeepSeek was only founded in 2023, and has less than 100 staff and much more limited computing resources than the western frontier labs. Larger models may be more fluent, but that does not necessarily imply that they are more advanced. Exponential increases in the computational capacity of the models bring only linear gains, as current test results show.

…demonstrating China's ability to innovate… DeepSeek's cost-efficient alternative approach – prioritizing algorithmic efficiency over brute-force computation – challenges the assumption that AI progress demands ever-increasing computing power. If market forces lead, the most cost-effective solutions may prevail. Restrictions have likely accelerated China's domestic innovation, as evidenced by DeepSeek's development. China has shown, in certain cases, it can overcome barriers of limited access to top-tier chips by boosting efficiency or compensating for lower-quality hardware with quantity. China has the lowest cost of LLM manufacturing (DeepSeek V3 and Alibaba Qwen allow frontier AI performance at a fraction of the cost – DeepSeek is now manufacturing AI at US$1.1 per million tokens vs. GPT-4o output token price of US$10 and Claude 3.5 at US$15).

…and close the AI technology gap. The flurry of impressive Chinese releases suggests the US's AI lead has narrowed. Beyond the likes of Alibaba, Tencent and ByteDance – the cloud heavyweights, the emergence of smaller innovators is increasingly carving out China's AI ecosystem. Leading China's AI sector innovation are the established 'six tigers' of Moonshot, 01.AI, Baichuan, Stepfun, Zhipu AI, and Minimax, along with research-focused DeepSeek, ModelBest, and heterogeneous computing cluster provider Infinigence AI, all continuing to grow in influence. Even non-tech companies, such as Xiaomi and Meituan, have entered the AI space, integrating AI into their products and services.

…and the path forward

The future of AI will likely be a contest for data and for talent. China is building a robust AI ecosystem that integrates infrastructure, data, talent, and innovation. China is home to the world's largest 5G network and the second-largest data center industry, backed by energy-efficient and abundant power grids, which provide a solid foundation for AI applications. This supports the deployment of high-capacity computing power for future growth and the training of large-scale AI models. AI is also used for a variety of business purposes (e.g., online shopping) and in industry, with a focus on promoting automation. Building more powerful AI capabilities will depend on four essential ingredients: data, energy, raw computing power, and talent.

- **Data.** China's population of over 1.4 billion people and 1.1 billion internet users is a society that functions based on the mobile internet. This provides vast amounts of data that is crucial for training AI models. China's abundance of data – driven by the widespread use of mobile apps, e-commerce platforms, and social media – gives the country a significant edge in AI research. Technologies such as face and voice rec-

ognition, intelligent robots, virtual reality, and driverless vehicles are widely used in the country and adopted in fields such as transport, education, medical care, science and technology, logistics, agriculture, and entertainment.

- **Energy.** China has more nuclear power plants under construction than the rest of the world combined. As generative AI adoption accelerates, the energy needed to support its growth becomes a critical consideration. Morgan Stanley Utilities/Renewable energy sector analysts estimate that data center power demand will account for 10% of China's total power consumption in 2035, up from 4% in 2030 and 2% in 2024. China aims to supply 100% of DC power demand from green energy (mainly wind and solar) by the early 2030s (*China's Emerging Frontiers: Aligning AI with Green Energy and Smarter Grids*). The government's commitment was reinforced by the 14th Five-Year Plan (2021–2025), which aims to build 150 new reactors over the next 15 years, reaching 200GW of nuclear power by 2035 (enough to power over a dozen cities the size of Beijing) – it built 10 nuclear power plants in 2024 and plans for a further 10 in 2025.

- **Computing.** Advanced chips are incredibly hard to make, and US export controls limit China's access to the most cutting-edge semiconductors but still allow the sale of less powerful chips that meet the restrictions' threshold. China's path to full self-sufficiency in advanced chip manufacturing remains uncertain, although it has demonstrated resilience and progress with Huawei's advanced 7nm chipset built by SMIC. However, it still faces limited access to critical tools, such as EUVs (extreme ultraviolet lithography) needed to produce advanced chips, and must resort to less efficient DUV (deep ultraviolet lithography) systems, due to US export controls, resulting in higher production costs and lower yields.
- **Talent.** China is home to some of the world's top AI researchers and has a wealth of AI talent, producing 47% of all AI researchers, according to the World Economic Forum. It has invested heavily in developing its AI workforce, with government-backed programs encouraging students to pursue AI-related degrees and critical skills. Major Chinese universities, such as Tsinghua and Peking University, are driving cutting-edge AI research and producing a growing pool of AI professionals.

Challenges

Competing for limited computing resources. China has relied heavily on US semiconductor technology for its AI development, and current US export restrictions of advanced semiconductor technology to China represents a major challenge. The US controls since October 2022 extend to the tools, software, and expertise needed to produce advanced chips, and were tightened again in October 2023, with a further tightening expected to follow under the current US administration, leaving Chinese firms to rely on larger quantities of older, less efficient chips for AI computing. However, "where there is blockade, there is breakthrough; where there is suppression, there is innovation", according to Chinese Foreign Minister, Wang Yi, on the US's strict export controls.

- Rather than training a massive LLM from scratch, Chinese companies have relied primarily on the OpenAI GPT-X API, Google's Gemini, or open-sourced models like Meta's Llama-3 for their distilled versions of LLMs.
- For bigger Chinese platforms, such as Alibaba, Tencent, Baidu, and Bytedance, we believe that there are sufficient stockpiles of advanced GPUs to cover processing power over the next several years to train their models.
- Smaller start-ups that are looking to train new models will likely turn to these domestic cloud vendors.
- There are other key players, such as Huawei, that increasingly rely on their own cloud services powered by domestically produced chips (Ascend series), and are looking for novel ways to configure their own hardware and GPU capabilities to optimize for large model training.
- Long term, however, there is no denying that hardware issues will become an increasing challenge for Chinese firms, and the only way to stay competitive will likely be to rely on leveraging open-source tools and seek even higher efficiency.

Power of standards

China is actively involved in participating and leading the formulation of international standards on AI. It is taking a more active part in the global governance of AI and improving its collaboration with other countries to develop AI laws, regulations, and international rules to "jointly cope with global challenges". For example, China's embracing of open-source AI models, which are freely available for the public to download and modify, is in contrast with the mostly closed Western models (Meta's Llama or France's Mistral are notable exceptions). If China's open-source models become more commonly used by the rest of the world and Western developers, it could gain an important stake in the global AI space.

Systemic alignment with China's technological standards. China hopes that the cumulative effects of its theoretical and technological breakthroughs in AI will be increased influence in global markets, helped by cooperation with countries to strengthen R&D, industry

alliances and application of AI technology. As China's AI platforms anchor critical infrastructure, other nations increasingly become permanent clients and a first-mover advantage compounds this: Chinese firms such as DeepSeek could help set the rules for AI deployment, leaving less room for others or homegrown alternatives. But if geopolitics and entrenched interests preside, a complex web of rules and exceptions will likely emerge. China's low-cost, open-source model could empower emerging economies' own AI innovation and entrepreneurship. Chinese cloud providers are also expanding in emerging markets, seeking to embed themselves as the default AI provider for regions.

Government commitment. China's government is willing to put in the resources to achieve success in its AI plan by providing the infrastructure and supporting conditions for companies to flourish. This is being implemented more like a target objective, rather than an actual enforcement, where the government identifies a list of technologies it would like to see built and then provides incentives to local officials to promote private sector development of those technologies, via subsidies, public contracts, and AI-friendly policies. China has already demonstrated forethought, planning and sustained execution to become a market leader in areas such as telecommunications, critical minerals, solar panels, electric vehicles, and more.

Expert interviews

We interviewed three industry experts working in the AI industry (listed below) to understand their views on DeepSeek's impact on AI, the recent breakthrough of AI development, and what to expect both near term and in the distant future. Below are our key takeaways.and what to expect in both near-term and distant future.

- **Tej Desai - Founder and AI researcher at Intuition Labs**
- **Sami Torbey - Founder and CEO at Palette Ventures LLC**
- **Adam Beberg - Founder and CTO at Mithral**

1. What is the most significant breakthrough of DeepSeek's model? How do you think DeepSeek will impact the future development of AI?

- **Most of the techniques that were mentioned in DeepSeek's paper were not originally invented by DeepSeek, but their team did collect all the good ideas and execute them really well. They fine-tuned the techniques of Mixture of Experts and Reinforced Learnings, which significantly improved the cost efficiency in training and quality in inferencing. (See technical details discussed here: How Does DeepSeek Work?)**
- **DeepSeek's biggest value-add is that it democratized AI and made it universally abundant for even individuals and small- to mid-size enterprises.**

2. Is China closing the gap with the US in AI competition? What is the most challenging issue ahead?

- **We think that if DeepSeek was not published by a Chinese company, amid ongoing geopolitical tensions between China and the US, it would likely have had less impact than we saw in January 2025, because industry developments are advancing every day at an accelerating pace.**
- **It is always a lot easier to match performance than to lead, as replication means less risk.**
- **Export controls are still a long-term challenge for China, because even though Chinese companies can make models that are good enough to commercialize, less advanced GPUs and less compute power will still cap their capability to innovate and to compete at the foundational level.**

3. What is the next step for AI capex? Where do you think the competitive dynamics will change?

- Industry experts do not see risks to near-term AI capex from hyperscalers, given the race to AGI (artificial general intelligence), and they can always rent out chips.
- However, token per dollar efficiency faces substantial deflation as DeepSeek/other efficient open-source models provide alternative solutions for enterprises or individuals with a more effective way to leverage AI.
- Beneficiaries will be the ones that can manufacture the tokens cheaper, and some industry experts see a good opportunity for ASIC (application-specific integrated circuit) makers.
- LLMs should quickly be commoditized. Start-ups are popping up everyday because of efficiency gains, and AI business is moving towards individuals, with more personalized data run locally.

4. Why do we need so many LLMs? When do you think we can reach the state of AGI?

- At the current stage, it is still a race among cloud service providers, as everyone wants to take the leadership position, but we think LLMs will eventually become utilities, just like the internet.
- AGI is a vague term, and the definition itself is arguable. If you only want to use AI to automate your daily tasks, you can achieve that by having hundreds of smaller, more specialized models, or you can have a very powerful foundational model that handles every task.

5. What does DeepSeek mean for Edge AI?

- Essentially you need to use much smaller models trained on really good quality data to be able to perform effectively on edge. However, an alternative way to do this is to have thousands of smaller specialized models instead of one single general purpose model, similar to what Apple Intelligence is doing.
- Agentic moving to edge devices should happen soon, because all the hardware is ready, but more complex tasks will still need cloud services. The future deployment will likely be a mixture of cloud and edge, with routing models to dedicate different tasks accordingly.

6. What is the impact on memory?

- Memory content growth is not linear with the size of the model. Reasoning is not going to get faster simply by adding more memory.
- Faster memory is still necessary, though, as the faster the model's memory, the more tasks it can parallelize.

7. What are the risks that could challenge the current AI supercycle trend?

- From a supply perspective, if TSMC's supply catches up and premium GPUs become commoditized.
- Massive improvement in algorithmic development, which does not need scaling but can significantly improve efficiency and save costs.
- AI works – the biggest threat to AI could be AI itself. If 50 things you do by yourself in daily life get to be replaced by AI and you think that is good enough, then there will be no additional demand.

China AI – Competitive Dynamics

China's AI strategy dates back to the July 20, 2017 State Council announcement (New Generation Artificial Intelligence Development Plan), reinforced by President Xi in October 2017, on the importance of AI as a key area for technological and economic development. China aimed to become a primary innovation hub for the technology by expanding its core AI industry to over US$140 billion by 2030, and boosting related sectors to US$1.4 trillion in value during the same period. AI is not just another technological advancement, but could be the dominant force shaping this decade and likely beyond. China is circumventing existing barriers and strategically developing asymmetric advantages, which we discuss in five categories: Investment, Talent, Research, Patents, and Models.

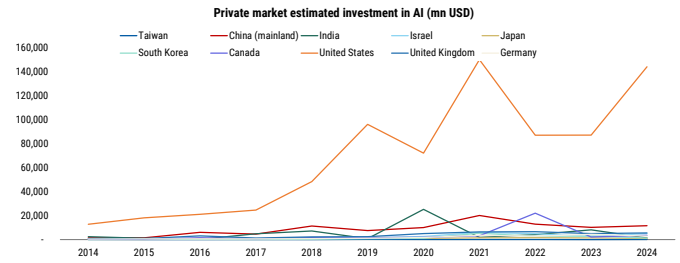
How China is developing its AI ecosystem

The Chinese government maintains a high priority on financial support for the development of domestic AI companies in its pursuit of global leadership in AI innovation and technology. There are two important mechanisms in place that the government utilizes for funding: 1) government guidance funds that are state-directed capital funds, raised from both the public and private sector, for projects that align with government objectives. Between 2000 and 2023, the Chinese government backed venture capital funds investing in 9,623 unique firms in the AI space through more than 20,000 transactions, totalling US$184bn (National Bureau of Economic Research); and 2) subsidies, such as Beijing city's subsidies for firms that purchase domestically produced AI chips (Reuters).

According to CSET (Center for Security and Emerging Technology), China spent Rmb13.5bn-19bn (US$2.0bn-8.4bn) on AI R&D in 2018, and IDC estimates China's AI R&D spending reached US$20bn~25bn in 2024. Fast-forward to 2025, on March 5 the NPC meeting pledged to bolster tech innovation by increasing support for AI applications and a new generation of intelligent terminals (NEVs, EdgeAI devices and Humanoids) – NPC: Modest Stimulus, Tech Focus.

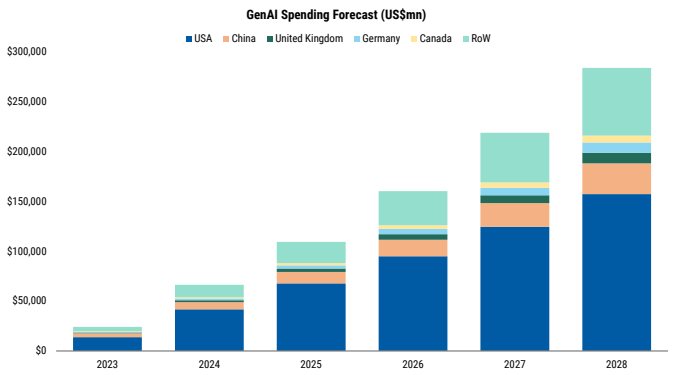
By 2028, China is estimated to account for over 10% of global GenAI spending, compared with the US's over 55%, according to IDC. However, China has less private AI investment compared with the US in terms of investment dollars, but China's robust academic foundations, innovative methodologies, and increasing foreign investment are propelling it towards becoming a leading AI powerhouse.

Exhibit 11: US leads the rest of the world in private market AI investment



Source: ETO

Exhibit 12: US & China are expected to account for more than 65% of global GenAI spending by 2028



Source: IDC historical data and estimates

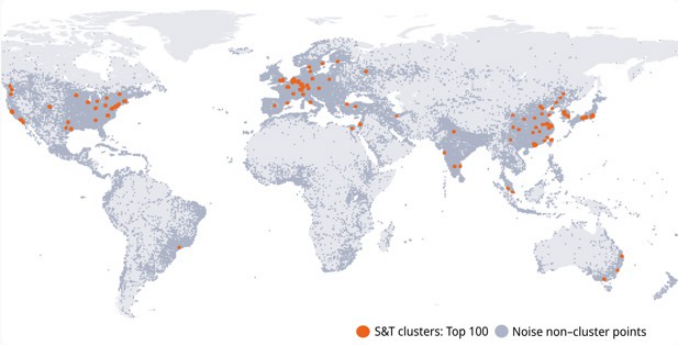
World's largest pool of AI talent

MacroPolo's Global AI Tracker found that in 2022, 28% of top AI researchers were working in China, up from only 11% in 2019. This trend could indicate that China is successfully creating attractive opportunities and environments for its top talent and fostering domestic innovation (Wipo). In 2024, as in previous years, the top 100 S&T clusters continue to be predominantly located in three regions: North America, Europe, and Asia, with a particular concentration in two key economies: China and the US. Clusters within China once again demonstrated significant increases in S&T output in 2024. China hosts the two fastest-growing clusters globally – Hefei (+23%) and Zhengzhou (+19%). Hefei's growth was driven by strong growth in Patent Cooperation Treaty (PCT) applications, and in particular the growth of applications filed by DRAM memory maker ChangXin Memory Technologies (CXMT), headquartered in Hefei, while Zhengzhou's rapid growth was driven by the number of scientific articles published from its largest contributor, Zhengzhou University.

Research capabilities

China surpassed the US in published GenAI-related papers as of 2023, with around 12,450 vs. 12,030, respectively. Despite the similar number of research publications in 2023, one of the major factors maintaining the US's leadership in AI industry-driven research is the active involvement of private-sector firms in AI research, which allows for rapid conversion of high-quality research into impactive technologies and applications. All of the top 10 institutions in AI research from China are academic institutions, while the institutions producing top-tier AI research from the US are a mix of academic organizations and private-sector firms. Consequently, as of 2023, the US produced 61 notable machine learning models, while China produced 15. Most of the foundation models have originated from the US, at 109, compared with 20 from China.

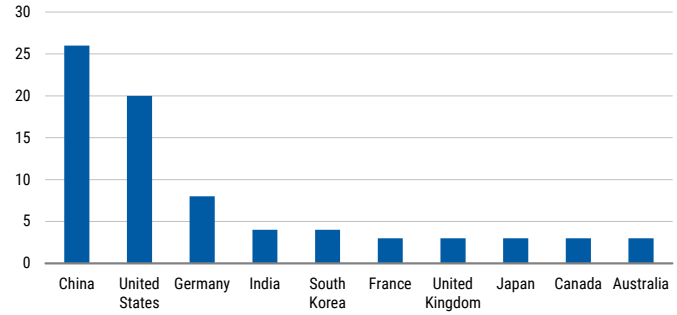
Exhibit 13: Top 100 Science & Technology clusters worldwide, 2024



Source: WIPO Statistics Database, April 2024

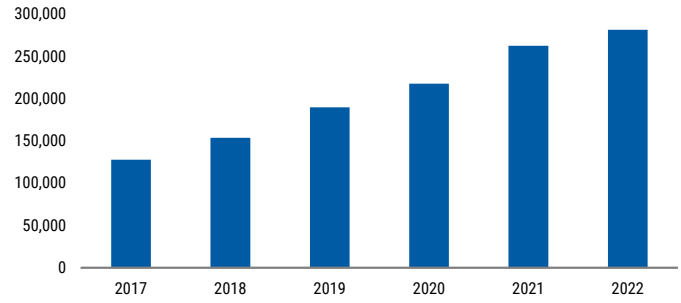
Note: Noise refers to all inventor/author locations not classified as being within a cluster.

Exhibit 14: China, for the second consecutive year, leads with the most clusters (26) in the top 100



Source: WIPO Statistics Database, April 2024

Exhibit 15: Estimated AI research articles published per year



Source: ETO, Morgan Stanley Research

Exhibit 16: Leading Organizations in AI Research in 2023

All research		Top cited	
Insitution	**Country**	**Insitution**	**Country**
Chinese Academy of Sciences	China	Alphabet	US
Tsinghua University	China	UC Berkeley	US
Standford University	US	Universite de Montreal	Canada
Alphabet	US	Stanford University	US
Shanghai Jiao Tong University	China	Meta	US
Massachusetts Institute of Technology	US	DeepMind	UK/US
Zhejiang University	China	Seoul National University	Korea
Harvard University	US	Massachusetts Insitute of Technology	US
Carnegie Mellon University	US	Chinese Academy of Sciences	China
University of Oxford	UK	Imperial College London	UK

Source: ITIF, Morgan Stanley Research

Exhibit 17: List of non-academic Chinese AI Research Institutes (not exhaustive)

PRIVATE-FIRM

Baidu Research	The technical arm of Baidu focuses on AI technology, including labs for cognitive computing and deep learning. Directed by Wang Haifeng, Baidu aims to build a general AI research platform. In 2021, Baidu launched the advanced language model "ERNIE 3. 0 Titan," achieving top scores in NLP tasks.
Alibaba's DAMO Academy	A branch of an e-commerce company, founded in 2017, has 16 research labs and aims for advanced AI.
Tencent AI Lab	Research arm of Tencent, founded in 2016. The lab researches computer vision, speech recognition, NLP, and ML. The lab stated in July 2021, that "AI game research will be a key step for Tencent to overcome the ultimate AI research problem (AGI)".
JD Research Institute	Established in 2017, as a division of the Beijing-based e-commerce company (JD.Com). The institute has three labs for ML, Computer Vision and NLP aimed at achieving 'human-like cognition abilities' in language and speech.
JD Explore Academy	Second research arm of JD.com, founded in 2020 for trusted AI, super deep learning, and quantum ML.
General AI Lab	Founded by Horizon Robotics, as the only major Chinese company to research 'general AI' in California's Silicon Valley, with the mission to build AGI.

GOVERNMENT-BACKED

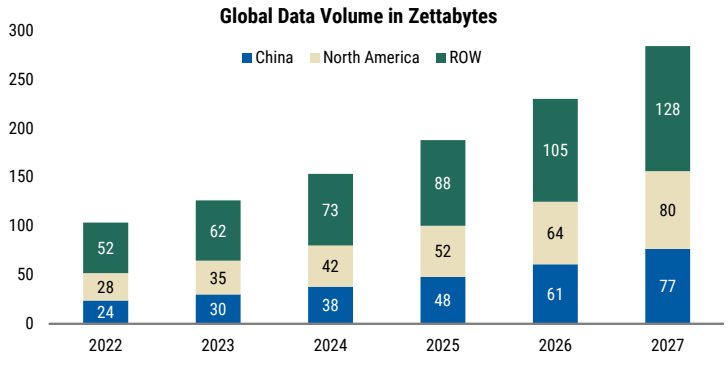
Pengcheng Lab	Founded in March 2018, as a provincial research lab by the Guangdong and Shenzhen governments. The state-supported insitution lists 59 universities, corporates and research institues as 'strategic collaborators' beyond the Baidu and Huawei links.
Beijing Institue for General Artificial Intelligence	Under Ministry of Science and Technology and Beijing Municipal auspices.

Source: CSET, Morgan Stanley Research

Unique data-focused strategy. China's top institutions are engaged in one or more of the three typological areas: 1) Data-driven AI research, 2) Brain-inspired AI studies, and 3) Brain-computer interfaces. Most of the non-academic Chinese AI research institutes account for the traditional AI research, while the remaining two research areas are driven by academic institutions. The annual volume of data produced in China will grow from 24 ZB in 2022 to an estimated 77 ZB in 2027, according to IDC – a compound annual growth rate (CAGR) of 26% that is unrivalled elsewhere.

As AI technology continues to evolve, its interplay with data will become increasingly vital. China has unveiled a comprehensive data strategy that positions data as a cornerstone for national development and technological innovation. Central to this strategy is the launch of the National Data Administration, a government agency tasked with coordinating data-related policies, promoting the construction of data infrastructure and enhancing data governance across the country. This data-focused strategy also marks a shift in China's approach to the digital economy – from the internet plus model, which focuses on internet integration with traditional industries, to a data multiplier model that emphasizes data's transformative impact across sectors.

Exhibit 18: The scale of data in China has achieved a CAGR of 26%, ranking first globally



Source: IDC

Patents leadership. AI patent grants worldwide increased by almost 63% from 2021 to 2022, and since 2010 the number of granted AI patents has grown more than 30-fold. The US and China dominate filings for AI patents, followed by Japan. These three offices accounted for 73% of total patent filings in 2023, according to the latest report from WIPO.

Closing the gap on frontier AI models. China's open-source LLM ecosystem is gaining significant traction with the launch of DeepSeek. Alibaba's LLM series Qwen 1.5 has shown impressive capabilities across various sizes, in particular its largest model with 72 billion parameters. Some iterations of China's open-source models also beat their US counterparts in terms of benchmark scores, according to Artificial Analysis, such as Zhipu AI's ChatGLM3 and Baichuan's Baichuan2, which outperformed Google's Gemma and Meta's Llama 2 series. In addition, Hugging Face, which evaluates open-source models, ranks several iterations of Chinese AI start-ups' open-source models highly for common sense reasoning, math, coding, and reading ability. The makeup of players developing China's top models are a mix of start-ups and tech giants. Models from large tech giants include Baidu's Erniebot, Alibaba's Tongyi Qianwen, and Tencent's Hunyuan, while models from the start-up scene are being led by Zhipu AI, Baichuan AI, Moonshot AI, and MiniMax.

Exhibit 19: Number of AI Patents as of 2024

Rank	Country	Total AI Patents (2024*)	Number of Companies in Dataset	Patents per Company	Key Jurisdictions
1	China	12,945	523	24.8	CN, US, EP
2	United States	8,609	257	33.5	US, EP, CN, JP
3	South Korea	1,537	43	35.7	KR, US, CN, EP
4	Japan	1,537	41	37.5	JP, US, CN, EP
5	Germany	784	18	43.6	EP, US, CN
6	United Kingdom	369	11	33.5	GB, EP, US
7	Netherlands	249	7	35.6	EP, US, CN
8	Sweden	243	4	60.8	EP, US
9	Finland	180	1	180	EP, US
10	Taiwan	156	11	14.2	TW, US, CN

Source: R&D World

Exhibit 20: Open-weight Models by Big Tech Firms

Open-weight Models by Chinese Big Tech Firms					
	Alibaba	Baidu	ByteDance	Huawei	Tencent
Description	Large ecommerce player and Hyperscaler (Alibaba Cloud) largest shareholder of Ant Group	China's largest search engine, and operator of Wenxin Yiyan, and AI chatbot with a reported ~300m users	Parent company of Douyin (TikTok) and Toutiao, one of China's leading news applications	Global telco leader and one of the world's largest smartphone manufacturers	Parent company of Riot Games and WeChat, the 'all-in-one super app' of China; Hyperscaler with their Tencent Cloud offering
AI Strategy (High-level)	- Release open weights models - More recently launched proprietary models - Offer inference on Alibaba Cloud	- Actively integrating proprietary models into search platform - Long time leader in self-driving AI	- Develop proprietary models and integrate across their consumer platforms	- Develop proprietary, domain-specific models and offer on Huawei Cloud	- release open weights models and offer proprietary models on Tencent Cloud
Non-reasoning	Qwen 2.5 Max Intelligence: 79	Ernie 4.0 Turbo Intelligence: 76	Doubao 1.5 Lite Intelligence: 77	Pangu 5.0 Large	Hunyuan Large Intelligence: 74
Reasoning	QwQ Intelligence: 78	-	Doubao 1.5 Pro Intelligence: 80	-	
Text to Sppech	v	v	v	v	v
Speech to Speech	-	-	v	-	-
Image Generation	v	v	v	v	v
Video Generation	v	v	v	v	v
3D Generation	-	-	v	-	-
Primary Consumer Apps	Tongyi Qianwen	Wenxin Yiyan, Wenxin Yige	Doubao	Celia	Yuanbao, Yuanqi
Valuation (US$)	235B	32B	300B	128B	469B

Source: Artificial Analysis (in US$ valuations), Morgan Stanley Research

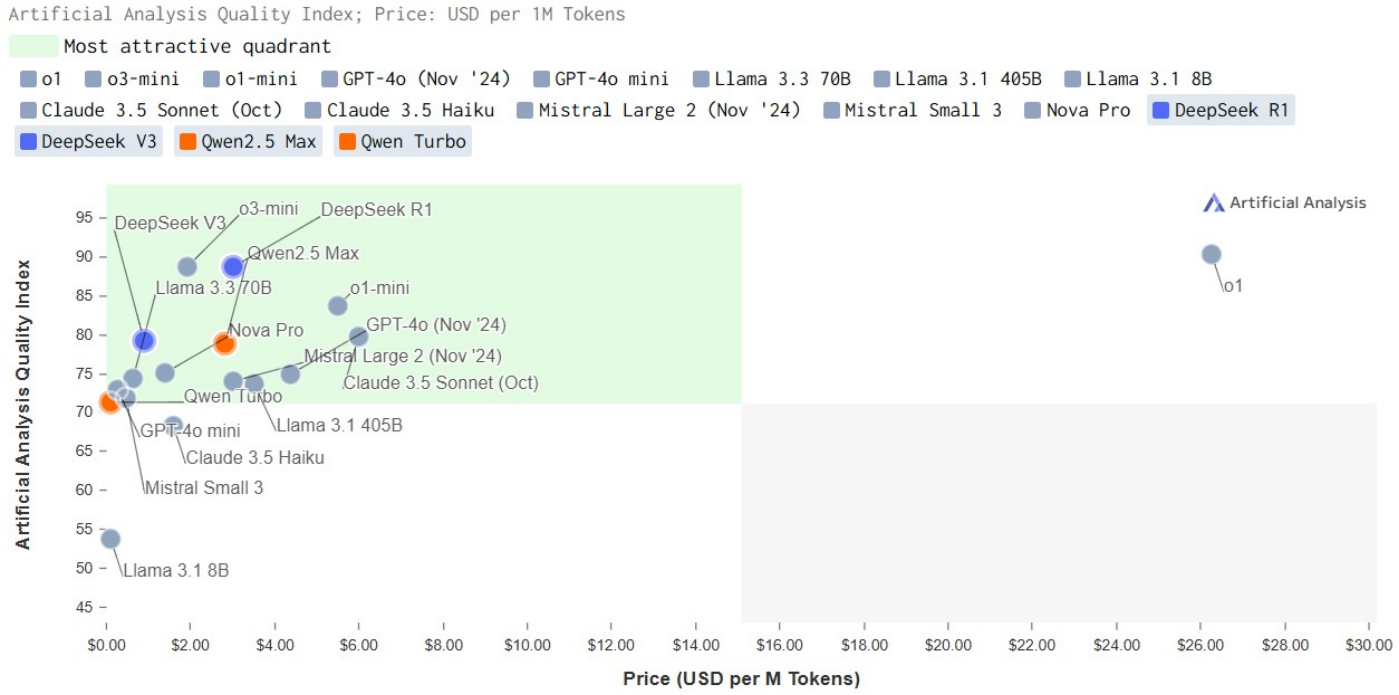
Exhibit 21: Open-weight Models by Start-ups

Open-Weight Models by Chinese AI Tigers and Startups							
	Minimax	Moonshot AI	Yi-Ligtning	DeepSeek	Zhipu-AI	Baichuan	Stefun
Description	China AI Tiger and publisher of Talkie AI app (4th most downloaded in the US in 1H24)	China AI Tiger with 2M Chinese character context window model; China's most well-funded AI startup based on available information	Chinese AI startup focused on smaller language models founded by Lee Kai-Fu (author, former head of Google China)	Chinese AI lab originating out of an AI focused quantitative trading firm	China AI Tiger with nearly ~700k enterprise and developer users	China AI Tiger with a focus on medical AI models founded by Wang Xiaochuan.	First Chinese AI startup to develop a trilion-parameter model; founded by Jiang Daxin (ex-Chief Scientist, Microsoft Research Asia)
Non-reasoning	MiniMax-Text-01 Intelligence: 76	V1-128K Intelligence: 52	Yi-Lightning Intelligence: 73	V3 Intelligence: 79	GLM-4-Plus Intelligence: 70	Baichuan 4-Turbo Intelligence: 65	Step-2-16k Intelligence: 82
Reasoning	-	Kimi k1.5 Intelligence: 87	-	R1 Intelligence: 89	GLM-Zero-Preview Intelligence: 81	Baichuan M1-Preview Intelligence: 83	Step-R-mini Intelligence: 84
Text to Sppech	v	-	-	-	-	-	v
Speech to Speech	-	-	-	-	v	v	-
Image Generation	-	-	-	v	v	-	v
Video Generation	v	-	-	-	v	-	-
3D Generation	-	-	-	-	-	-	-
Primary Consumer Apps	Hailuo AI Chat, Hailuo AI Video	Kimi	YiChat	DeepSeek Chat	ChatGLM	Bai Xiaoying	Yuewen, PopDuck
Valuation (US$)	0.85b	1.67B	0.2B	Unknown	1.12B	1.04B	Unknown

Source: Artificial Analysis (in US$ valuations), Morgan Stanley Research

China's frontier AI models are closing the performance gap with the US. China's innovation is showing its strength in agility, infrastructure, talent, and AI usage, driven by state support. We expect the AI economy to grow significantly by 2030, supported by key factors such as computing power and talent. The US, on the other hand, is more focused on building a strong AI ecosystem, potentially leading to a split global AI landscape. DeepSeek's emergence offers more options for accessing advanced AI capabilities.

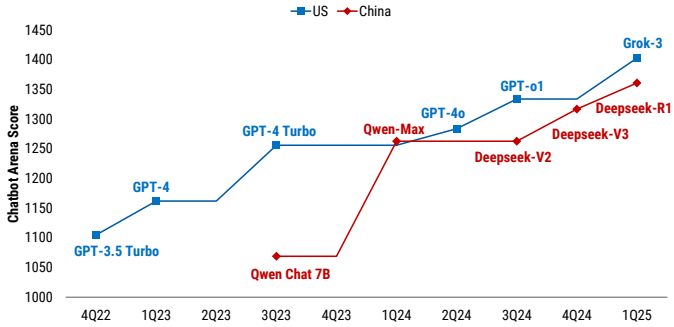
Exhibit 22: How competitive are Chinese LLMs? Quality vs. Price



Source: Artificial Analysis

Catching up on innovation. The final months of 2024 saw the emergence of numerous high-performance models from top Chinese AI labs. This resulted in a closing of the gap between the level of intelligence offered by models from Chinese AI labs and US AI labs. Several Chinese models are now competitive with models from the top US labs. The reasoning models that have a "chain-of-reasoning" were first introduced by OpenAI in 3Q24. Within months, Chinese competitors, led by DeepSeek, have largely replicated the intelligence of o1. Several AI labs in China now have frontier-level reasoning models that are competitive with the leading models globally.

Exhibit 23: Frontier AI model intelligence



Source: Chatbot Arena score: measured by votes on style control, hard prompts, coding, match, creativity writing, instruction following, longer query and multi-turn. Release date is based on first public launch of the model.

Exhibit 24: China vs. US State-of-the-Art models (reasoning)

Creator	Model	Context window (k)	Parameter (B)	Open/closed source	Blended Input (US$/mn tokens)	Output (US$/mn tokens)
China						
Bytedance	Doubao-1.5-pro-32k	32	n.a	Closed	0.1	0.3
	Doubao-1.5-pro-256k	256	n.a	Closed	0.7	1.3
Alibaba	QwQ-32b	131	33	Open	0.3	0.9
	Qwen 3	130	235	Open	n.a	n.a
Tencent	hunyuan-T1	n.a	n.a	Closed	n.a	n.a
Baidu	Ernie x1 Turbo	n.a	n.a	Open	0.1	0.6
DeepSeek	Deepseek-R1	128	671	Open	0.4	2.3
Moonshot	k1.5	n.a	n.a	Closed	n.a	n.a
StepFun	Step Reasoner mini	n.a	n.a	Open	n.a	n.a
Baichuan	M1-Preview	n.a	n.a	Closed	n.a	n.a
Zhipu	GLM-Zero-Preview	n.a	n.a	Closed	1.4	1.4
Xiaomi	MiMo-7B-RL	n.a	7	Open	n.a	n.a
US						
OpenAI	o1	200	n.a	Closed	11.3	60.0
	o3-mini	200	n.a	Closed	0.8	4.4
	o4-mini	200	n.a	Closed	1.1	4.4
Meta	Llama 3.1-405b	128	405	Open	3.6	3.6
Google	Gemini 2.5 Pro	1000	n.a	Closed	1.9	12.5
	Gemini 2.5 Flash	1000	n.a	Closed	0.1	0.4
Anthropic	Claude 3.7 Sonnet Thinking	200	n.a	Closed	3.8	15.0
xAI	Grok-3 mini	128	n.a	Closed	n.a	n.a

Source: Company data, Artificial Analysis, updated as of May 2025

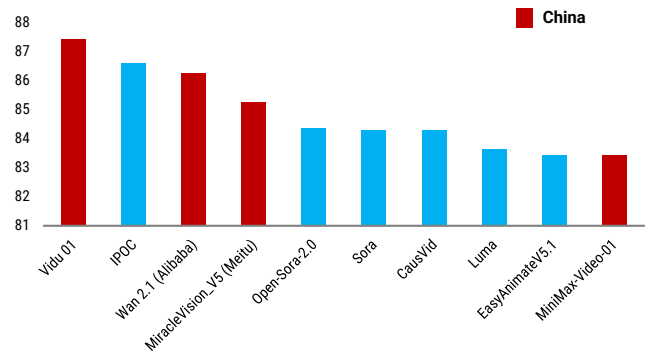
Exhibit 25: China vs. US State-of-the-Art models (non-reasoning)

Creator	Model	Context window (k)	Parameter (B)	Open/closed source	Blended Input (US$/mn tokens)	Output (US$/mn tokens)
China						
Alibaba	Qwen2.5-Max	32	n.a	Closed	0.3	1.4
Baidu	Ernie 4.5 Turbo	n.a	n.a	Open	0.1	0.5
Tencent	hunyuan-turbo-latest	n.a	n.a	Closed	0.3	1.4
	hunyuan-turboS	n.a	n.a	Closed	0.1	0.3
DeepSeek	Deepseek-V3	128	671	Open	0.2	1.1
Minimax	MiniMax-Text-01	4000	456	Open	0.1	1.1
Baichuan	Baichuan4-Turbo	n.a	n.a	Closed	2.1	2.1
01.ai	Yi-Lightning	n.a	n.a	Closed	0.1	0.1
Zhipu	GLM-4-Plus	n.a	n.a	Closed	7.1	7.1
US						
OpenAI	4o	128	n.a	Closed	1.9	10.0
	GPT-4.5	128	n.a	Closed	56.3	150.0
Meta	Llama 4 Maverick	n.a	n.a	Open	0.2	0.5
Google	Gemini 2.0 Flash	1000	n.a	Closed	0.4	0.4
Anthropic	Claude 3.5 Sonnet	200	n.a	Closed	3.0	15.0
	Claude 3.7 Sonnet	200	n.a	Closed	3.8	15.0
xAI	Grok-3	1000	n.a	Closed	n.a	n.a

Source: Company data, Artificial Analysis, updated as of May 2025

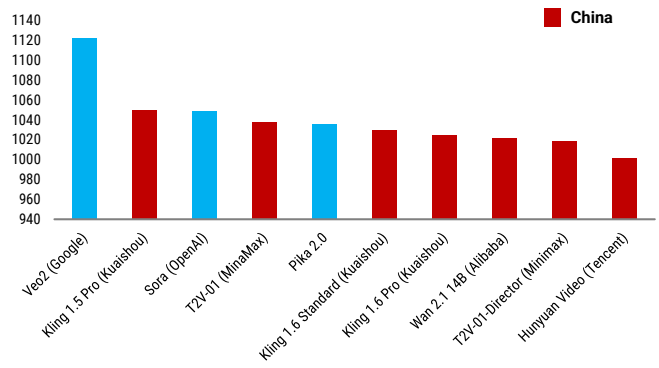
Multi-modal strengthened by proprietary data. In addition to LLMs, China has also developed multi-modal capabilities and is a leader in video AI models globally. We believe the video model performance is largely contributed by the public video data for pre-train, and more importantly, proprietary video data produced daily for post-train. The current leading players in video models are also the leaders in the vision industry, such as Google (YouTube), Alibaba (Youku), Kuaishou, Meitu (Meitu Xiuxiu) and Tencent (Tencent Video). China has two video platform giants – Bytedance and Kuaishou – which have around 80mn new videos generated per day, with the total length larger than that of YouTube. We believe Bytedance and Kuaishou are likely to maintain their leading positions in video AI models and enlarge the gap vs. non-video platforms worldwide.

Exhibit 26: Video model leaderboard – Vbench



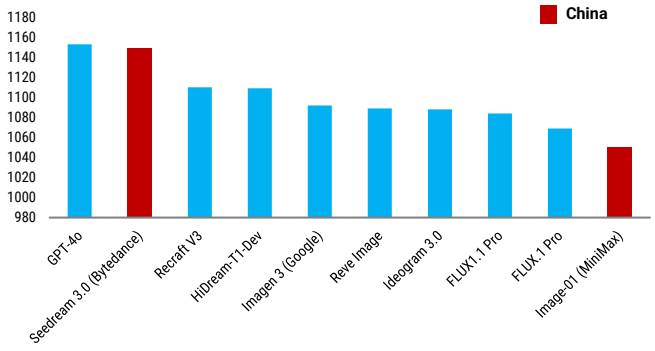
Source: HuggingFace, updated as of May 2025

Exhibit 27: Video model leaderboard – generation score



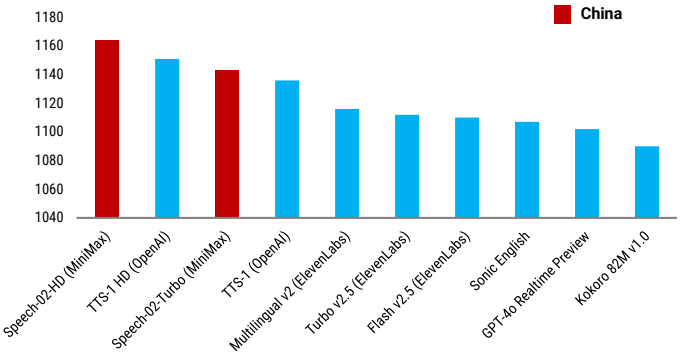
Source: Artificial Analysis, updated as of May 2025

Exhibit 28: Text-to-Image model leaderboard



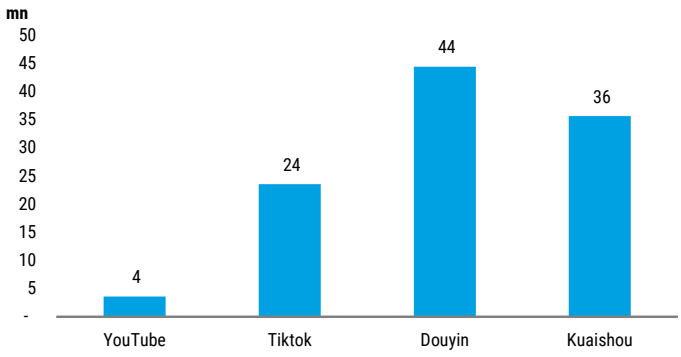
Source: Artificial Analysis, updated as of May 2025

Exhibit 29: Text-to-Speech model leaderboard



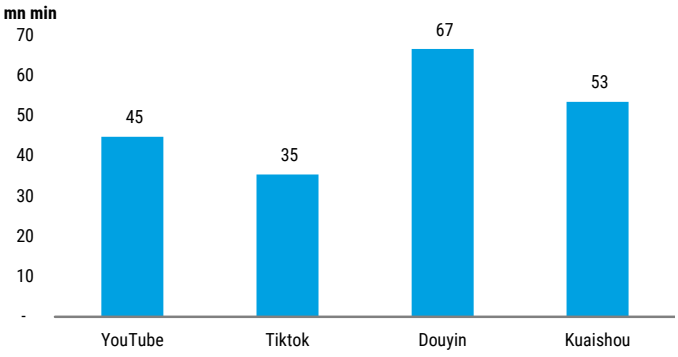
Source: Artificial Analysis, updated as of May 2025

Exhibit 30: No. of videos uploaded daily



Source: photutorial, sendshort.ai, statista, Morgan Stanley Research estimates

Exhibit 31: Video length uploaded daily



Source: photutorial, sendshort.ai, statista, Morgan Stanley Research estimates, we estimate average video length of YouTube at 12min and Tiktok/Douyin/Kuaishou at 1.5min

Risks and potential impact from US sanctions

In January 2025, the US government announced a new 'Framework for Artificial Intelligence Diffusion', which is unprecedented in scope and scale. At its core, this new regulation is targeted at preventing China from accessing AI compute to build frontier models (Semiconductor Tariffs - Quantifying Risks). However, with DeepSeek, we have learnt that computational capabilities aren't the only aspect that drives technology to newer heights. It appears that US restrictions will likely reduce the addressable market for HBM and may accelerate the demand pivot towards cheaper legacy memory.

Exhibit 32: Regulatory Restrictions

Rule	Summary	Dates	Impact
October 2022 Controls	Initial restrictions on frontier GPUs. Both performance and interconnect thresholds had to be breached for the GPU to be restricted.	Annnounced: 7 Oct 2022 Effective: 21 Oct 2022	**Restriction Classification & Criterion** Total Processing Performance (TPP): TPP >= 4,800 Interconnect Bandwidth: TPP >= 600GB/s
October 2023 Controls	Revised framework to prevent workarounds. Restricted exports of GPUs to China based on TPP or Performance Density (PD)	Announced: 17 Oct 2023 Effective 17 Nov 2023	**Groupings & Criterion (Datacenter GPUs)** Group 1 Presumption of denial: TPP>= 4,800 or TPP >= 1,600 AND PD >=5.92 Group 2 Restrictive NAC licensing review: 2,400 <= TPP <= 4,800 AND PD >=1.6 or TPP >= 1,600 AND PD>= 3.2 Group 3 No Restrictions: TPP < 1,600 or PD <3.2
BIS Final Rule	Crackdown on indirect imports by Chinese-afiliated chip manufacturing entities.	Announced: 2 Dec 2024 Effective: 31 Dec 2024 Updated: 16 Jan 2024	Did not impact restricted chips 140 entities (majority Chinese) from advanced chip sector now face a presumption of denial and added to Entity List in December 2024
AI Diffusion Rule	Extensive three-tiered licensing framework segregating access to GPUs by countries.	Announced: 13 Jan 2025 Effective: 15 May 2025	Tier 3 countires (including China) face a de facto ban on advanced AI chips All exports of controlled chips to these Tier 3 countries now require an export license, subject to a presumption of denial during review Tier 2 countries now face limitation on large orders of AI chips
AI Due Diligence Rule	Companion KYC rule for AI Diffusion Rule	Announced: 16 Jan 2025 Effective: 31 Jan 2024	Requires companies to conduct KYC-like compliance checks on their customers and comply with the AI Diffusion Rule
US AI Chips Restrictions	The US government has enacted new licencing requirements for shipments of some of AI chips products to China or companies headquartered in China along with any D:5 countries	Announced: 16 Apr 2025 Effective: 16 Apr 2025	Chinese CSP's mainstream AI chips such as H20 and MI308 are now banned under this restriction.

Source: Federal Register, Morgan Stanley Research

The Race For Intelligence

From 'fast follower' to 'global leader' in innovation is not easy… China has reached a new stage in its economic development, with much greater innovation capabilities in its universities and domestic companies. It leads, or is on par with, other global leaders in commercial nuclear power, electric vehicles and batteries, but for now lags behind in other key sectors, such as robotics, biopharmaceuticals, chemicals, and AI. But it is making rapid progress on many fronts, and is likely to surpass these peers within a decade, in our view. The combination of low costs and growing innovation capability make an increasing number of Chinese companies formidable global competitors.

…but the last decade has shown China becoming a globally competitive producer of technology, such as telecom equipment, machine tools, computers, solar panels, high-speed rail, ships, drones, satellites, heavy equipment, electric vehicles, and pharmaceuticals. In all these industries, China has gained significant global market share, and it is now making rapid strides in emerging industries, such as robotics, AI, quantum computing and biotech. In the next decade, if China can combine its cost advantage with an innovation advantage or parity, the challenge to innovative industries in Western nations will become much more significant – combining quality, innovation, and price.

What's next for China beyond AI? The competition is no longer just about power – it is about making AI cheaper and more accessible. In addition to development of AI capex and adoption, China has also stay on top of the next stage development in quantum computing, neuromorphic and photonic computing, as well as atomic-level manufacturing, if it wants to reduce the impact of US sanctions and accelerate the overall adoption of new technologies that will significantly reshape future economic development.

What's China's competitive edge in AI?

Efforts to hold back China's AI progress may not succeed, in our view. China is advancing rapidly in AI research and application, challenging the world in this critical field. Robust academic foundations, innovative methodologies, and increasing foreign investment are propelling it toward becoming an AI leader. US efforts to restrict China's access to advanced technology through export controls appear to hinder near-term development, but these measures may have helped spur China to advance its homegrown ecosystem. Chinese companies are circumventing restrictions by training in public clouds wherever they can, and innovating with developing on-premises private clouds, such as Huawei's "AI-in-a-box" products, wherever they can't.

Open-source AI is likely China's best way to compete without access to the best chips or the advantage of an early lead. China has seen a rapid increase in large-scale AI models from leading industry and academic labs since 2023. Companies must seek government approval before introducing AI chatbots built on LLMs into the market. As of August 2024, China's Cyberspace Administration had approved at least 188 generative AI products, and, according to data provider IT Juzi, at least 262 start-ups are competing to bring out generative AI products in China.

- The gap between the leading models from US industry leaders and those developed by China's foremost tech giants and start-ups is closing quickly. See Exhibit 24
- China's top models are a mix of start-ups and tech giants. Start-ups are led by Zhipu AI, Baichuan AI, Moonshot AI, and MiniMax, while tech giants are represented by cloud providers.
- The open-source LLM ecosystem is gaining the most traction in China. Open sourcing AI can decentralize development and tap into global AI talent to refine open-sourced models. US sanctions may also be mitigated, as high-end chips become less of an obstacle when the rest of the world can train and improve China's models on alternative hardware.
- AI advances through iteration create an ecosystem where global developers continually improve their models, without shouldering all the development costs. Every new LLM release builds upon the last, expanding capabilities and improving efficiency.
- The scale of this approach could fundamentally reshape AI's economic structure, where AI is abundant, but profits not so. This is similar to the internet, which is free today and serves as the 'highway' to build applications on top.

What is innovation and can it sustain? Innovation is not the same as invention and not necessarily about entrepreneurship. Just as iPhone did not invent the smartphone, nor Tesla the electric powertrain, innovation is about bringing to market new products or services at scale. While part of the new thinking element is critical, so is its widespread diffusion and adoption, and so is the process of technology innovation. Upon assessment of Chinese AI innovation capabilities, we identify three main areas where China may have a strong competitive edge in AI competition:

1. **Cheaper energy – China's AI energy edge over the US has been overlooked.** As AI advances, energy demands are surging. Foundation models require substantial computing power and can consume up to 33 times more energy in order to complete a task compared to task-specific software. In response to these demands, China is prioritizing sustainable energy solutions to power AI (246 green data centers already built) while minimizing its environmental impact. China aims to supply 100% of DC power demand from green energy (mainly wind and solar) by the early 2030s. (*link*)
2. **Talent.** With China's rapid advances in AI technology, demand for skilled AI professionals has surged. More than 535 universities in China currently offer AI-related majors, with 30 reflecting a growing emphasis on AI talent cultivation across the country and broadening to part of the curriculum at primary school level from this year. It is estimated that China now accounts for nearly half of the world's top AI researchers, with Tsinghua University renowned as a hub for top AI start-ups founded by its faculty and alumni. China's emphasis on AI clustering strengthens its talent pipeline by creating hubs of excellence centered around leading universities and research institutions. These clusters create a self-reinforcing cycle of talent and resource aggregation, further driving AI innovation and boosting China's competitiveness in the global AI talent landscape.
3. **Scaling AI innovation in industries.** China's extensive industrial landscape and supply chains help create a rich environment for AI adoption and innovation. As such, AI technology offers significant growth opportunities in key industries in China, particularly in manufacturing, automotive, retail, healthcare, finance, utilities and public services. The deep integration of AI technology with business use cases in China has become a catalyst for both driving AI innovation and accelerating industrial transformation. China's AI innovation is also increasingly characterized by cross-disciplinary fusion, which involves integrating AI with 5G, industrial robotics and other advanced technologies. This multidisciplinary approach, in turn, amplifies the impact of AI across sectors. For example, there were 1.7 million industrial robots operating in China's factories in 2023 and total annual installations of robotics in China represented 51% of global demand, according to the International Federation of Robotics.

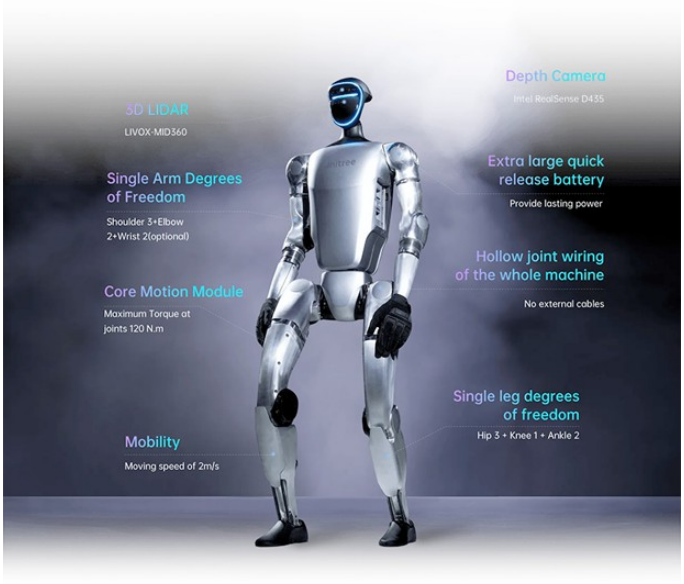
Physical AI

Economic and geopolitical shifts where AI and robotics converge fast. If AI models can be trained and run on dramatically cheaper, less power-hungry hardware, that extends to robotics, then China could end up leapfrogging the West in AI-driven manufacturing, logistics, and humanoids. The same efficiency gains that are driving AI adoption could do the same for Physical AI – a term for robots that actually understand and interact with the real world. The assumption that robotics would require high-end chips running massive AI models locally is no longer true, thanks to the likes of DeepSeek's efficiency breakthroughs. If AI can run on less memory and lower-power hardware, it frees-up the humanoid robot's head and can unlock smaller, cheaper, and more power-efficient designs.

The future of AI isn't just digital – it's physical, and it's here. Investment is accelerating now, and physical AI is quickly becoming a feature of the new frontier models that are currently being developed. The robotics, or humanoid, conversation last year was largely a conceptual framework for how things might be done, but companies are starting to spend money now on developing models for the physical domain. Most companies will make money when autonomous cars, or robots, are deployed, but we expect processor and component revenues to come much earlier, as their hardware dominates the profits during that investment phase, and if the cost curve keeps dropping, physical AI will likely be everywhere. And it's coming faster than anyone expected. Key improvements that have come together in recent months include:

- AI modelling capability that is multi-modal, or able to execute on visual and audio data as well as words.
- Reasoning capability that we are now starting to see for the first time, to make full use of such data.
- Modelling the physical domain will be significantly different from investments in AI for language or vision. To model the robotics use cases, companies are talking about investing in real world data gathering and also creating simulated data from projects.

Exhibit 33: Unitree G1



Source: Unitree

Exhibit 34: Fourier GR-2

Source: Fourier

Quantum computing

Global competition over quantum leadership – US and China on divergent paths. Both are competing to gain dominance in quantum technology, but they are using very different innovation paths – the US leads in quantum computing hardware with higher qubit development and advanced error correction, while China excels in quantum communication or network and matches the US in quantum sensing. China excels in market-ready technology and commercial applications, while the US dominates high-impact areas. China's centralized approach has created a tightly integrated ecosystem centered around institutions, while US quantum innovation is largely based on the private sector, universities and venture-capital-backed start-ups to push the boundaries of quantum computing. European countries are leaders in quantum research but have struggled to translate these research results into practical applications.

Why quantum matters. Quantum technologies are not only important for national security, but they also have the potential to exert a transformative influence on the economy and society. As such, in China quantum research is being conducted via a highly coordinated and government-directed approach, led by government labs and leading universities, and operating under a unified national strategy, ensuring that research efforts align closely with state objectives. The aim of leading in quantum technology by 2035 has long been at the core of President Xi's plan to enhance the country's global competitiveness.

Quantum computing chip breakthrough – Zuchongzhi-3. In quantum computing, China is behind the US, but it recently unveiled a breakthrough with Zuchongzhi-3, a 105-qubit machine that demonstrated exceptional coherence time necessary to perform complex operations and computations, processing calculations at speeds that dwarf even the most powerful supercomputers. This is a superconducting quantum computing prototype, equipped with 105 qubits and 182 couplers developed by the University of Science and Technology of China (USTC), part of the Chinese Academy of Sciences, along with its partners. In quantum communications, China has secured global leadership, notably demonstrated through the development of the world's longest quantum key distribution (QKD) network – the 1,200-mile Beijing-Shanghai backbone.

Supercomputing

By 2028, China's AI computing power will surpass 2,782 exaFLOPS, according to IDC, exceeding the combined AI computational power of multiple leading economies.

China has developed capabilities in neuromorphic and photonic computing as a means to overcome the challenges of US chip sanctions, supported by top domestic academic institutions and leading internet firms. AI-driven neuromorphic computing will enable machines to process information at speeds rivaling human cognitive functions.

- In 2024, researchers from the Chinese Academy of Sciences, in collaboration with Swiss Scientists, developed Speck, a low-power neuromorphic chip capable of dynamic computing, which can handle visual tasks with just 0.7 milliwatts, providing an energy-efficient, responsive, and low-power solution for AI applications as an alternative way to overcome US sanctions (news).
- There have also been several pilot launches of photonic chips, such as Tsinghua University's "Taiji-II", which enable efficient and precise training of large-scale neural networks in optical computing systems (news).
- In March 2025, Chinese researchers developed the world's first large-area 2D metal material, which paves the way for further technological advancements in areas such as ultra-miniature low-power transistors, high-frequency devices, transparent displays, ultra-sensitive sensors and highly efficient catalysis, and eventually atomic level manufacturing (news).

See more details:

- *The Future of Technology: Neuromorphic Computing – The Human Brain In Silicon (March 9, 2023)*
- *The Future of Technology: Cognitive Computing (March 6, 2023)*

Global Influence and Standardization

China's approach to influencing AI governance and development on a global level. China is implementing a comprehensive AI governance framework that could help to shape international AI policies - the "Global AI Governance Initiative", and which is aimed at ensuring that AI development remains secure, ethical, and strategically controlled. Government officials believe that by 2030, AI will be deeply embedded across all sectors of China's economy, supported by a strong regulatory environment. China frames AI as a strategic technology that will elevate its status among the most innovative and competitive nations globally, in addition to protecting its national security interests.

A centrally planned approach to AI is aimed at creating competitive advantages in AI systems across societies and economies. China has acknowledged the areas of AI in which it must improve in comparison to other developed countries. These include areas such as basic theory, core algorithms, key equipment, and high-end chips.

- **AI standardization and compliance leadership.** China is seeking to establish at least 50 sets of artificial intelligence (AI) standards by 2026 (*announcement*), covering machine learning safety, AI ethics, bias detection, and autonomous decision-making frameworks. Risk assessment protocols will ensure full compliance in AI models used in finance, healthcare, security, and automation, and a regulatory board will monitor, evaluate, and enforce AI transparency, accountability, and responsible development. Safeguarding national and corporate AI-driven innovations and data protection laws will help prevent unauthorized access.
- **AI laws, IP protection, and cybersecurity.** IP protection will expand China's patent leadership in AI-driven automation, deep learning, and generative AI. An enhanced cybersecurity scheme will be created to protect China's digital infrastructure from AI-powered cyber threats and data leaks, and compliance protocols will align with global AI safety measures, ensuring responsible cross-border AI collaboration. With these advancements, China aims to set the 'gold standard' for AI regulation, governance, and intellectual property protection, ensuring its AI leadership remains secure, structured, and future-proofed.

The world of standardization is undergoing a profound period of change, in our view, as economic balances of power shift, and where standards define technology and technology defines the modern world. The US and China are both making rapid gains in AI capabilities, and while conventional wisdom has been that the US is well ahead, China is striving to close the gap with efforts to shape global technology standards and norms that are at the heart of China's ambitions to achieve technological self-reliance, along with support for economic growth and improved societal well-being. China has incorporated a standardization dimension into its AI Initiative, which could evolve into wider adoption across the world as its AI products are much cheaper and closer to the mass market.

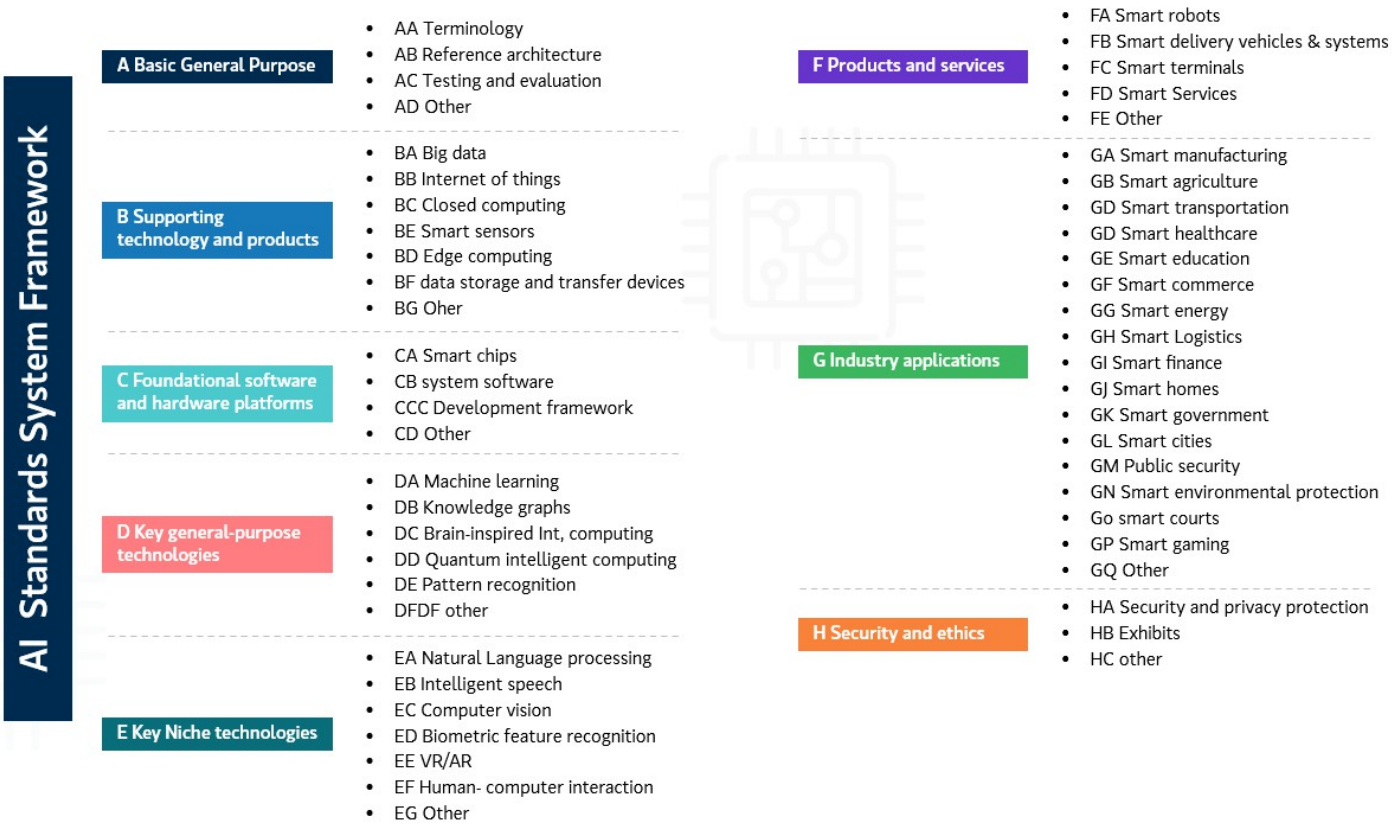
The scope and breadth of standards is massive. They are a consensus process on technical cooperation where influence matters along with innovation. While the US has traditionally led in standards-setting, especially in cutting-edge technology sectors, China has raised its game substantially on global standards in next generation technologies – AI, 6G and the internet architecture of the future itself (i.e., quantum internet). We think they will increasingly be China-influenced. For existing foundational technologies, it will probably take China considerable time to replicate six decades of US semiconductor infrastructure, IP, and efficiencies before becoming competitive. But for newer technologies that are emerging in the data era, the playing field is level and China is well positioned. It all begins with the power of standards and rule-making process.

- **Standards are often invisible, yet they play a fundamental part in bringing outsized benefits to society at large**.
- **They can be seen as a powerful form of transnational authority** by defining the status of public and private parties involved in standardization and regulation.
- **Authority is recognized when complying to standards**, and defines the status of public and private participants.
- **The fast-evolving AI technology sector will require a vast array of new industry standards** to support it.
- **Setting AI standards is part of the China Standards 2035 framework, which could help set the global governance agenda, and China's ability to shape international norms** and widely practiced standards.

China is seeking to establish at least 50 sets of artificial intelligence (AI) standards by 2026, according to the latest AI policy from Beijing, as it pushes to close the gap with the US in developing this technology. The proposed standards will include those that pertain to the training of large language models (LLMs) – the technology underpinning generative AI services like ChatGPT – as well as safety, governance, industrial applications, software, computing systems, data centres, and the technical requirements and testing methodologies for semiconductors. At least 1,000 Chinese technology companies are expected to be covered by those standards, according to Ministry of Industry and Information Technology (MIIT). The document (link) also maintained that China will take part in establishing at least 20 international AI standards. China's AI industry chain, according to the draft policy, consists of four layers: the foundation – including the computing power, algorithms and data required to train LLMs – as well as the framework, model and applications.

China's multidimensional AI approach. China frames AI as a strategic technology that will elevate its status among the most innovative and competitive nations globally, in addition to protecting its national security interests. By aligning with the "Global South", China looks to be positioning itself as a formidable force in international AI governance, challenging traditionally Western-centric views.

Exhibit 35: Scope of China AI Standards defines 12 areas as critical technologies in the following buckets



Source: MIIT

The Chinese Approach vs. the International Model

Standardization today is mainly a matter of private self-regulation in the West, while China is taking a state-driven approach to technical standardization. This top-down approach, however, is not unique from a historical perspective. Many nations that drove industrialization were just like China is today, using capital and government support. Industrialization in Germany and Japan were top-down driven, and the US semiconductor industry was formed by state funding for military and space. So the present may look different, but from a historical context it is similar.

Success in rule-making involves three criteria:

1. **Innovation is critical**. China's indigenous semiconductor innovation may be lagging but it is leading in new areas such as 5G/6G, quantum communication, digital payments and autonomy.
2. **Influence is critical and participating in standards creation requires understanding of the rules**. China's participation rates are some of the highest among major standards organizations like ISO, more than twice the voting members of Japan, Korea and the US in 3GPP responsible for 5G standard setting, and the current presidents of both IEC and ITU are from China.
3. **Leadership is important**, as reliance on market forces alone will not change current hegemony.

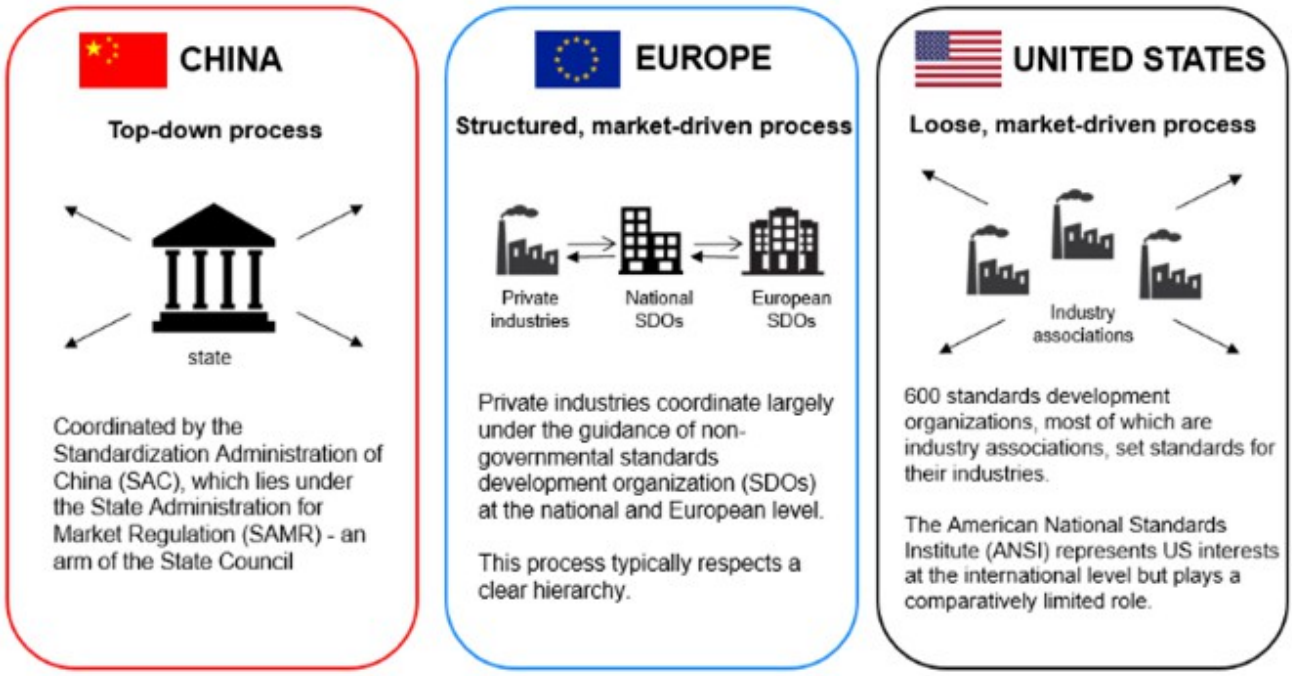
For China, clearly a matter of national priority. China's AI strategy is clearly state-centric, with the government playing a pivotal role in marshaling resources and steering AI advancements. This centralized approach is manifested in the government's ability to amass and deploy vast data and resources, which are indispensable for AI development. Such strategic synchronization has enabled significant strides in areas including surveillance, facial recognition, health data management, autonomous vehicles, and robotics. These advancements extend beyond mere technological achievements, and craft enterprise AI solutions that align with China's industrial and strategic ambitions, demonstrating their strategic flexibility and alignment with government directives.

It is important to point out that China's AI objectives diverge from a generic consumer-oriented strategy, and are instead geared toward enhancing China's industrial strength and global competitiveness. The deployment of AI in manufacturing processes, healthcare systems, and smart city initiatives is indicative of this targeted application. China's approach to data, which is crucial to training AI systems is differs from that of Western countries, where the regulatory environment regarding data privacy is less restrictive, providing Chinese tech companies access to enormous datasets.

Relevant links:

China Standards 2035 – Poised to Reshape a Multipolar World (May 6, 2021)

Exhibit 36: Standards setting in China, Europe and the US



Source: IFRI, Morgan Stanley Research

Commoditization of Foundation Models

China is not only closing the gap with the US in terms of AI model performance, but it is at the forefront of commoditization of foundation models, led by DeepSeek and Alibaba. Note the below features in China's AI models:

1) China has a good enough amount of AI model developers with both reasoning and non-reasoning models.

2) Chinese AI models are generally cheaper than those of the US with similar performance.

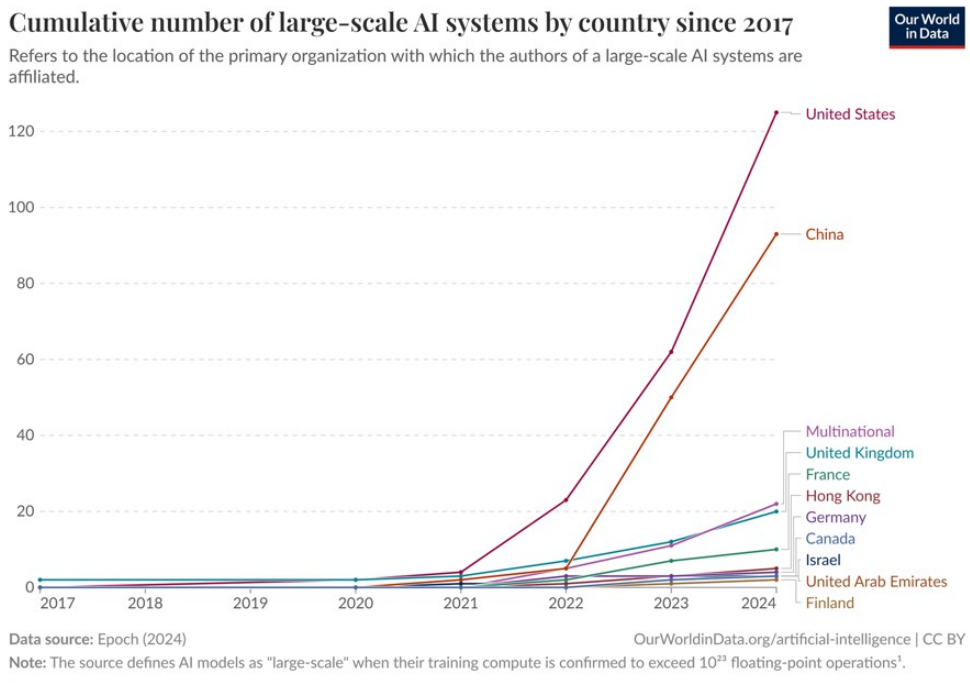
3) China leans towards providing open-source and small-size AI models.

Multipolar AI world

Ever since the birth of GPT-4 in 2022, the US has kept its leading position in the iteration of new AI models, with China being No.2 and catching up, despite having joined the AI club a year later, and despite being heavily constrained by chipset supplies. By end 2024, the US had accumulated 125 LLMs, while China was at 93, followed by other countries. China is not only closing the gap with the US in terms of model quantities, but also in terms of quality. We identified at least 12 leading AI enablers in China having launched SOTA (state-of-the-art) AI models matching the performance of the leading AI models in the US, covering reasoning and non-reasoning, open- and closed-source, as well as large and small sizes. These 12 AI enablers in China comprise:

- **Four internet hyperscalers:** Alibaba, Bytedance, Tencent, Baidu
- **Six start-ups:** Minimax, StepFun, Zhipu, Moonshot, 01.ai, Baichuan
- **A quant-fund backed company:** DeepSeek
- **Hardware giant:** Xiaomi

Exhibit 37: Worldwide AI model amounts



Source: Epoch, Our World in Data

Exhibit 38: China vs. US State-of-the-Art models (reasoning)

Creator	Model	Context window (k)	Parameter (B)	Open/closed source	Blended Input (US$/mn tokens)	Output (US$/mn tokens)
China						
Bytedance	Doubao-1.5-pro-32k	32	n.a	Closed	0.1	0.3
	Doubao-1.5-pro-256k	256	n.a	Closed	0.7	1.3
Alibaba	QwQ-32b	131	33	Open	0.3	0.9
	Qwen 3	130	235	Open	n.a	n.a
Tencent	hunyuan-T1	n.a	n.a	Closed	n.a	n.a
Baidu	Ernie x1 Turbo	n.a	n.a	Open	0.1	0.6
DeepSeek	Deepseek-R1	128	671	Open	0.4	2.3
Moonshot	k1.5	n.a	n.a	Closed	n.a	n.a
StepFun	Step Reasoner mini	n.a	n.a	Open	n.a	n.a
Baichuan	M1-Preview	n.a	n.a	Closed	n.a	n.a
Zhipu	GLM-Zero-Preview	n.a	n.a	Closed	1.4	1.4
Xiaomi	MiMo-7B-RL	n.a	7	Open	n.a	n.a
US						
OpenAI	o1	200	n.a	Closed	11.3	60.0
	o3-mini	200	n.a	Closed	0.8	4.4
	o4-mini	200	n.a	Closed	1.1	4.4
Meta	Llama 3.1-405b	128	405	Open	3.6	3.6
Google	Gemini 2.5 Pro	1000	n.a	Closed	1.9	12.5
	Gemini 2.5 Flash	1000	n.a	Closed	0.1	0.4
Anthropic	Claude 3.7 Sonnet Thinking	200	n.a	Closed	3.8	15.0
xAI	Grok-3 mini	128	n.a	Closed	n.a	n.a

Source: Company, Artificial Analysis, updated as of May 2025

Exhibit 39: China vs. US State-of-the-Art models (non-reasoning)

Creator	Model	Context window (k)	Parameter (B)	Open/closed source	Blended Input (US$/mn tokens)	Output (US$/mn tokens)
China						
Alibaba	Qwen2.5-Max	32	n.a	Closed	0.3	1.4
Baidu	Ernie 4.5 Turbo	n.a	n.a	Open	0.1	0.5
Tencent	hunyuan-turbo-latest	n.a	n.a	Closed	0.3	1.4
	hunyuan-turboS	n.a	n.a	Closed	0.1	0.3
DeepSeek	Deepseek-V3	128	671	Open	0.2	1.1
Minimax	MiniMax-Text-01	4000	456	Open	0.1	1.1
Baichuan	Baichuan4-Turbo	n.a	n.a	Closed	2.1	2.1
01.ai	Yi-Lightning	n.a	n.a	Closed	0.1	0.1
Zhipu	GLM-4-Plus	n.a	n.a	Closed	7.1	7.1
US						
OpenAI	4o	128	n.a	Closed	1.9	10.0
	GPT-4.5	128	n.a	Closed	56.3	150.0
Meta	Llama 4 Maverick	n.a	n.a	Open	0.2	0.5
Google	Gemini 2.0 Flash	1000	n.a	Closed	0.4	0.4
Anthropic	Claude 3.5 Sonnet	200	n.a	Closed	3.0	15.0
	Claude 3.7 Sonnet	200	n.a	Closed	3.8	15.0
xAI	Grok-3	1000	n.a	Closed	n.a	n.a

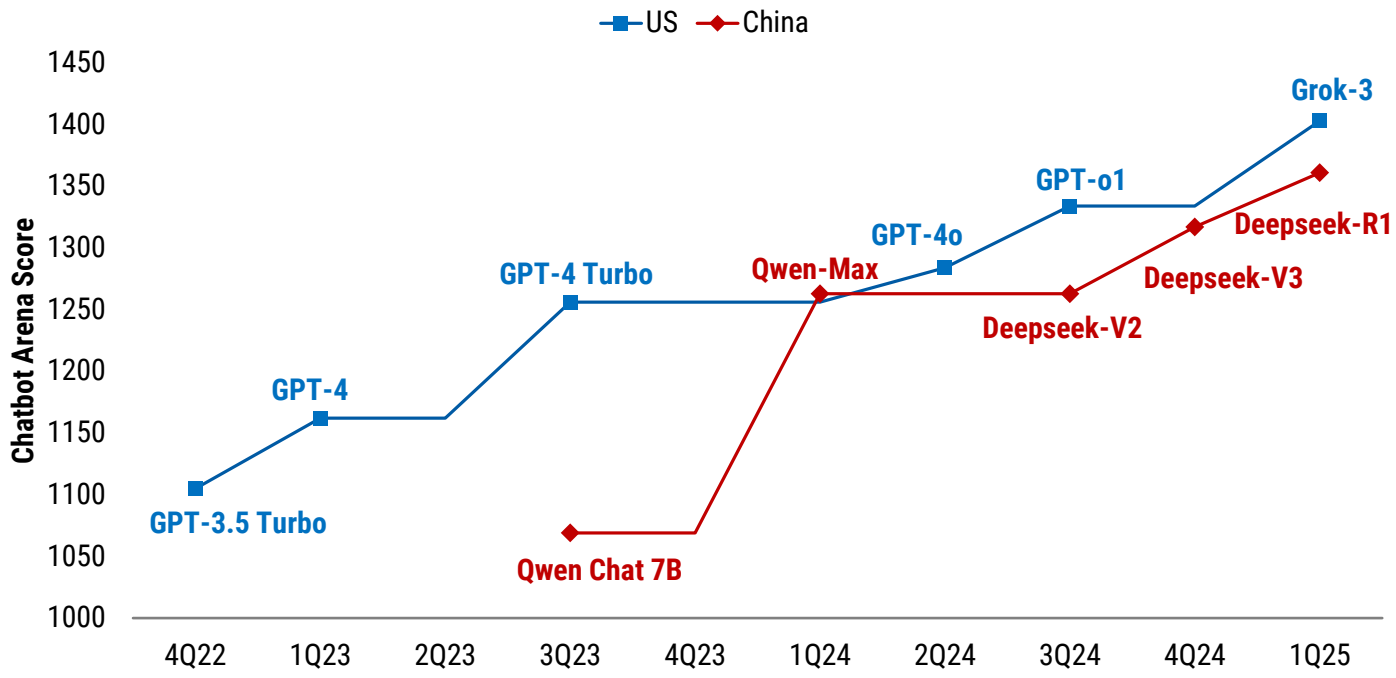
Source: Company, Artificial Analysis, updated as of May 2025

China is also closing the gap in terms of model performance. As measured by Chatbot Arena scores as a proxy for model intelligence, the frontier AI models in China were closing the gap with US frontier AI models in 1Q25. On the worldwide AI model leaderboard summarized by Artificial Analysis combining multiple representative performance benchmarks, Chinese AI models also achieved similar performance with US peers, with DeepSeek-R1 ranked in the global No.2 position for reasoning and knowledge (MMLU-Pro).

"Closed" US and "Open" China. China is not only keeping up with US in AI models, but also leads the world in terms of open-source AI models. Among the SOTA models we selected, 1/2 reasoning models and 1/3 non-reasoning models in China are open-source, compared to 1/8 reasoning and 1/7 non-reasoning models in the US. On the HuggingFace open-source AI model leaderboard, China holds 40% of the top 10 seats, with Qwen2.5-72B-Instruct (Alibaba) ranked in the global No.1 spot. On Feb 24, DeepSeek opened more code repositories, including FlashMLA (an efficient Multi-head Latent Attention decoding kernel optimized for Hopper GPUs). We believe China's AI roadmap is more skewed towards open-source, algorithm enhancement, and infrastructure optimization, to offset the computing power constraints.

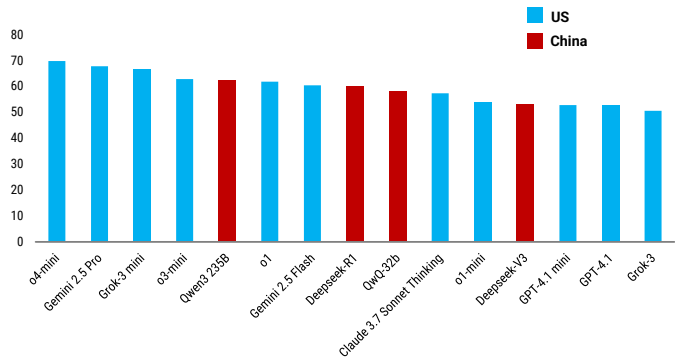
While there's no significant performance difference between closed and open-source AI models, open-source AI models generally have smaller sizes and can accelerate the progress of AI rollout, ecosystem establishment, and adoption by businesses and consumers, resulting in faster commoditization and commercialization of AI in China.

Exhibit 40: Frontier AI model intelligence



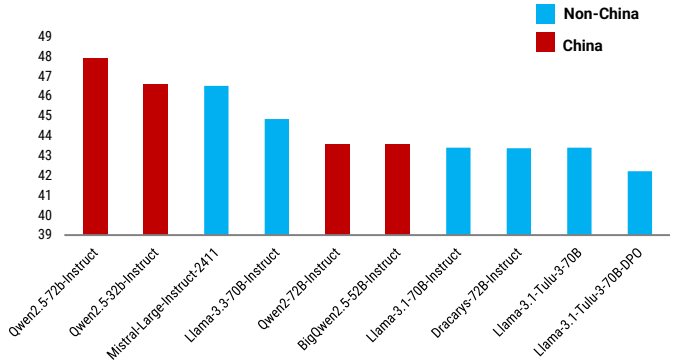
Source: Chatbot Arena score: measured by votes on style control, hard prompts, coding, match, creativity writing, instruction following, longer query and multi-turn. Release date is based on first public launch of the model.

Exhibit 41: AI model leaderboard



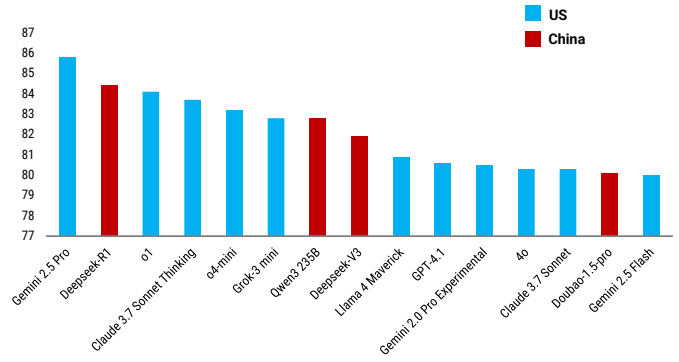
Source: Artificial Analysis, combination metric of MMLU-Pro, GPQA Diamond, Humanity's Last Exam, SciCode, AIME, MATH-500, updated as of May 2025

Exhibit 42: Open-source AI model leaderboard



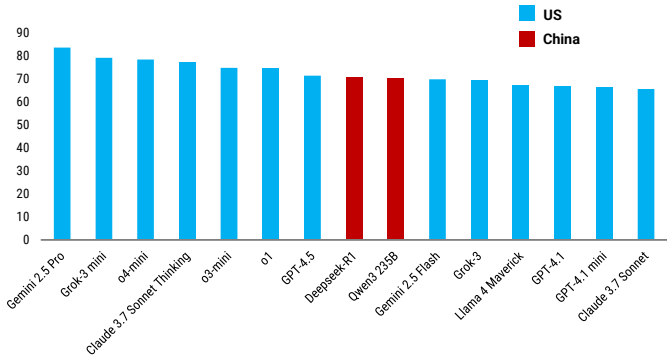
Source: HuggingFace, combination metric of IFEval, BBH, MATH, GPQA, MUSR, MMLU-Pro, updated as of May 2025

Exhibit 43: AI model benchmark – MMLU-Pro



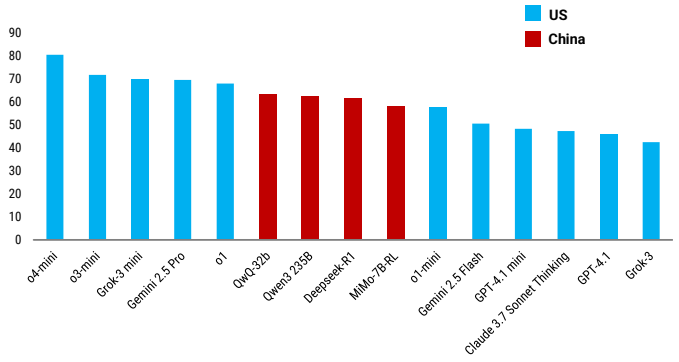
Source: Artificial Analysis, company self-reported, updated as of May 2025

Exhibit 44: AI model benchmark – GPQA



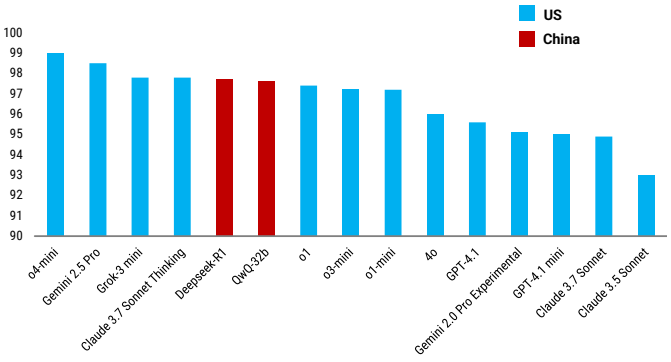
Source: Artificial Analysis, company self-reported, updated as of May 2025

Exhibit 45: AI model benchmark – LiveCodeBench



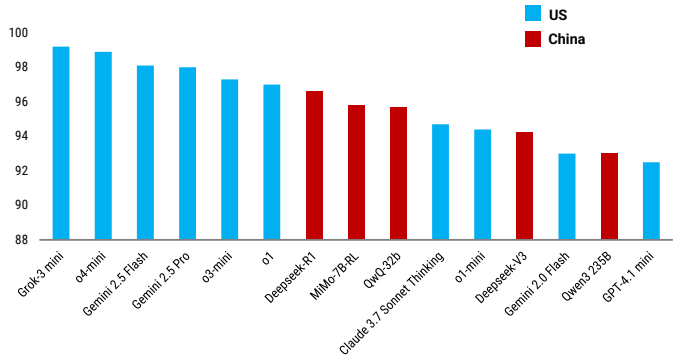
Source: Artificial Analysis, company self-reported, updated as of May 2025

Exhibit 46: AI model benchmark – HumanEval



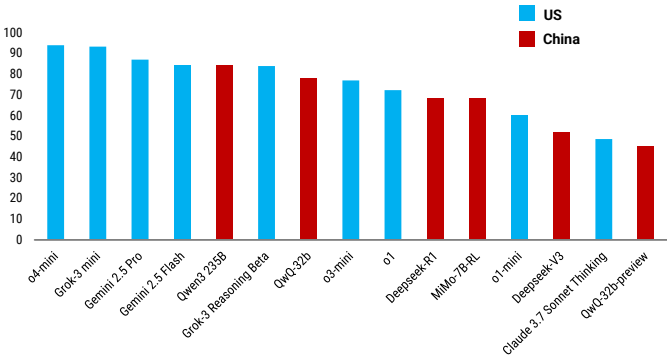
Source: Artificial Analysis, company self-reported, updated as of May 2025

Exhibit 47: AI model benchmark – MATH-500



Source: Artificial Analysis, company self-reported, updated as of May 2025

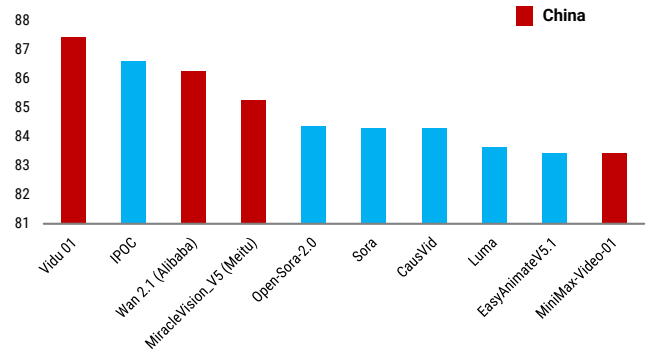
Exhibit 48: AI model benchmark – AIME 2024



Source: Artificial Analysis, company self-reported, updated as of May 2025

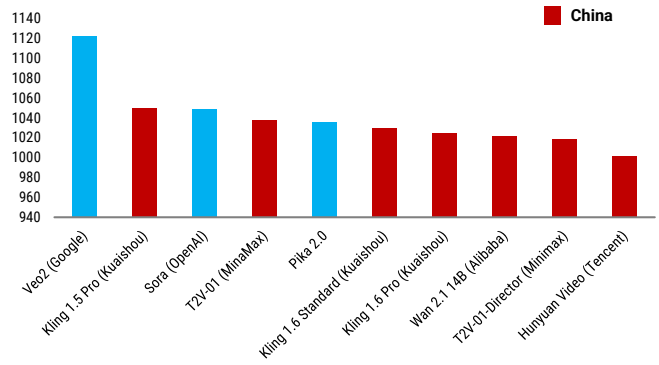
Multi-modal strengthened by proprietary data. In addition to LLMs, China has also developed multi-modal capabilities and is a leader in video AI models globally. We believe the video model performance is largely contributed by the public video data for pre-train, and more importantly, proprietary video data produced daily for post-train. The current leading players in video models are also the leaders in the vision industry, such as Google (YouTube), Alibaba (Youku), Kuaishou, Meitu (Meitu Xiuxiu) and Tencent (Tencent Video). China has two video platform giants – Bytedance and Kuaishou – which have around 80mn new videos generated per day, with the total length larger than that of YouTube. We believe Bytedance and Kuaishou are likely to maintain their leading positions in video AI models and enlarge the gap vs. non-video platforms worldwide.

Exhibit 49: Video model leaderboard – Vbench



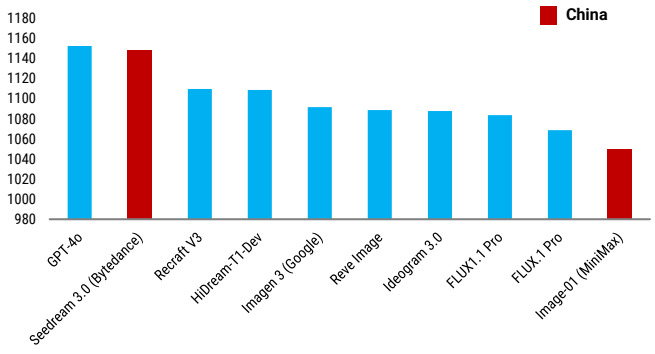
Source: HuggingFace, updated as of May 2025

Exhibit 50: Video model leaderboard – generation score



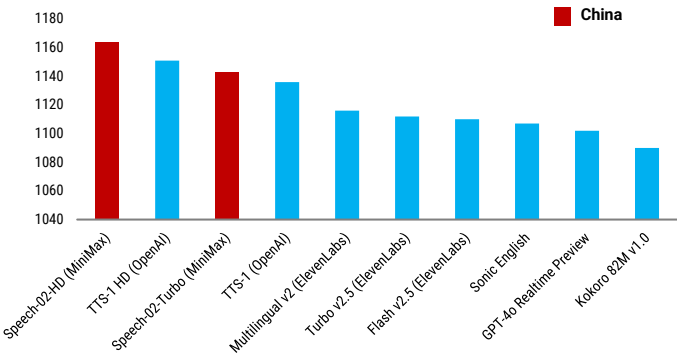
Source: Artificial Analysis, updated as of May 2025

Exhibit 51: Text-to-Image model leaderboard



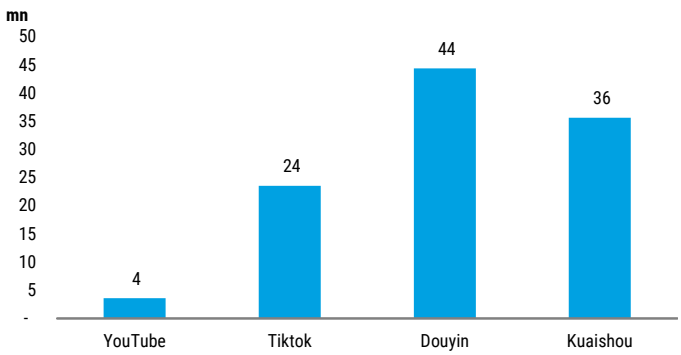
Source: Artificial Analysis, updated as of May 2025

Exhibit 52: Text-to-Speech model leaderboard



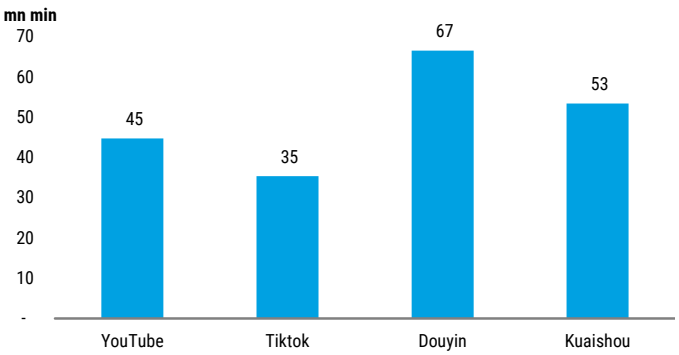
Source: Artificial Analysis, updated as of May 2025

Exhibit 53: No. of videos uploaded daily



Source: photutorial, sendshort.ai, statista, Morgan Stanley Research estimates

Exhibit 54: Video length uploaded daily



Source: photutorial, sendshort.ai, statista, Morgan Stanley Research estimates, we estimate average video length of YouTube at 12min and Tiktok/Douyin/Kuaishou at 1.5min

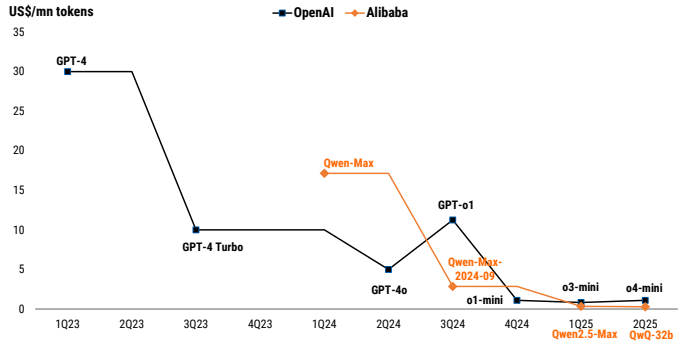
AI model commoditization

China triggers global AI price competition. Since the commercialization of AI models in 2022, the API prices of AI models have declined more than 10x within two years, represented by OpenAI's and Alibaba's flagship AI models. OpenAI was actually the first player to slash AI inference prices, by cutting 50% input prices and 25% of output prices of GPT-3.5 Turbo in 1Q24 to US$0.5/mn tokens and US$1.5/mn tokens. However, GPT-4 Turbo as its SOTA model still maintained a high price at that time, at US$10/mn tokens and US$30/mn tokens. OpenAI slashed AI prices as it had launched more expensive and better AI models.

Round 1: Commoditization begins. Chinese AI models made the first move in SOTA AI model price competition in 2Q24, as started by DeepSeek, which opened the source code of DeepSeek-V2 with only Rmb1/mn tokens (c.1% of GPT-4 Turbo). Zhipu immediately followed, lowering the price of the personal version of GLM-3 by 80%, to Rmb1/mn tokens. Bytedance then launched the Doubao series with the SOTA model priced at Rmb0.8 (US$0.1)/mn tokens, which was 99%+ cheaper than domestic peers' offerings at that time.

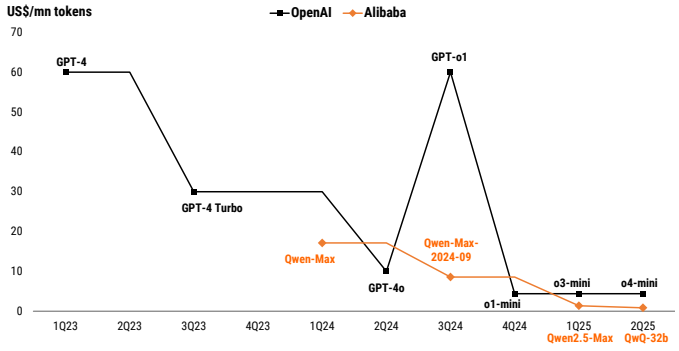
Price competition soon rolled out across the entire AI space in China, with all AI leaders cutting their API prices by 70-90% across their product offerings, including SOTA models, even offering entry-level models for free. We saw quick deflation in the frontier AI market in China. Global peers soon also followed, with OpenAI cutting GPT-4o input/output pricing by 62%/33%, and Google cutting Gemini-1.5-Pro by 50% for both input and output prices in 3Q24. Since these price cuts, Chinese AI models have generally become cheaper than US peers.

Exhibit 55: Inference API price for input



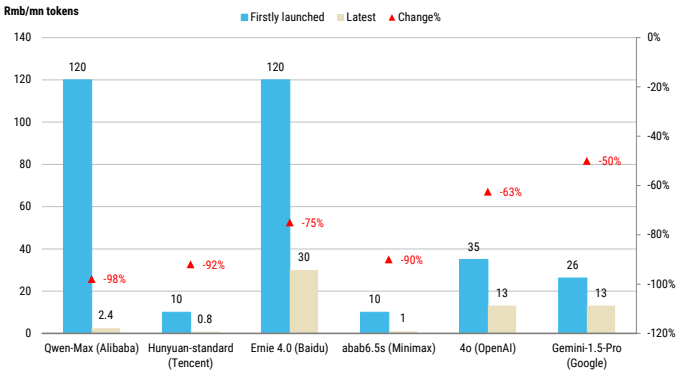
Source: Company, Morgan Stanley Research, input price blended with cached and non-cached prices (1:1)

Exhibit 56: Inference API price for output



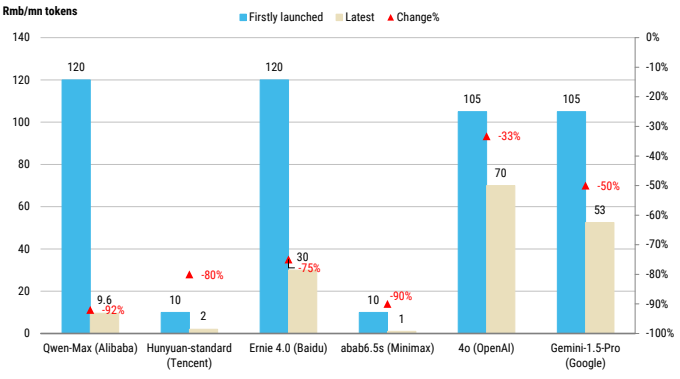
Source: Company, Morgan Stanley Research

Exhibit 57: China AI model input API price



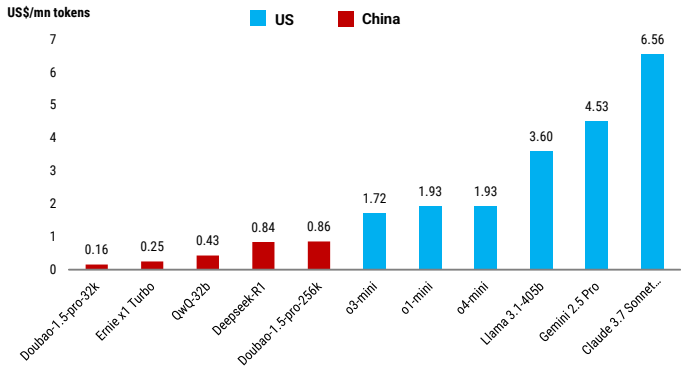
Source: Company, Morgan Stanley Research, input price blended with cached and non-cached prices (1:1), latest price updated Feb 2025

Exhibit 58: China AI model output API price



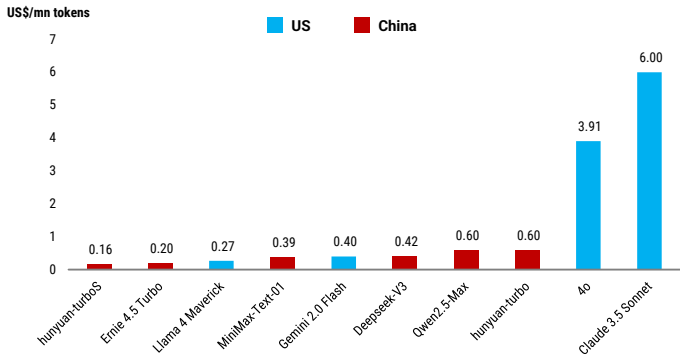
Source: Company, Morgan Stanley Research, latest price updated Feb 2025

Exhibit 59: SOTA reasoning model API price



Source: Company, price blended with input and output (3:1), price updated as of May 2025

Exhibit 60: SOTA non-reasoning model API price

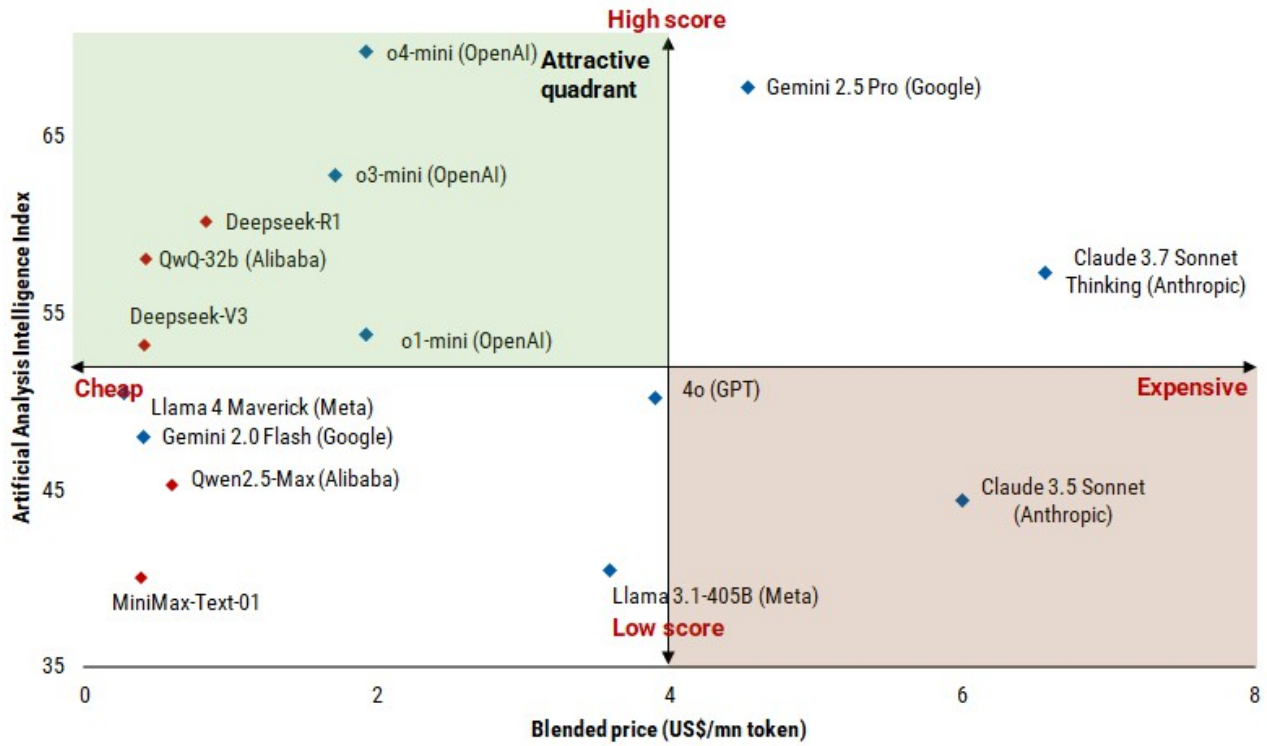


Source: Company, price blended with input and output (3:1), price updated as of May 2025

Round 2: Not just cheap, but also good ... The global AI inference commoditization was further escalated with DeepSeek launching its flagship reasoning model DeepSeek-R1 in 1Q25, ranking ahead of the world's AI models, with only a US$0.4/mn tokens blended input price and US$2.3/mn tokens output price – c.50% of the price of the previous leading reasoning model, o1-mini, developed by OpenAI. We believe DeepSeek-R1 also further stimulated AI price competition globally in 1Q25 right after its debut: 1) OpenAI launched o3-mini with a 25% price cut on input; and 2) both Google and xAI launched their SOTA reasoning models (Gemini-2.0-Pro Experimental and Grok-3) with free accessibility to subscribers. DeepSeek helped establish China as a developer of inexpensive AI models with world-class performance.

After a new round of price cuts in 1Q25, most of the SOTA models are priced at US$0-2/mn tokens blended input and output. However, Chinese AI models are still largely cheaper than US peers with similar intelligence. DeepSeek and Alibaba in China as well as OpenAI in US have models falling into the attractive quadrant in Exhibit 52, with relatively low price and best performance.

Exhibit 61: Model intelligence vs. price



Source: Artificial Analysis, the index is a combination metric of MMLU-Pro, GPQA Diamond, Humanity's Last Exam, LiveCodeBench, SciCode, AIME, MATH-500; price blended with input and output prices (3:1), updated by May 2025

China's Answer to Powering AI

For more detail, please see our report – China's Answer to Powering AI

Data center supply-demand dynamics in China: Strong demand – fueled by Chinese hyperscalers' aggressive capex in AI, driven by inference workload – will finally digest previous multiyear oversupply.

GPU availability – it's been the biggest risk to the "powering AI" theme in China: With NVIDIA H20 shipment restrictions having materialized, the key downside risk has played out, and IDC stocks look oversold to us. Meanwhile, we are bullish on GPU localization, for both performance and capability. We lay out three scenarios:

- Base case: No H20 license, but domestic GPUs will meet requirements at some expense in performance and time to market. AI capex is back-end loaded.
- Bull case: H20 becomes available; AI capex is front-end loaded.
- Bear case: No H20 license; domestic GPU production/yield issues lead hyperscalers to cut capex.

Our tech team also notes that the breakthrough in China AI hardware could further address the constraints of export controls and silicon supply by using the abundant availability of scale and power. Over the longer term, self-sufficient supply of GPU and hardware will further enhance supply chain robustness for datacenter vendors.

Power supply – not a bottleneck: We calculated that the electricity usage of data centers will likely account for <3% of the social electricity in three years time, not a significant number, in our view. Our utilities team also further notes that, in the longer term, datacenter power should be 100% funded by green energy, and the capacity should be sufficient to do so. See their latest Insight report.

The potential dynamics for DC rental pricing: We expect high volume, stable prices, and better move-in terms, as our base case – good enough to lift project IRRs 1ppt. Rental hikes for new projects are in our bull case.

REIT issuance in China – more upside to come: We develop the thinking in our Insight report from last year. Access to pre-REITs and private REITs has played out; public C-REITs (most liquid, highest valuation) are on the way.

Implications for industrial players and telcos: We see a TAM of Rmb55-60bn per year for upstream equipment – especially in gensets and cooling. For telcos, we see more of a top-down push – with the central government to guide SOEs and state/local governments to adopt more AI-related processes.

Examining data center supply-demand dynamics in China – and the impact of AI

Following the hyperscalers' capex rise after the DeepSeek moment, in China, the availability of GPUs has become the overwhelming debate about data center demand. This is separate from the US narrative on power constraints for AI development. We believe the AI inference-driven demand has low requirements for GPUs, and domestic technology is not only capable but also has enough produc-

tion capacity to meet the demand (see our semi team's report), assuming exports of NVIDIA's H20 are restricted indefinitely. We also believe China's hyperscalers will continue to execute their AI investment plans if H20 is unavailable, with good inventory levels to mitigate the short-term disruption, assuming there is a full migration to domestic GPUs.

Our analysis suggests similar total data center IT power capacity demand under different GPU procurement scenarios, and they all translate to record-high new bookings demand of ~4GW per year for data centers in China. By our estimates, this means:

1. Data center market growth will accelerate from 9% in 2024 to 20% in 2024-27.
2. Annual TAM will be Rmb55-60bn for upstream cooling and power equipment market.
3. Data center power consumption will increase rapidly, from 1.8% of total power in 2024 to 2.9% in 2027.

Based on our supply-demand analysis, we expect northern China to lead a data center market demand-supply turnaround in the next 6-12 months – meaning that strong demand will finally digest previous multiyear oversupply.

In terms of pricing trends after the turnaround:

- Our base case assumptions are for stable headline rental pricing but more favorable terms on move-in, which is good enough to raise project IRR mildly.
- Our bull case is that rental price hikes for new DC projects will mark the return of pricing power. We note that lack of pricing power was the key reason behind the big valuation gap between Chinese and overseas data centers.
- Our bear case is for stable rental pricing but higher cost to build, which will squeeze IDC returns.

We think other markets, like eastern and southern China, will eventually follow the northern China market, but the time lag could be long.

Kicking off a new multiyear upcycle for data centers and their value chain

The demand inflection point for China's data center industry was three quarters ago, and a new round of AI inference investment from hyperscalers triggered by the DeepSeek R1 model is likely to scale demand up to the next level.

We estimate that Chinese hyperscalers' aggressive capex in AI will translate into 3-4GW in new data center bookings per year during 2025-27 (vs. ~2GW in 2024 and ~1GW in 2023), driving industry capacity growth acceleration from 9% in 2024 to 20% over 2024-27.

We see a much lower overshoot risk compared with powering AI in the US, given:

- The overall investment size is much smaller (only one-eighth of US hyperscalers' annual capex).
- AI inference workload is a key growth driver (at least 60-70% of new demand), rather than training.
- This capex upcycle could also mean a Rmb55-60bn TAM per year (IDCs' capex) for upstream power/cooling equipment opportunities.

We estimate that data center electricity usage will reach 345TWh in 2027, accounting for 2.9% of total social power usage, or 4% of 2022's usage vs. the US at close to 11%.

We are more bullish on the data center industry as this demand upcycle is happening together with an interest rate downcycle in China, and REITs are becoming an effective way of revitalizing DC assets.

What about the risk of GPU supply?

Contrary to the biggest constraint in the US – electricity supply – the availability of GPUs has been the biggest risk factor for the "powering AI" theme to play out in China.

We are bullish on domestic GPU performance (Huawei Ascend series) and production capacity (SMIC's advanced node capacity). Our analysis suggests that even if NVIDIA's H20 GPU is unavailable, the total DC IT power capacity demand in the long run will be intact. For the short term, migrating to domestic GPU will cost some efficiency (25-30%) and time to market (three months, well covered by hyperscalers' H20 inventory days). For more details on domestic GPUs, please see our tech team's report here.

- In our base case, we assume H20 restriction will make hyperscalers' capex back-end loaded, without meaningful cuts.
- In our bull case, we assume thar H20 will be available and that hyperscalers' AI investment will be front-end loaded.

The biggest downside risk is poor domestic GPU production yield if the US government does not allow H20 chips to be exported to China, and hyperscalers have to cut capex significantly, which is our bear case assumption.

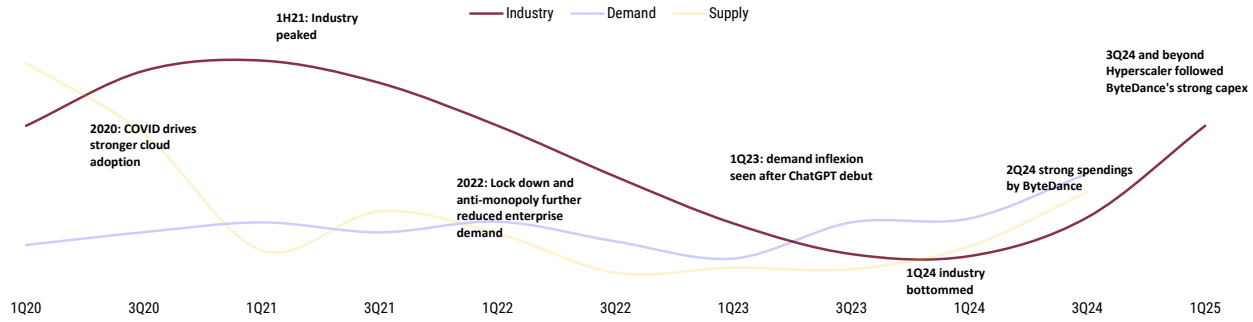
What about DC pricing trends in China?

Beijing's surrounding area is the top data center market in China by investment return. We expect this market to lead a demand-supply turnaround in the next 6-12 months.

We estimate total inventory available for short-term delivery on new orders is ~2.0-2.5GW in the northern China market, vs. an incremental >3GW from hyperscalers.

- In our base case, we assume stable headline rental pricing but more favorable terms on move-in, which should be good enough to lift the unleveraged project IRR 1ppt. This balances out the strong demand and the strong bargaining power of hyperscalers.
- Our bull case is for a rental price hike on new DC projects, which would mark the return of pricing power. We note that a lack of pricing power was a key reason behind the big valuation gap between Chinese and overseas data centers.
- Meanwhile, our bear case is for stable rental pricing but higher cost to build, which would squeeze IDC returns.

Exhibit 62: Where are we in the cycle?



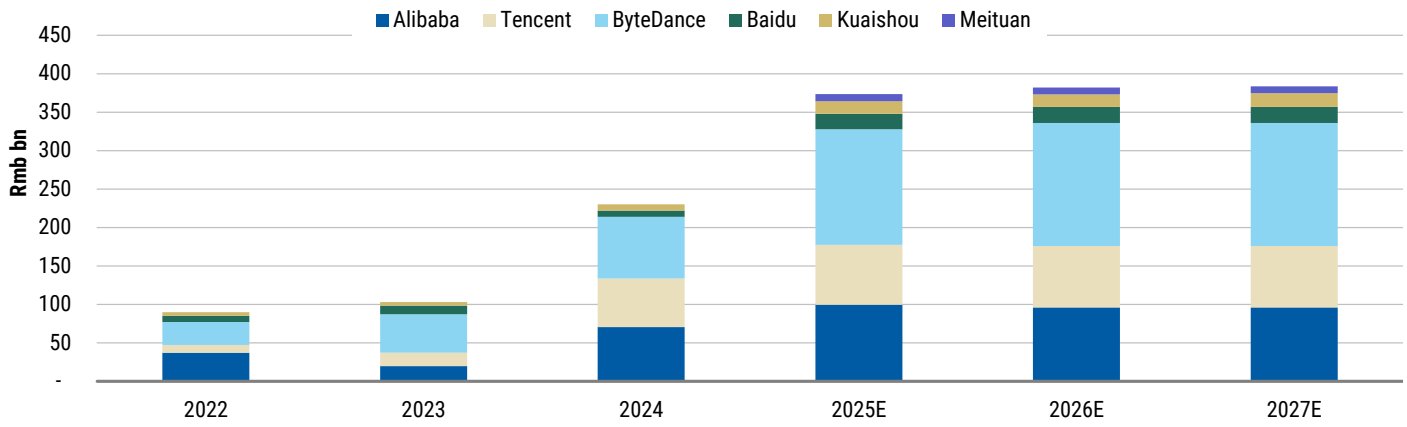
Source: Morgan Stanley Research estimates.

Exhibit 63: DC power demand: NV H20 vs. Huawei Ascend 910B – power usage is not a key difference

	2024	2025E	2026E	2027E	CAGR
H20					
Power usage (MW)	2,139	3,359	3,685	3,963	23%
Electricity (TWh)	180	214	251	290	17%
Computing power (EFLOPS, FP16)	536	967	1,445	1,962	54%
910B					
Power usage (MW)	2,085	3,268	3,584	3,851	23%
Electricity (TWh)	180	213	249	287	17%
Computing power (EFLOPS, FP16)	536	1,701	2,992	4,389	102%

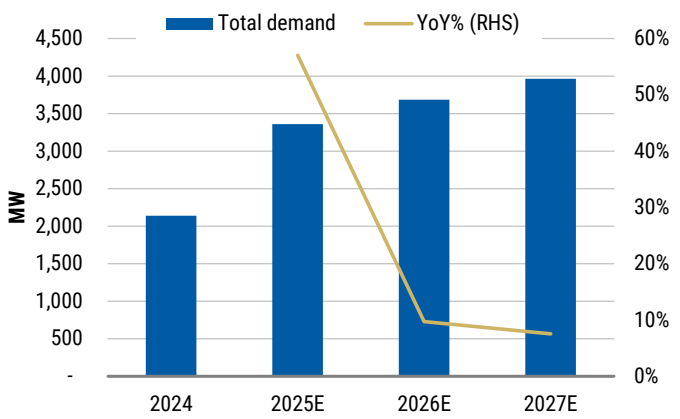
Source: Company data, Morgan Stanley Research (E) estimates.

Exhibit 64: Total capex spending by top players



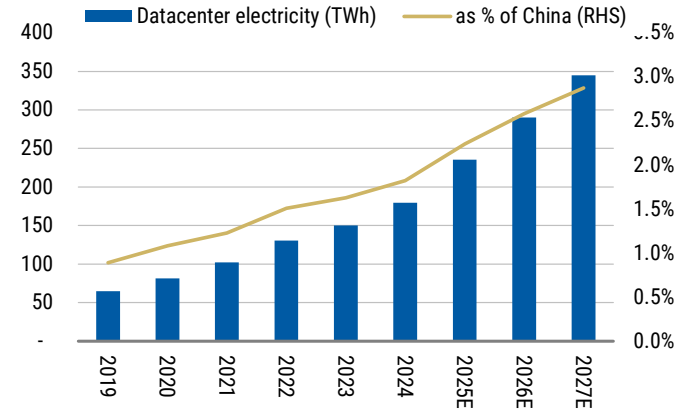
Source: Company data, Morgan Stanley Research (E) estimates.

Exhibit 65: Data center demand forecasts



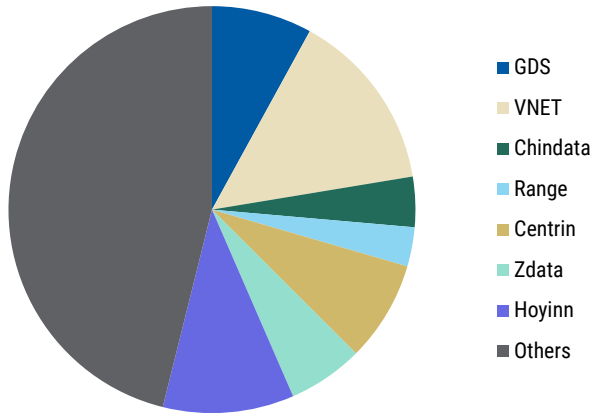
Source: Company data, Morgan Stanley Research (E) estimates.

Exhibit 66: Data center power



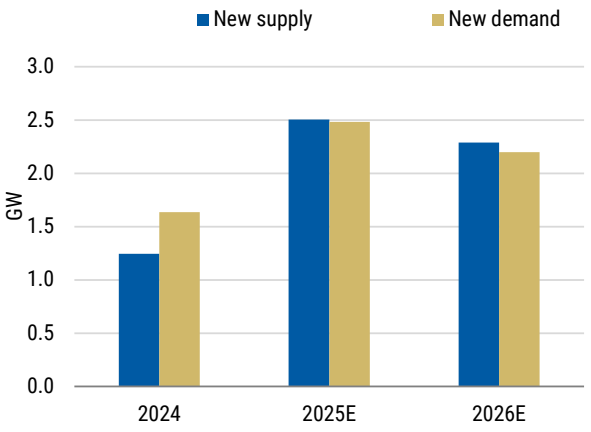
Source: NBS, Morgan Stanley Research (E) estimates.

Exhibit 67: 2025E incremental supply share in the northern China market



Source: Company data, CIC, Morgan Stanley Research estimates.

Exhibit 68: New capacity and utilization in northern China



Source: CIC, Morgan Stanley Research. Region includes Greater Beijing, Inner Mongolia and Datong.

AI Infrastructure: China Cloud and Data Centers

After four years of downcycle in China's public cloud market (initially due to an internet regulation reset, and later due to Covid lockdowns and the macro backdrop falling into deflation), the potential fast adoption of AI applications will likely accelerate China's IaaS/PaaS (infrastructure as a service/ platform as a service) market growth significantly and also boost cloud's profitability.

We believe the future of the public cloud market dynamics heavily relies on two things: 1) growth of datacenter/cloud companies' parentco core business growth in the AI era, and 2) competition in the GPU supply chain.

Given the enterprise-focused demand and late-cycle nature of enterprises' IT spending, we do not think the China SaaS market can recover before the macro economy climbs out of deflation.

According to IDC, the public cloud market in China totaled US$40bn in 2023 and is expected to grow at a 17% CAGR, to US$88bn in 2027. In terms of mix, IaaS is the biggest contributor, accounting for >50% of the TAM mix as of 2023. Meanwhile, the US public cloud market has a total TAM of US$367bn and will expand at a 19% CAGR, to US$871bn by 2027, according to IDC. SaaS (software as a service) is the biggest TAM contributor for the US market, with >1/3 of the mix. As of 2024E, China's public cloud TAM was only 11% of the US market, and the major drag has been the SaaS market (only 4% of the US market); meanwhile, IaaS is much higher, at 40% of the US market.

From an enterprise ICT spending perspective, we note that IDC forecasts total enterprise ICT spending of US$204bn in China in 2024E, where public cloud spending is ~22% of the mix. In the US, public cloud spending will account for 35% of its enterprise ICT spending (US$1,249bn) in 2024E, per IDC estimates.

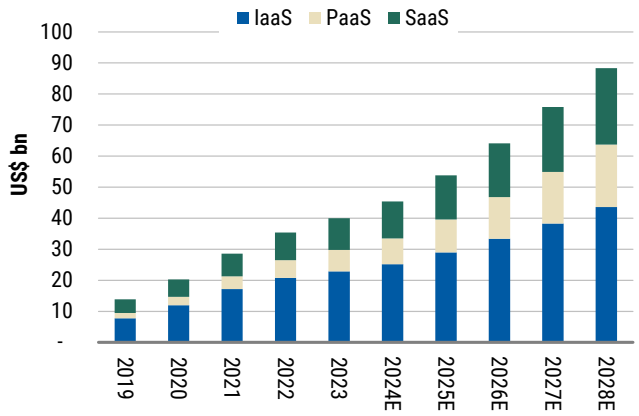
We see a few major factors contributing to the differences between the two markets:

China has a preference for hardware over software: This is evident in both the mix of public cloud market and the mix of ICT enterprise spending between the two countries. China has a larger share of IaaS in the public cloud market, which is mainly driven by infra sharing services, while in ICT spending, China's mix of hardware spending is 55% vs. the US at 25%. China has tended to have a preference for tangible assets (servers, computers) versus intangible assets (software). We have often observed in the Chinese software industry that many companies are reluctant to spend too much on buying software, especially large enterprises with a strong preference for customized software or even internally developed software product/platforms. This has been a major hurdle to driving higher SaaS adoption in China. Furthermore, the lack of strong copyright protection has also led to some adoption of pirated software, further reducing the software TAM.

A higher focus on data security, leading to more adoption of private cloud: The US IaaS market is dominated by four vendors – AWS, Azure, GCP and Oracle Cloud, while, in China, AliCloud and Tencent are the major public cloud players, but a large share of the pie is captured by private cloud providers, including the telcos and Huawei. These companies mainly provide cloud services to the government and SOEs, which are also major customers of the cloud market. These customers typically have higher requirements for data security, and naturally prefer on-premises and private cloud or hybrid cloud deployment, vs. public cloud.

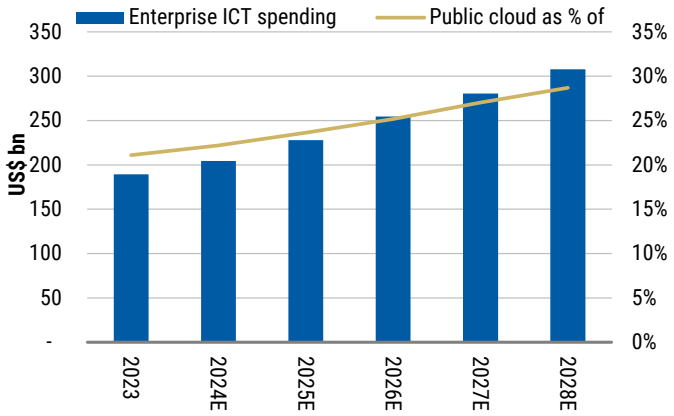
Cost competition is high: Although it is natural for infrastructure costs to fall as consumption scales up, the cost-down process sometimes goes a bit too fast in China, where players are more willing to sacrifice margins to drive higher volume and demand from customers. As a result, we note that profit margins of public cloud players in China are usually lower than those in the US. We estimate AliCloud could deliver an EBITDA margin of ~20%, and EBITA margin of 8.5%, in FY25 vs. AWS's EBITDA margin of 58.5% and operating margin of 37% in 2024.

Exhibit 69: China public cloud market



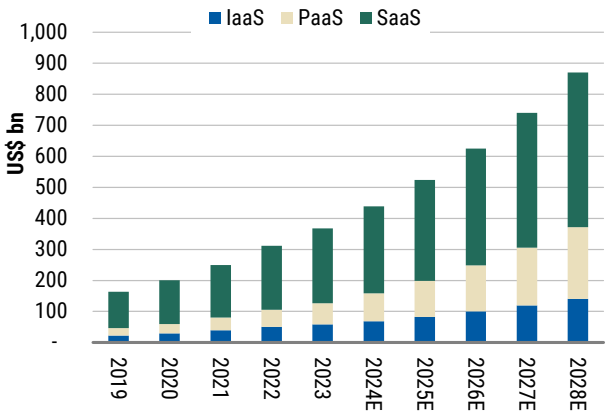
Source: IDC estimates.

Exhibit 70: China public cloud as % of enterprise ICT spending



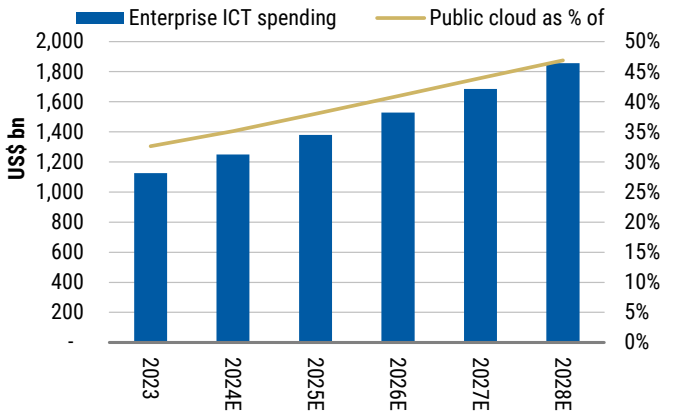
Source: IDC estimates.

Exhibit 71: US public cloud market



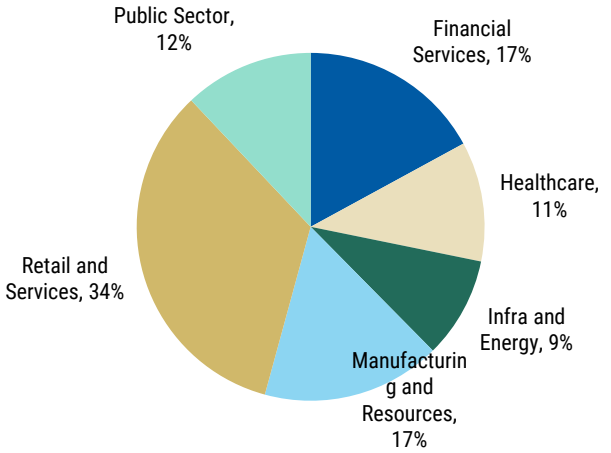
Source: IDC estimates.

Exhibit 72: US public cloud as % of enterprise spending



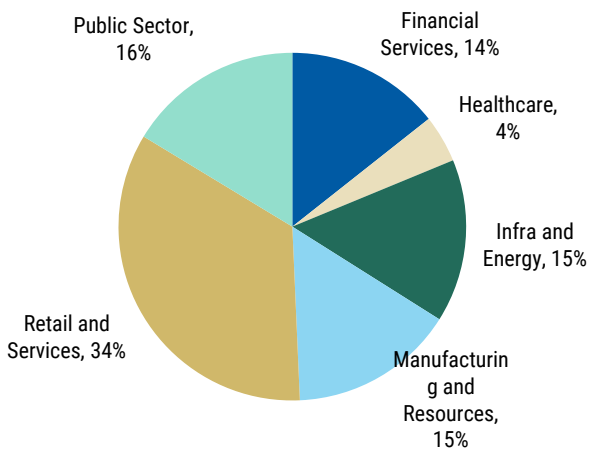
Source: IDC estimates.

Exhibit 73: US ICT spending, by vertical, 2024



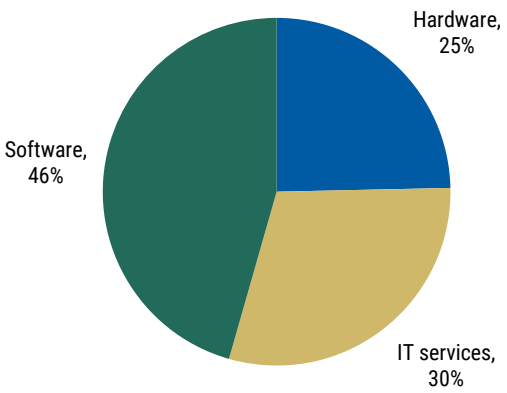
Source: IDC, Morgan Stanley Research.

Exhibit 74: China ICT spending, by vertical, 2024



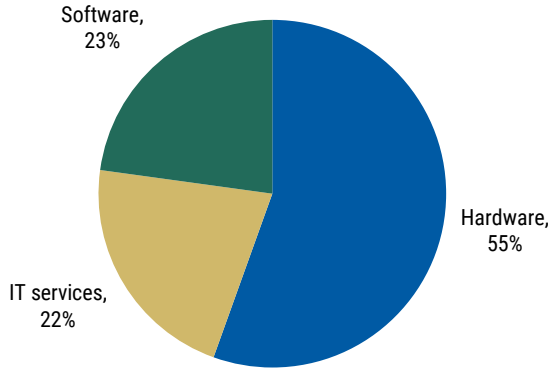
Source: IDC, Morgan Stanley Research.

Exhibit 75: US ICT spending, by tech category, 2024



Source: IDC, Morgan Stanley Research.

Exhibit 76: China ICT spending by tech category, 2024



Source: IDC, Morgan Stanley Research.

What could AI bring to the IaaS market? We note that there have been a few trends emerging in the AI era that could change the laaS landscape in China.

AI becoming a top priority in enterprises' investment: And it's not just the private sector – the government and public sector are also well aware of the importance of GenAI, with a top-down push from the central government for the public sector to deploy AI. Unlike public cloud deployment, which is still under debate, AI seems certain to be deployed throughout the governmental system. According to IDC, the GenAIaaS market in China reached Rmb5.2bn in 1H24, which, by our estimate, already accounts for 6.1% of the IaaS market.

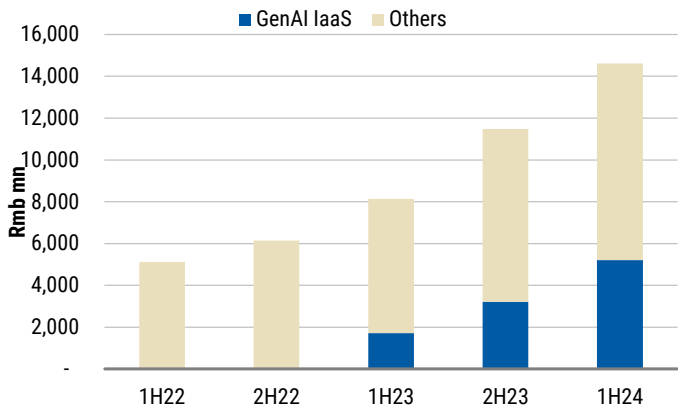
Public cloud IaaS/PaaS will benefit from internet/tech companies' fast adoption of AI and monetization. We view internet companies as the pioneers in AI adoption, not for internal usage, but to offer various AI-enabled applications like super apps to their customers (a billion-size user base), which means a very high amount of IaaS business volume. Internet companies have been growing their business based on the most efficient back-end structure, public cloud IaaS. In addition, we have much higher confidence in internet companies' potential AI monetization via ads or transactions than software subscriptions. On top of that, other pioneers in AI adoption are also using public cloud intensively, like smart EV and smart hardware manufacturers. For most SOEs and government entities, our base case is that AI will not change their continued preference for private cloud over public cloud, and their AI investment usually focuses on the AI models on integrated servers (especially for DeepSeek and this kind of open-source model with low hardware requirements).

Resources are scarce, and the GPU supply chain will likely become the key battle ground for cloud players: Unlike CPUs in the cloud era, the availability of GPUs is limited in China because of: 1) US restrictions on exports, and 2) domestic capacity is still ramping up and has a low yield. Therefore, market share could become more concentrated in top cloud providers that have larger scale and better procurement. Notably, the landscape in the GenAIaaS market is very different, with ByteDance accounting for a bigger chunk of the pie vs. the traditional IaaS market where it has minimal presence.

Margins could improve dramatically as a result: The combined effect of the incremental demand coming from AI inferencing and GPU computing needs, and a better landscape due to supply-side restrictions (i.e., limited GPUs in China), could eventually lead to upward revisions to EBITDA margins for the cloud players. Meanwhile, the previous downcycle and capital market conditions stopped cloud vendors' irrational pricing behavior, with an end to intense price competition, which even saw negative GPMs to boost revenue. Even for assets valued at EV/sales multiples, capital markets are scrutinizing their trajectory to profitability. Most internet clouds have also cleaned up their low-margin business, such as CDN, system integration and smart cities. We noted this in our Feb. 23, 2025 BABA upgrade (link) where we expect BABA's cloud EBITDA margin to improve from ~20% in FY25 to ~35% in FY28.

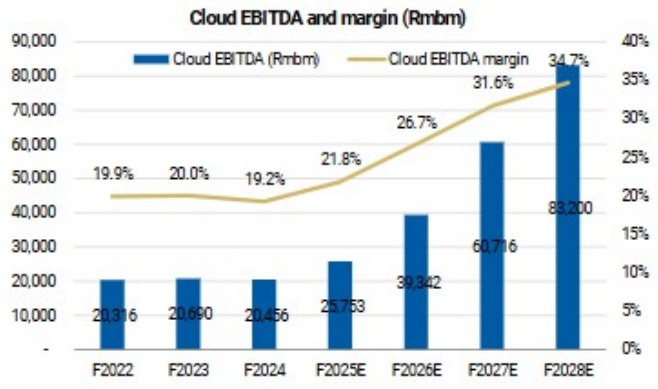
Will market share dynamics show new trends? We think it likely. Similar to the US, there is no meaningful independent cloud company in China. The rise of AliCloud and Tencent Cloud in China has been from their parentcos' high traffic volumes in the mobile internet era. The rise of Huawei Cloud has been from its big tech hardware business. And the rise of telcos' cloud businesses has been from the government attaching high importance to data security. We believe that the robustness of a cloud player relies heavily on whether the parentco's core business can consistently capture new growth opportunities. At the same time, rising new tech giants could provide the roots for a big new cloud company (potential examples could include Volcano Engine under ByteDance).

Exhibit 77: GenAIaaS is capturing more share of the IaaS market



Source: Company data, Morgan Stanley Research (E) estimates.

Exhibit 78: We expect BABA margins to improve, benefiting from AI



Source: Company data, Morgan Stanley Research (E) estimates.

Implications for data centers

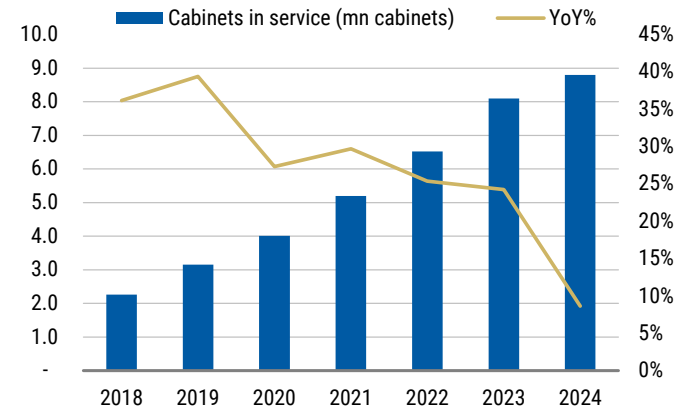
Data center operators can directly benefit from higher cloud capex due to AI from hyperscalers by hosting their new computing power. Industry demand passed an inflection point in 3Q24 and is currently digesting previous oversupply at a rapid pace, in an unbalanced structure (mainly in the North China market, and almost purely from 3 hyperscalers – Alibaba, Tencent, ByteDance) and a few big tech companies (Kuaishou, Meituan, Baidu). We expect overall data center industry new bookings to increase dramatically, from 2.1GW in 2024 to 3.7GW per year in 2025-27, translating to 76% growth in 2025E.

China's data center industry rental pricing has stabilized at a low level given the ongoing inventory digestion (vs. the US rental hike of ~30% since the AI investment cycle), but projected return is still improving sequentially because of: 1) lower funding cost from banks (low interest environment in China), 2) faster customer move-in, and 3) the benefits from certain new cost optimization initiatives do not need to be fully transferred to customers (such as some additions of customer equipment to the white list and other cost optimization). The low pricing environment is also one reason behind Chinese hyperscalers' low interest in expanding their in-house data center footprint, at least in the near term. Another key reason is time-to-market, as growing in-house capacity would not likely be able to meet hyperscalers' urgent business requirements. We think it likely that we will see the end of inventory digestion in the North China market in the next 6-12 months; whether data center operators can raise rental prices then is still highly uncertain, given the very strong bargaining power of hyperscalers.

Due to strong supply chain capabilities and relative weak demand from other sectors, there is no shortage in data centers upstream, including power generation, power equipment and cooling systems, which is a completely different situation than in the US. We think, in the foreseeable future, there will be no meaningful shortage from upstream.

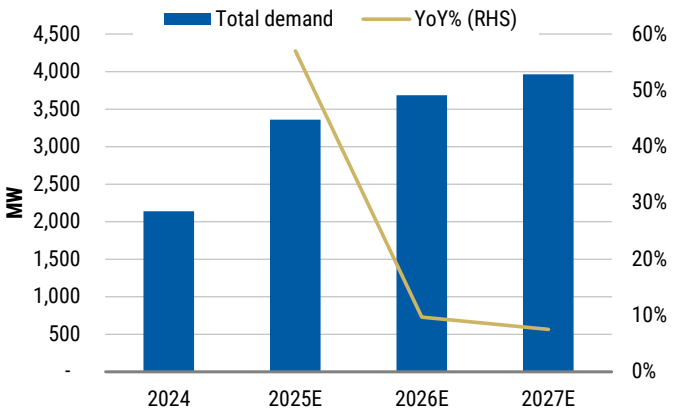
With AI investment shifting from the training stage to inference stage, we expect new data center locations will shift from remote areas in North China (such as Ulanqab in Inner Mongolia) to the surrounding areas in tier one markets, due to network transmission latency issues. We expect inference's percentage to rise quickly from very low levels in 2024, to >50% in 2025, and be the majority of cloud capex in 2026 onwards. Having said that, we note some of the computing power is taking care of AI training and inference workload at the same time, which means it is not a black-and-white trend.

Exhibit 79: China: total cabinets in service



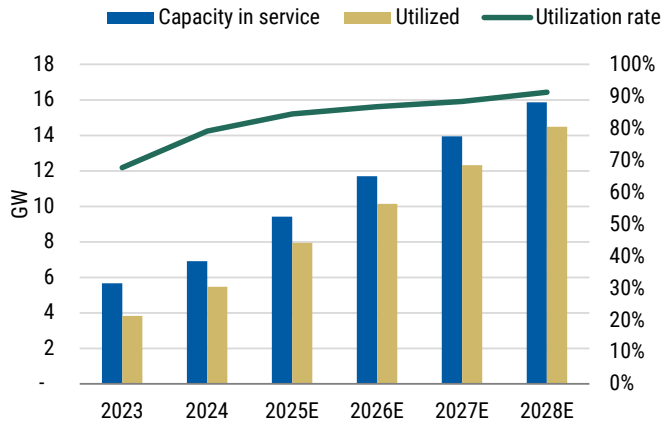
Source: MIIT, Morgan Stanley Research.

Exhibit 80: Total new demand from hyperscalers



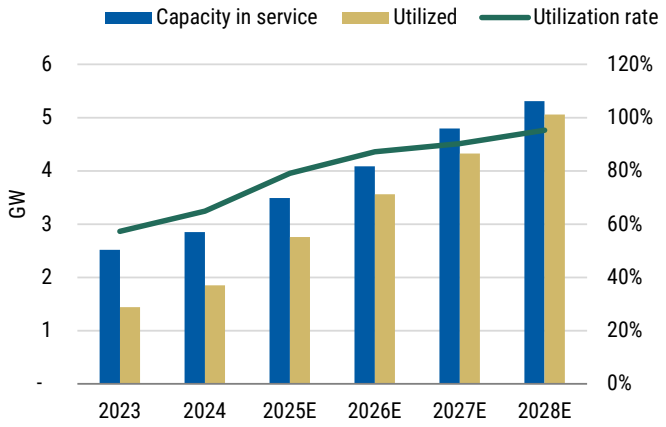
Source: Company data, Morgan Stanley Research (E) estimates.

Exhibit 81: Greater Beijing area supply and demand balance



Source: CIC, Morgan Stanley Research. CIC estimates.

Exhibit 82: Yangtze Delta supply and demand balance



Source: CIC, Morgan Stanley Research. CIC estimates.

Implications for BAT cloud

Internet companies are the direct beneficiaries of the rise in AI adoption. Since the launch of DeepSeek, demand for GenAI has significantly increased with a much lower training/inference cost, which has driven robust cloud revenue growth for internet platforms, primary BAT.

AliCloud is the largest hyperscaler in China with superior cloud infrastructure and runs the largest model as a service community in China. BABA's Qwen LLMs have consistently been ranked high on global leaderboards, including the recent launch of flagship MoE-based model Qwen3 that has achieved competitive results in benchmark evaluations of coding, math, and general capabilities, among others. BABA has recently announced a significant increase in AI investment with cumulative spending in the next three years exceeding that of the past decade. We expect an imminent acceleration in AliCloud's revenue growth from 13% in F3Q25 to 18% in F4Q25 and 25% in F2026.

Tencent's Hunyuan LLM initially was mainly used within the WeChat ecosystem to enhance ads targeting, content creation and conversion/reach within WeChat verticals, as well as its gaming businesses. The near-term focus is to explore the potential for 2C applications via its proprietary app Yuanbao and leverage the vast amount of data collected within the WeChat ecosystem to generate monetization opportunities. Tencent has recently announced capex equating to a low-teens percentage of revenue, and intends to allocate more resources to external cloud customers (especially strategic customers) vs. prioritizing internet demand previously, which should drive an acceleration in cloud revenue growth from 2Q25 onwards (vs. low single digit growth in 4Q24).

Baidu is one of the earliest tech companies to launch its own LLM, Ernie Bot. Baidu cloud features its full stack 4-layer AI capabilities (computing power, deep learning framework, large language model, applications), providing a wide range of 2B cloud IAAS offerings.

Implications for telco operators

Telco operators do not have access to NVIDIA GPUs, given that they are on an export sanction list, and most of the telcos' GPUs are from domestic chip designers. This led to a low utilization rate in 2024, although they have built a few 10k+ GPU clusters in China. However, things changed post the inception of DeepSeek R1, where the demand for GPUs from SOEs and the government surged, leading to a rapid increase in utilization rates. China Mobile noted that its GPU utilization more than tripled, from 20% before DeepSeek to 68%, and China Telecom also commented that its smart computing utilization doubled to 90%+, while CU also reached 70%+.

We think the top-down push from the central government could become a key driver for telco operators' smart computing businesses. However, two key factors to consider are: 1) the further availability of GPUs, and 2) cannibalization of their traditional cloud business. We note that the telco operators generally should see benefits in two business segments – smart cloud computing and IDC.

Cloud computing: The telcos are capable of providing services including: 1) API usage, 2) bare metals, and 3) integrated services, including application development. Most of the smart computing services are provided to the government and SOEs. In particular, we also note there has been some demand from the healthcare sector.

IDC: We note that by the end of 2024, the three telco operators had a total of 1.4mn cabinets available for external sale, and the utilization rate had reached 65-70% thanks to greater demand. Most of those IDC businesses generate revenue from large internet customers. However, in contrast to third-party IDCs, their cabinets are spread across multiple regions, including the East Data West Compute nodes as a part of the policy push. They also provide fewer wholesale services to their customers.

Applications (2C): From Super Apps to AI Agents

Key conclusions:

- **We expect China to lead on 2C AI applications; it is well positioned (e.g., DeepSeek's moment, AI-native apps, super apps, open-source LLMs, capex, inference cost and competition) for mass-market adoption starting in 2025.**
- **Breakthrough in AI-native apps with better user retention, product differentiation and diversified functionality since 2H24 after overcoming some initial challenges in AI chatbots.**
- **Integration of AI features into existing super apps, leveraging user engagement and proprietary data.**
- **We see Tencent's WeChat ecosystem as a precursor to 2C AI agents, with the recent launch of Yuanbao AI assistant in WeChat a major catalyst.**

China to lead on 2C AI applications; well positioned for mass-market adoption starting 2025: Similar to the mobile internet era, mass-market adoption of to-consumer (2C) AI applications in China should be much faster than in other markets globally, in our view, driven by:

1. Inflection in user awareness after the **DeepSeek moment** in January;
2. Breakthrough in **AI-native apps**, after overcoming initial challenges in AI chatbots, by major internet companies and AI start-ups;
3. Integration of AI features into existing **super apps** leveraging proprietary data and user engagement;
4. Proliferation of **open-source LLMs** reducing entry barrier for AI adopters;
5. AI **capex** hike with a notable shift from model training to inference since 2H24;
6. Rapid decline in **inference cost** via engineering optimization, enabling free 2C offerings with managed capex; and
7. Step-up in R&D (for product development) and S&M (for user acquisition/retention) efforts because of **competition** for top-of-the-funnel traffic.

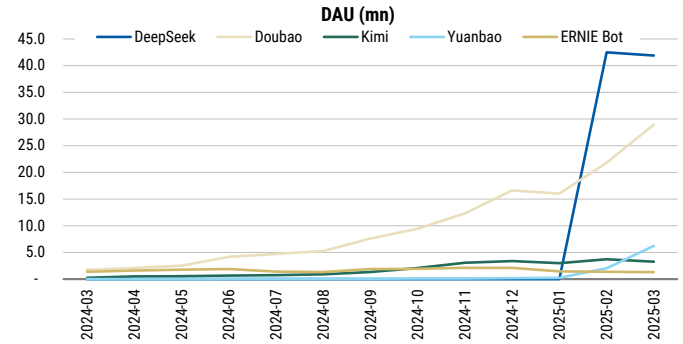
Breakthrough in AI-native apps since 2H24 after overcoming some initial challenges with AI chatbots: Since the launch of OpenAI's ChatGPT in the US in November 2022, Chinese internet companies and AI start-ups have introduced multiple AI chatbots (e.g., BIDU's Ernie Bot, Moonshot's Kimi), albeit they suffered initially from low user retention, with WAUs/DAUs around 1-2mn in 2023-2H24. Since 2H24, however, we have observed major breakthroughs in AI-native apps (e.g., ByteDance's Doubao, DeekSeep, Tencent's Yuanbao), with better user retention, product differentiation and diversified functionality. As of February, the combined WAUs/DAUs of the top 3 AI chatbots/AI-native apps reached over 50mn.

Integration of AI features into existing super apps leveraging proprietary data and user engagement: The China Mobile internet ecosystem has evolved around several super apps (e.g., Tencent's WeChat, BABA/Ant's Taobao/Alipay, ByteDance's Douyin, Meituan, and Didi), which offer all-in-one services in single apps, resulting in large user bases (breadth) and high user engagement (depth). Through these super apps, major internet companies have access to proprietary user data with unique behavioral, social and commercial traits, which is instrumental in providing customized AI offerings, such as personal AI assistants. Integration of AI features into existing super apps (in addition to newly launched AI-native apps) should foster mass-market adoption, leveraging the already large user base and high user engagement. The potential risk of losing top-of-the-funnel traffic to emerging AI applications also encourages super app developers to step up R&D (for product development) and S&M (for user acquisition/retention) efforts because of the competition (e.g., Tencent's accelerated AI strategy after the initial success of ByteDance's Doubao).

Looking ahead, we see Tencent's WeChat ecosystem as a precursor to 2C AI agents: An AI agent is a system capable of perceiving the environment with reasoning capabilities in order to make decisions and perform tasks towards specific goals on behalf of humans autonomously (i.e., without prompts). We view Tencent's WeChat ecosystem as a precursor to 2C AI agents, with the recent launch of the Yuanbao AI assistant in WeChat as a major catalyst. WeChat is one of the most powerful super apps globally, with a large user base (DAU of 1bn), high user engagement (45 sessions or 100 mins/user/day), and, most importantly, an all-in-one ecosystem, including social (messaging, moments), entertainment (games, video accounts), news and information (Tencent News, Official Accounts), search (WeChat Search), payment (WeChat Pay), e-commerce (Mini Shops), as well as all other functionalities (e.g., food delivery, ride hailing, travel) via Mini Programs.

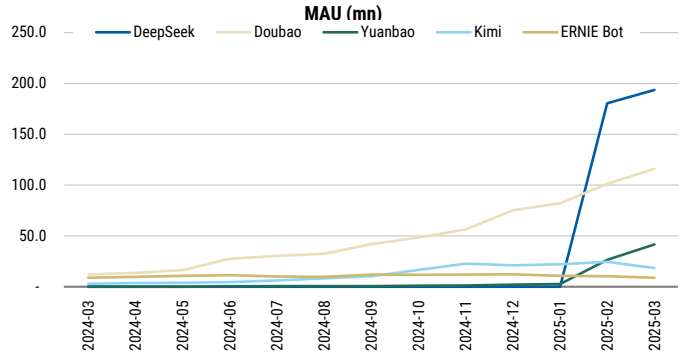
AI Chatbots and AI-native Apps

Exhibit 83: DAU



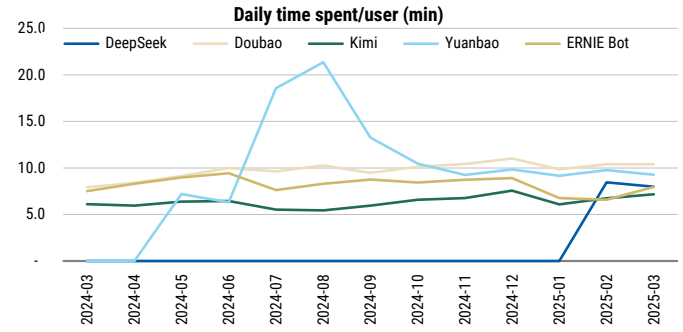
Source: Questmobile, Morgan Stanley Research

Exhibit 84: MAU



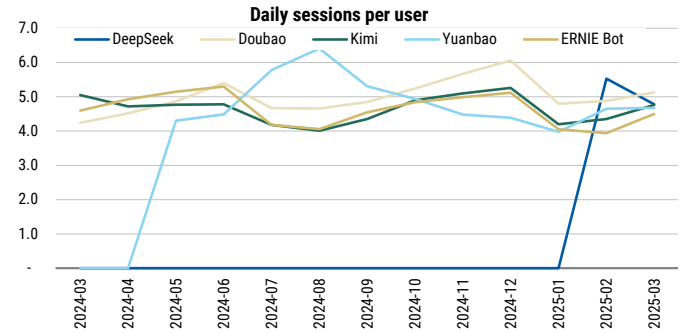
Source: Questmobile, Morgan Stanley Research

Exhibit 85: Daily time spent/user (min)



Source: Questmobile, Morgan Stanley Research

Exhibit 86: Daily sessions/user



Source: Questmobile, Morgan Stanley Research

We compared the functionality and positioning of the key Chinese AI-native apps so far:

Tool	Developer	Key positioning	Special features	Primary use case
Yuanbao	Tencent	General AI assistant, chatbot based	Integrated with WeChat ecosystem, can search through WeChat public content or upload documents from WeChat	Content creating, gaming, emotional interactions, research
Qwen/Tongyi	Alibaba	All round AI assistant, supports generic queries, work related support, casual conversational interactions	Supports multi media upload/generation. Supports e-commerce search results from Taobao/JD	Casual and light weight, more for emotional interactions or content generation
DeepSeek	DeepSeek	Technical tasks, coding, reasoning	Chatbot, does not support image generation	Coding, research, document analysis
Ernie Bot	Baidu	Multimodel AI integrated with Baidu ecosystem	Chatbot, supports multimedia generation	Enterprise solutions, general purpose LLM
Doubao	Bytedance	Casual, Light weight, social media entertainment	Chatbot, support media to video/text generation	Casual chat, emotional interactions, viral content creation
Kimi	Moonshot AI	Long context document analysis	Chatbot, similar to DeepSeek layout	Academic research, professional content generation

Positioning and target users:

Yuanbao

- Focuses on generic AI assistants, provides search functions across all WeChat verticals
- Supports document uploads from WeChat, Tencent Docs or QQ
- Suitable for general enquiries, creative content generation or an immersive conversational experience

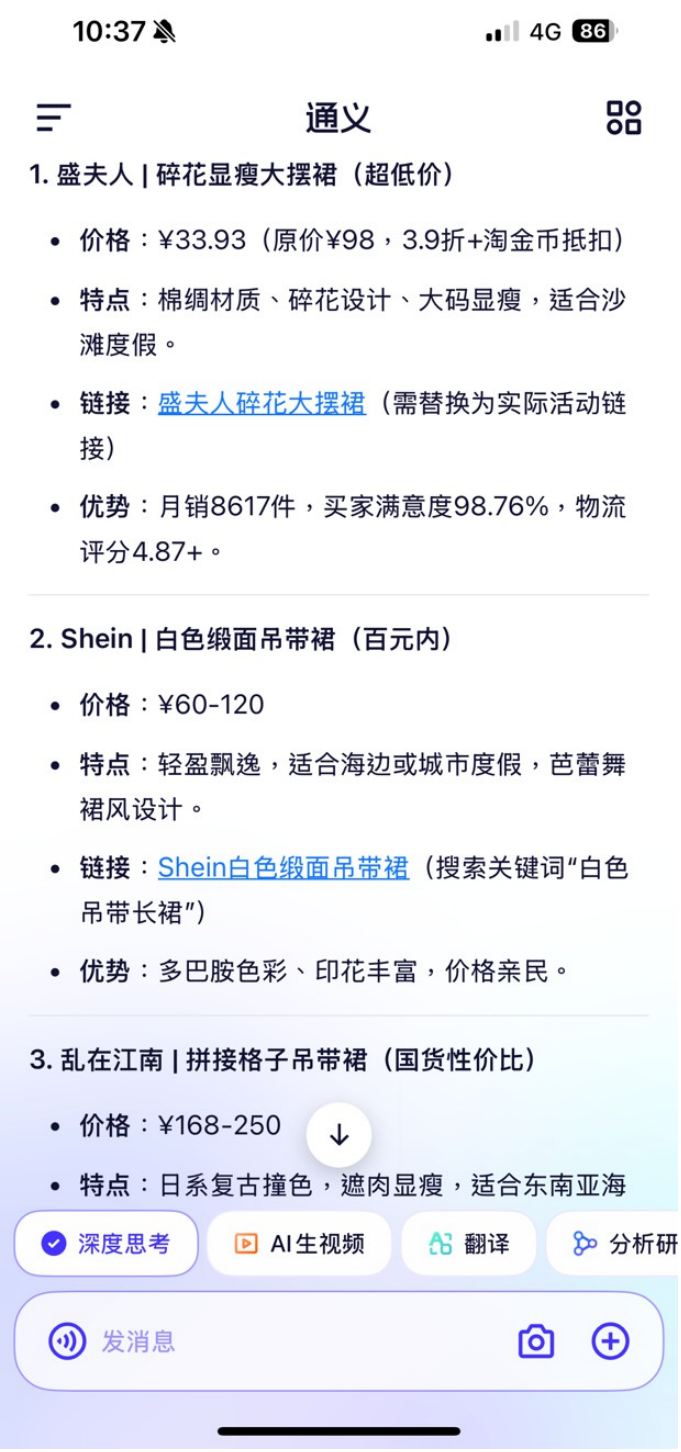
Qwen

- Casual based daily AI assistant support
- Provides virtual assistants for conversational needs
- Support e-commerce search results across JD/Taobao

Exhibit 87: AI virtual assistant for casual chat

Source: Alibaba Qwen

Exhibit 88: Results across e-com platforms



Source: Alibaba Qwen

DeepSeek

- Targets developers and researchers with coding, mathematical, and long-context analysis needs
- Strong analytical and reasoning use cases for technical users

Doubao

- For casual social media users creating trendy/viral content
- Focuses on humor, trends, and casual interactions with various virtual AI agents

Ernie Bot

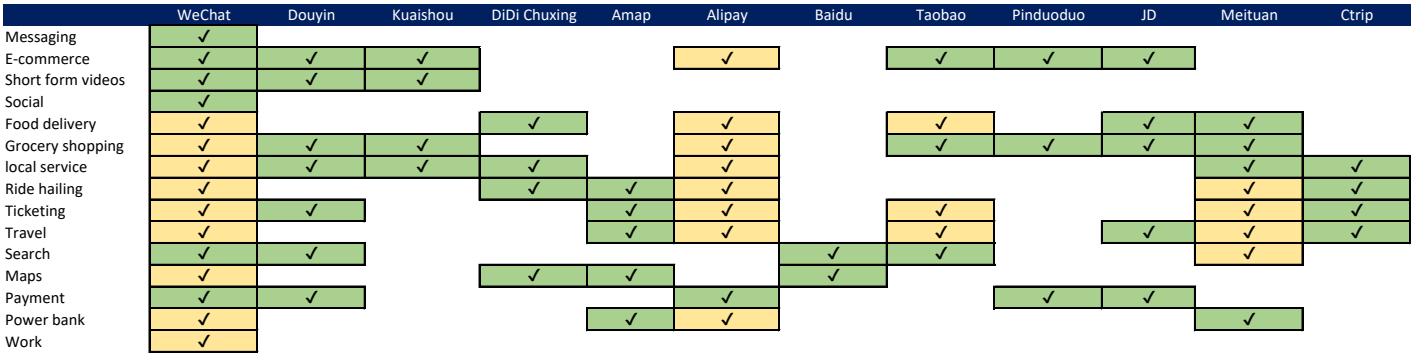
- Integrated with Baidu's services (search, cloud, ads), emphasizing enterprise solutions
- Used by businesses for marketing, customer service, and content generation

Kimi

- Specializes in long-context document processing
- Targets academics or professionals to summarize/research long texts (legal, research papers)

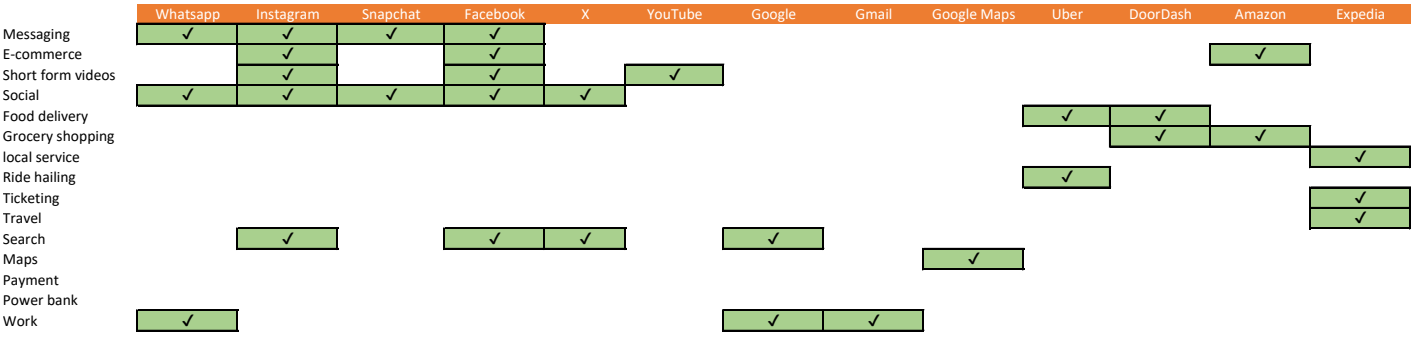
Integration of AI into Super Apps

Exhibit 89: Chinese super app functionalities



Note: green ones are functions provided by main app. Orange ones are provided via mini programs. Source: Company data, Morgan Stanley Research

Exhibit 90: US super apps functionalities

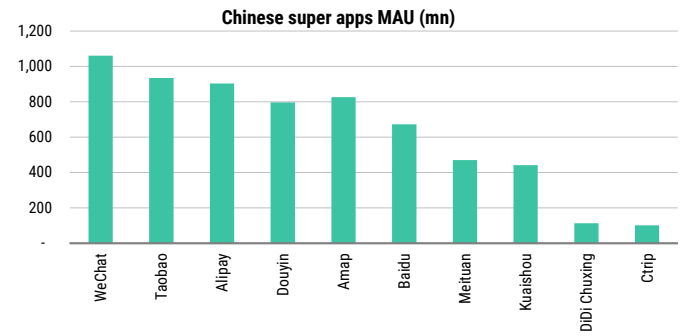


Source: Company data, Morgan Stanley Research

MAU

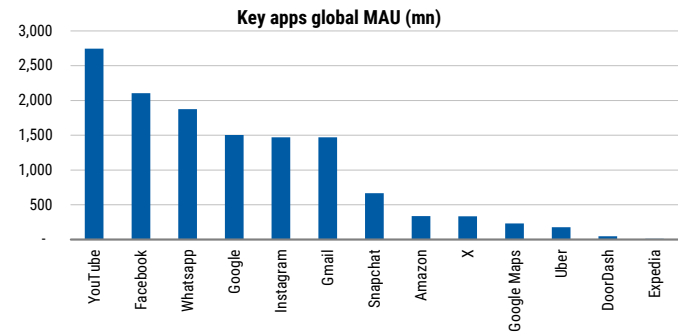
Compared with other core apps globally, China's super apps have large MAUs, with WeChat at 1.2bn, and Taobao and Alipay reaching 1bn – similar to Whatsapp and Google's global MAU.

Exhibit 91: China super apps – MAU (2024)



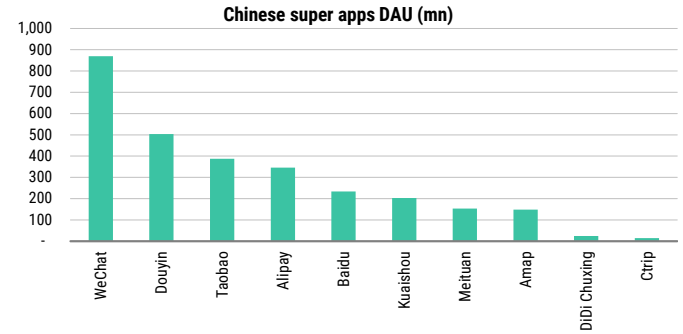
Source: Quest Mobile

Exhibit 92: Key apps – global MAU (2024)



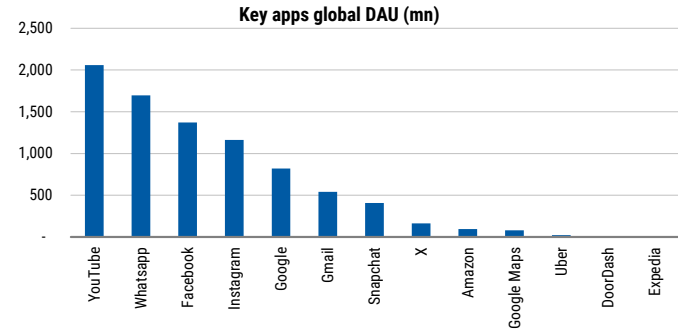
Source: Sensor Tower

Exhibit 93: China super apps – DAU (2024)



Source: Quest Mobile

Exhibit 94: Key apps - global DAU (2024)

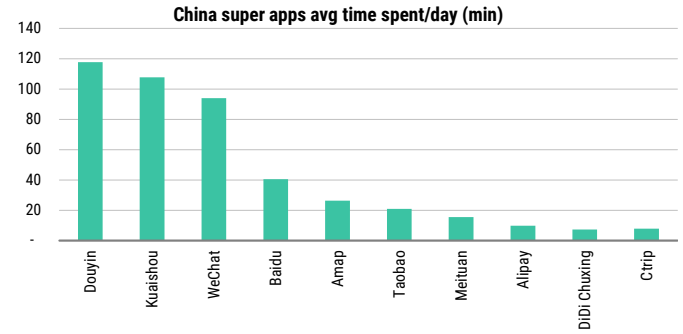


Source: Sensor Tower

Time spent/day

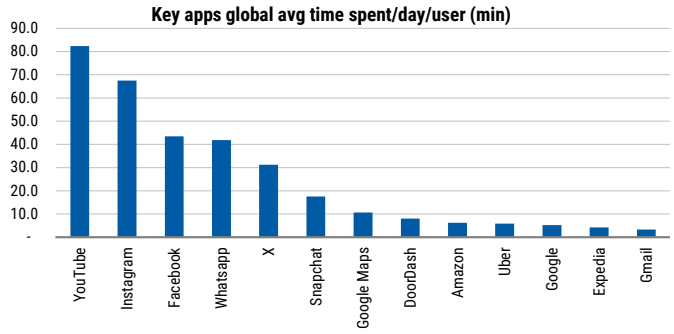
Chinese super apps generally see higher time spent/day, with short-form video platforms reaching >2 hours/day (Douyin, Kuaishou) vs. YouTube and Instagram at around 65-80 minutes per day. The average time spent on WeChat is about 95 minutes, similar to the aggregate of Facebook and Instagram at over 110 minutes globally.

Exhibit 95: China super app time spent/day (2024)



Source: Quest Mobile

Exhibit 96: Key app global time spent/day (2024)



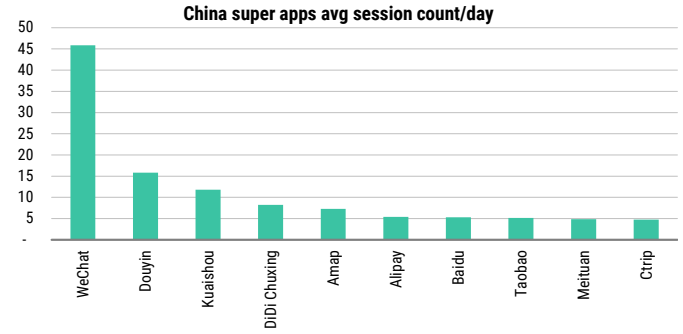
Source: Sensor Tower

Session count/day

Chinese super apps also see high user frequency and stickiness. The average daily session count for WeChat reached 45 times/user as of February, the highest among all Chinese super apps, and 3x that of #2 app, Douyin.

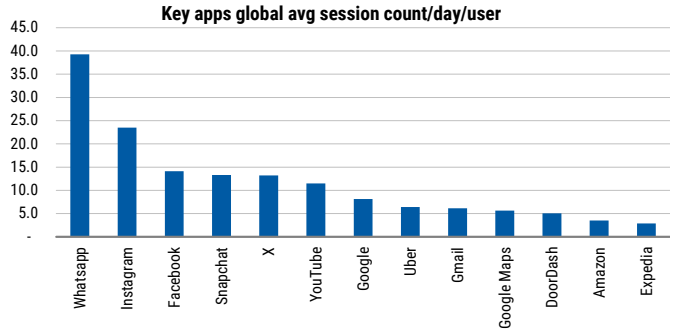
Comparing this globally, daily usage of WeChat is higher than the global usage of Whatsapp, and it is similar to the aggregate of Instagram plus Facebook plus Snapchat.

Exhibit 97: China super app session count /day (2024)



Source: Quest Mobile

Exhibit 98: Key app global session count /day /user (2024)



Source: Sensor Tower

Current integration of AI into super apps

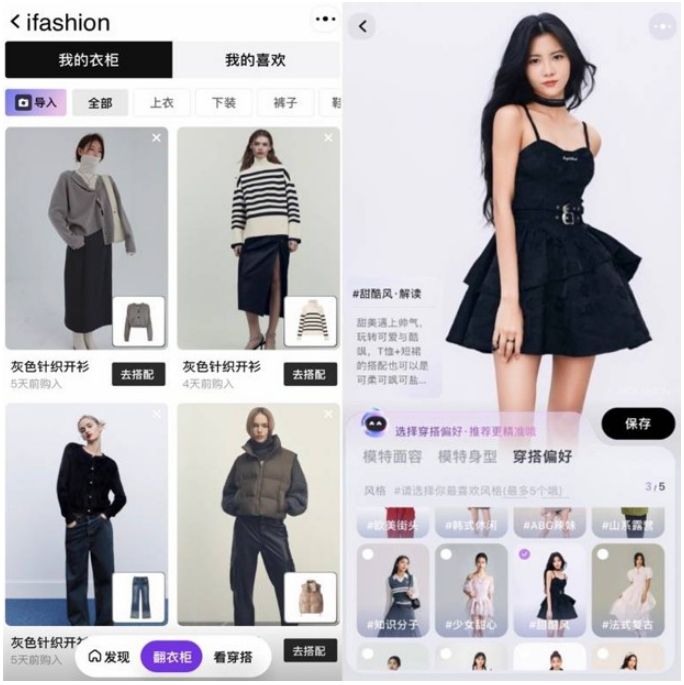
WeChat

- **Search:** WeChat integrated the DeepSeek-R1 model into Weixin search in February, as well as Tencent AI coding and Yuanbao. DeepSeek is able to utilize all data across WeChat verticals, including official accounts, mini programs and video accounts.
- **Ima.copilot:** Also integrated DeepSeek R1. It forms a database, integrating all data sources within the WeChat ecosystem. It supports search, content creation, notes consolidation and integration with all WeChat verticals, including mini programs and official accounts.
- **Yuanbao:** Access to Yuanbao is via WeChat namecard sharing within private chats.

E-commerce

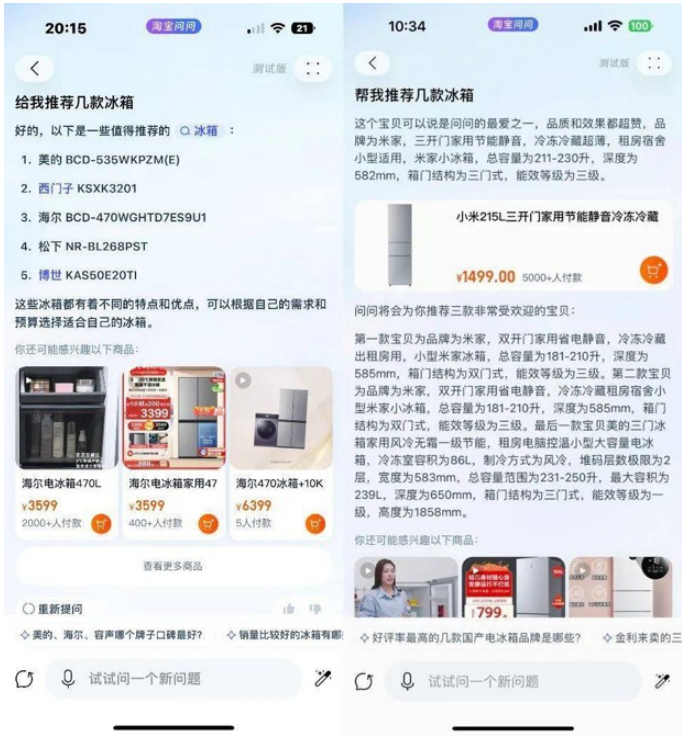
- Taobao now supports an AI fitting assistant; it will recommend products that suit the user's height and weight, as well as providing outfit previews based on user body features.
- Based on the Tongyi model, "Taobao AI ask" (trial version) launched in Nov. 2024, provides various AI assistants across "lifestyles", "food", "travel planner", and "procurement," on product recommendations, product comparisons, and trip planning services, based on user criteria.
- On the merchant front, Taobao also provides an AI platform for operational support to merchants, including sales data analytics and marketing tools generation (short videos, posters, banners) based on viral items/trends, and data consolidation, among others.

Exhibit 99: Taobao AI fitting



Source: Alibaba Taobao

Exhibit 100: Taobao AI Ask

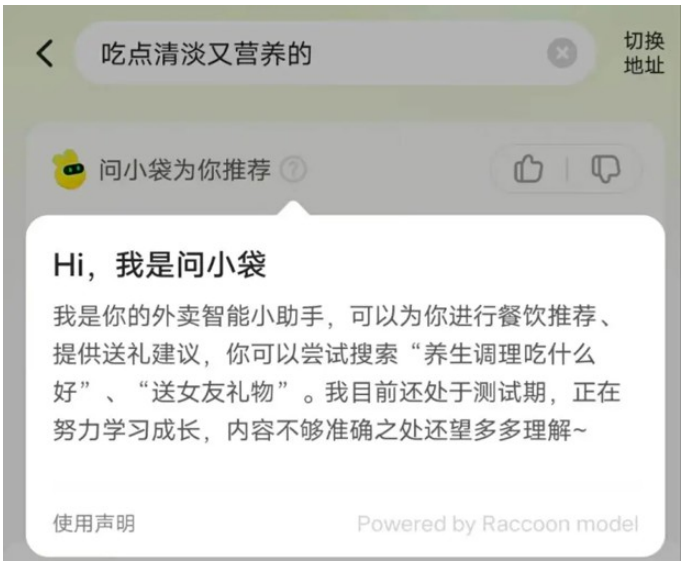


Source: Alibaba Taobao

Local Services

- Meituan has announced plans to launch AI-native 2C products that will cover all services on the platform. Currently, Meituan has an AI assistant (Wen Xiao Dai) to provide AI customer service for restaurant/product recommendations. Leveraging its proprietary LLM, Long Cat, Meituan is set to launch AI services in 2H25 that will cover all Meituan services, including a free personal AI assistant to fulfill food delivery orders, local service/restaurant booking, grocery ordering, and travel planning, thereby providing a one-stop service and fulfillment within one platform.

Exhibit 101: Meituan AI assistant



Source: Meituan

Exhibit 102: Meituan AI recommendations

Source: Meituan

Applications (2B): Fast Adoption, Slow Monetization

Key conclusions:

- **China's mass adoption cycle of 2B AI starting from 2025 is likely to be faster than its public cloud adoption cycle starting from 2013, driven by wide recognition of China's AI foundation model propelled by DeepSeek, comprehensive 2B application offerings, and enterprises looking to cut costs.**
- **But the monetization of China 2B AI applications could lag, especially compared to the US, due to China's low-pricing-driven economy, lower labor value, intense competition in the software market, open-source AI models as the mainstay, and enterprises' preference for private deployment.**
- **Compared to 2C AI applications, where super apps dominate, China's 2B AI application landscape will likely be more fragmented with various 2B AI agents specialized in particular verticals.**
- **2B software names with proprietary data (versus those that don't have proprietary data) could offer better AI functions by post-train, and therefore more opportunities to gain share with AI. 2B software names who can quantify its AI value creation for enterprises (i.e. how much costs they can save for enterprises by adopting AI) will see better monetization opportunities than others.**

Fast Enterprise Adoption

2B AI adoption from 2025 will be faster than the previous public cloud adoption cycle: It only took 5 years for China to come up with its first LLM following the first LLM globally, vs. seven years for public cloud, and two years for China to start mass production after the first product, vs. four years for public cloud. We believe mass adoption for 2B AI will also be faster than public cloud in China driven by:

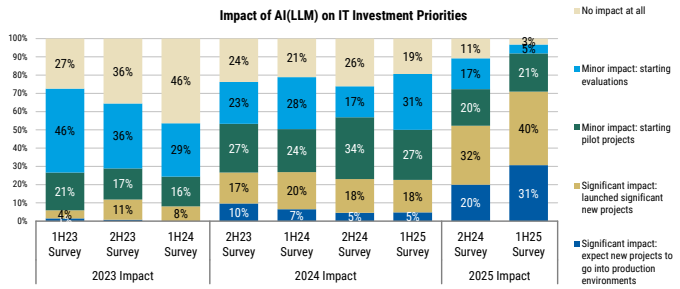
1. Nationwide recognition of China's AI foundation model capabilities propelled by the **DeepSeek moment**. SOEs and local governments are also strongly encouraged to adopt AI, while few enterprises recognized cloud computing back in 2013.
2. Before AI, China had developed **comprehensive local 2B software** offerings, which largely matched those of global peers, and AI has further enhanced these 2B applications. When mass adoption of public cloud computing started in China, local 2B software was at a very nascent stage.
3. Proliferation of **open-source LLMs** in China are meeting enterprises' demand for AI application flexibility and security, versus public cloud that was not widely accepted by SOEs for security reasons.
4. In 2025, we are seeing stronger demand from Chinese enterprises looking for **better management tools and lower costs** in the face of slower economic growth and deflationary pressure, compared with 2013. AI also appears to deliver more straightforward results than traditional software in terms of productivity improvement.

Milestone	Public Cloud	GenAI
Foundation theory	**1983:** Utility Computing by Sun	**2017:** Transformer by Google
First product	**2002:** AWS	**2018:** OpenAI GPT-1
Commercialization	**2006:** AWS EC2	**2022:** OpenAI GPT-3.5
China's first product	**2009:** AliCloud	**2023:** Baidu Ernie Bot
China mass adoption	**2013:** AliCloud, Tianyi Cloud, QingCloud, UCloud	**2025:** DeepSeek-R1, Alibaba Qwen2.5-Max, Bytedance Doubao 1.5-pro

Our 1H25 China CIO Survey results revealed that 2025 will likely be the mass adoption year of AI on the enterprise side. In 1H25, about 97% of enterprises believed AI would impact their IT investment priorities and 71% expected it to have a significant impact. In addition, about 73% of enterprises plan to have their first AI project in production within 12 months. These ratios have significantly improved in the 1H25 survey compared to our 2H24 survey. The AI adoption process is clearly accelerating among Chinese enterprises.

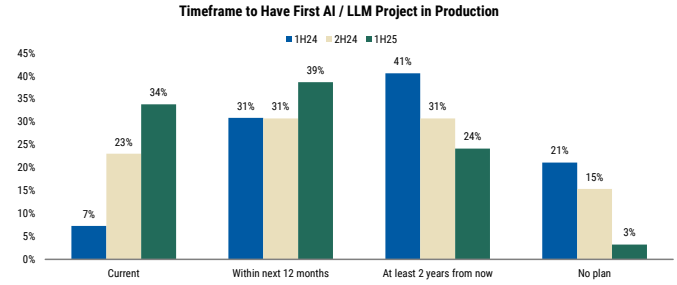
In addition, 66% of enterprises surveyed target to utilize AI for improving employee productivity and saving labor costs. And 75% of enterprises don't plan to raise total headcount in next three years due to AI. This implies solid demand from Chinese enterprises to deploy AI, and the value-add of AI will be largely evaluated by labor value.

Exhibit 103: Enterprises are increasingly prioritizing AI projects



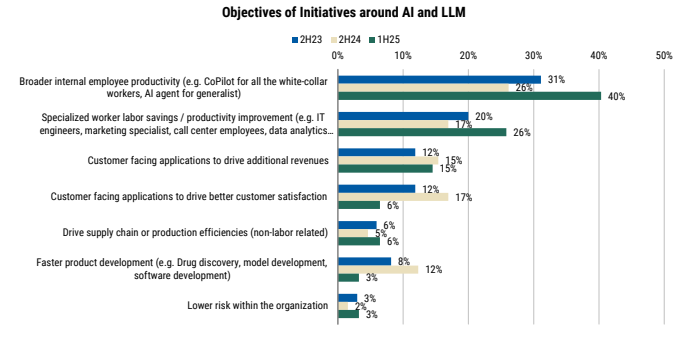
Source: AlphaWise China CIO Survey 1H25, Morgan Stanley Research

Exhibit 104: More than 70% of enterprises plan to adopt their first AI project in the next 12 months



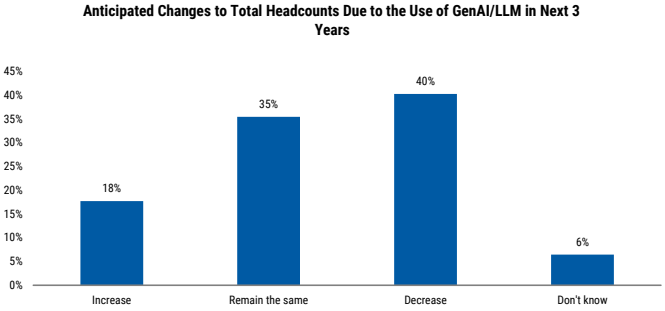
Source: AlphaWise China CIO Survey 1H25, Morgan Stanley Research

Exhibit 105: Enterprises are demanding AI for productivity improvement and labor cost savings



Source: AlphaWise China CIO Survey 1H25, Morgan Stanley Research

Exhibit 106: 40% of enterprises said they would reduce headcount due to AI

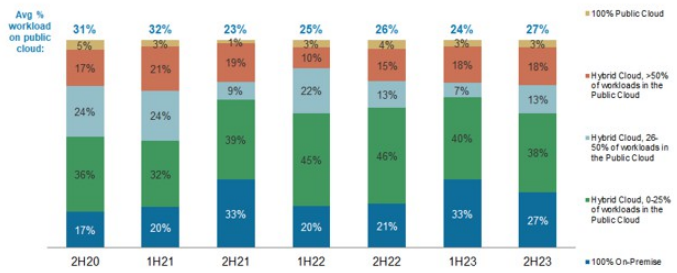


Source: AlphaWise China CIO Survey 1H25, Morgan Stanley Research

We estimate China enterprises' GenAI workload penetration to reach 31% in 2030. According to our AlphaWise China CIO Survey, Chinese enterprises' average percentage of workload on public cloud was 25% in 2022 (T+10 – since mass adoption of public cloud started in 2013 [T+1]). Meanwhile, enterprises expected 18% of their workload, in terms of hours spent, would be replaced by GenAI in three years.

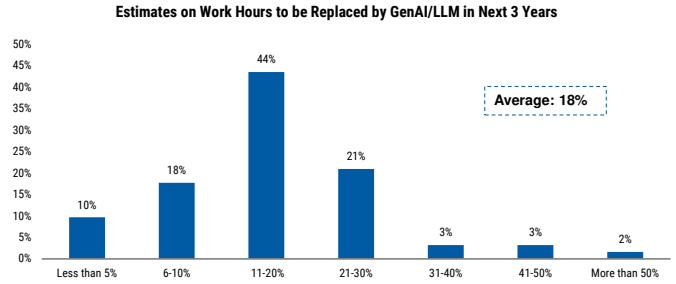
Combining these survey results, we assume it will only take Chinese enterprises half of the time that public cloud took to reach a similar workload penetration rate for GenAI. Since mass adoption in 2025 (T+1), we estimate China to reach 15% GenAI workload penetration in 2027 (T+3), 25% in 2029 (T+5), and 31% in 2030 (T+6). Our US research team estimates the US GenAI workload penetration rate to reach 31% in 2029 (T+5). Our estimate also implies that China adoption of GenAI will lag the US for about 12 months before reaching a similar level.

Exhibit 107: Chinese enterprise workload distribution in IT environments



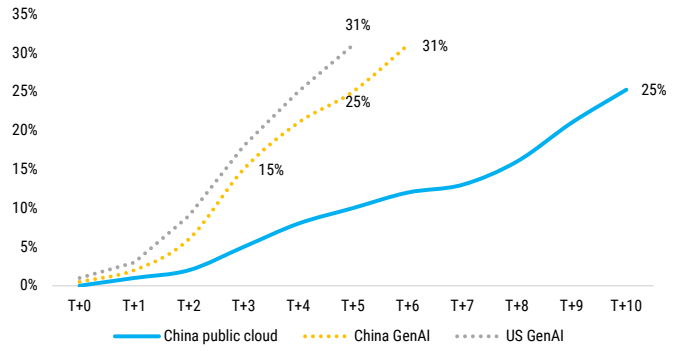
Source: AlphaWise China CIO Survey 2H23, Morgan Stanley Research

Exhibit 108: Chinese enterprises estimated 18% of workload to be replaced by AI in 3 years



Source: AlphaWise China CIO Survey 1H25, Morgan Stanley Research

Exhibit 109: Estimates of enterprise workload penetration



Source: Morgan Stanley Research, US GenAI workload penetration rate estimated by US research team

China has developed comprehensive 2B AI application offerings. We list out major enterprise software with their AI function in China and the US (and SAP from Germany), across office software, ERP (Enterprise Resources Planing), HRM (Human Resources Management), CRM (Client Resources Management) and IM/OA (Instant Messaging/Office Automation). We didn't find a significant gap between these two countries' offerings. The most common functions were AI agents, AI assistants, data analysis and development platforms. However, there are also some features unique to China.

- China enterprise software markets are more fragmented while the US has more super apps.
- AI offerings in China are more tailored-made to specific scenarios, while US AI offerings focus on the underlying technology that can be shared across scenarios.
- China's enterprise software has generally adopted more LLMs compared to the US, and DeepSeek appears to have become a must-have for Chinese enterprise software.

Exhibit 110: China vs. US 2B software

Software category	China			US/Global		
	Player	Major AI function	Major LLM adopted	Player	Major AI function	Major LLM adopted
Office	Kingsoft Office	- Office assistant (writing, reading, data, design) - Govt assistant (Q&A, writer, fact check) - Enterprise (AI hub, docs, workflow automation, data analysis)	DeepSeek/Minimax/Qwen/ Ernie/Zhipu/Sensetime	Microsoft Office Copilot	- Word (writing, summary, edit, data integration) - Excel (data analysis, chart & table creation, python integration, formula assistant) - PPT (generation, narrative building, content transformation) - Outlook (meeting summary, draft, assistant) - Assistant	OpenAI
ERP	Kingdee	- AI agent - Boss assistant - Finance assistant (multimodel financial review, smart contract assistant, indicator analysis..) - HR assistant (JD, interviewer..) - Development platform - Intelligent search - Note recognition - Risk analysis	OpenAI/DeepSeek/Qwen/ Llama/Kimi/Doubao/Ernie	SAP	- AI agent - Copilot (report, dashboard, plan creation) - Knowledge graph - Development platform - Business entity recognition - Data attribute recommendation - Document information extraction - Personalized recommendation	OpenAI/DeepSeek/Mistral
	Yonyou	- AI agent - Finance assistant (invoice recognition, financial trend prediction, tax filing..) - HR assistant (courses, training, task assignment..) - Business analysis - Knowledge graph	DeepSeek/Qwen/Doubao/ Zhipu/Baichuan	Oracle	- AI agent - Routine task automation - Predictive analytics - Decision-making and insights - Finance (cash flow prediction, invoice processing, intelligent payment..) - Supply chain (logistic & inventory mgmt, vendor selection..)	Command/Llama/Self-developed LLM
HRM	Beisen	- AI interviewer - AI staff assistant - AI hiring assistant - AI courses - AI testing - AI training - AI coach	OpenAI/DeepSeek/Qwen/ Kimi/Doubao/Zhipu, etc	Workday	- Predictive analytics - Skill and talent mgmt - HR process automation - AI assistant - Content generation (JD, employee communication, report draft) - Expense and financial mgmt - Enterprise planing	Not disclosed
CRM	Fxiaoke	- AI sales (recognize business opportunities, generate sales strategy, analyze sales data) - AI marketing (marketing materials/email/poster generation, customer communication) - AI service (customer service chatbot)	Not disclosed	Salesforce	- AI agent - AI sales (generate emails, summarize sales calls, automates sales process) - AI service (customer interaction support) - AI marketing (personalized customer experiences) - AI commerce (e-commerce AI tool) - AI assistant - Development platform	OpenAI/Amazon/Claude/ Cohere/Self-developed LLM
	Neocrm	- AI for consumer companies (recognize shelf groceries, generate order info) - AI assistant - Development platform	Hunyuan/DeepSeek			
IM/OA	Dingtalk	- AI assistant - Multimodal recognition, reading, summary, translation - Workflow - Automatic reply - Schedule optimization - Automatic approval process	Qwen/DeepSeek/Minimax/ Kimi/Zhipu/01/Baichuan	Microsoft Teams	- 365 Copilot - Meeting recap - Live transcript and translation - Noise suppression - Smart camera and people recognition - Voice command - Sentiment analysis and engagement insights - Chat suggestion - Content moderation and compliance	OpenAI
	Feishu	- AI assistant - Document generation - Meeting note transformation - Development platform	Doubao/DeepSeek			
	Weaver	- AI agent - Process optimization - Contract and document management - Knowledge graph	Doubao/DeepSeek/Ernie/ iFlytek			

Source: Company, Morgan Stanley Research

Exhibit 111: Kingsoft Office AI spreadsheet formula generation

Source: Kingsoft

Exhibit 112: Kingdee AI finance analysis

Source: Kingdee

Exhibit 113: Beisen AI interviewer

Source: Beisen

2B Monetization May Lag

However, we are more neutral on the monetization of 2B AI applications in China, compared to the US:

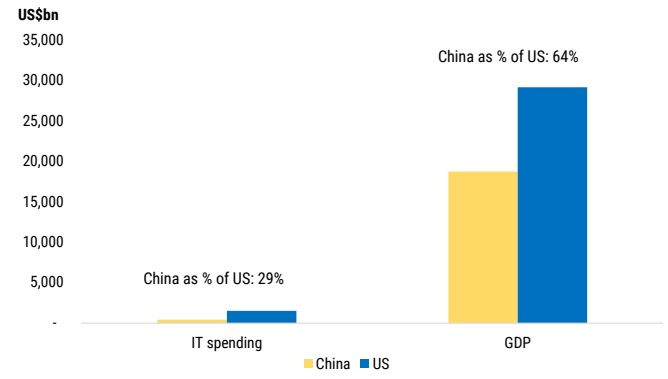
1. Low-price offerings are a major competitive edge of Chinese enterprises, compared to the high-premium branding strategy of US enterprises, which implies more **price discounts to 2B applications** in China.
2. Enterprises evaluate AI by labor value creation (whether from cost cuts or productivity improvement). China has relatively **lower labor costs** compared to the US.
3. Chinese enterprises are less willing to pay a premium for **open-source AI** model-based applications.
4. Compared to the US, Chinese enterprises' preference for **private deployment of AI** will likely lower the recurring software proportion in IT budget allocation.

Lower labor costs lead to lower monetization opportunities for AI on the enterprise side. The digitization penetration of Chinese enterprises is lower than that of US. In 2024, China's nominal GDP was 64% of the US's while total IT spending was only 29% of the US's. The gap in digitization penetration rate (IT spending as a percentage of nominal GDP) has further widened since China's deflation began in 2022. Chinese enterprises' willingness to pay for digitization is generally weaker and IT spending has become the major area for reductions in enterprises' budgeting during the economic downturn. We believe the low-price-driven economy and lower labor costs in China are the major reasons behind lower digitization penetration, and deflation further amplifies these features.

Preference for open-source AI models and private deployment. In our 1H25 China CIO Survey, 83% of enterprises preferred to adopt open-source AI models, and mostly because of the flexibility in modification and accessibility for private deployment. Meanwhile, only 21% of enterprises were willing to pay a premium for 2B AI applications built on open-source AI models. And 40% of enterprises expected to deploy their AI workload privately, and this ratio remained at 35% in the next three years.

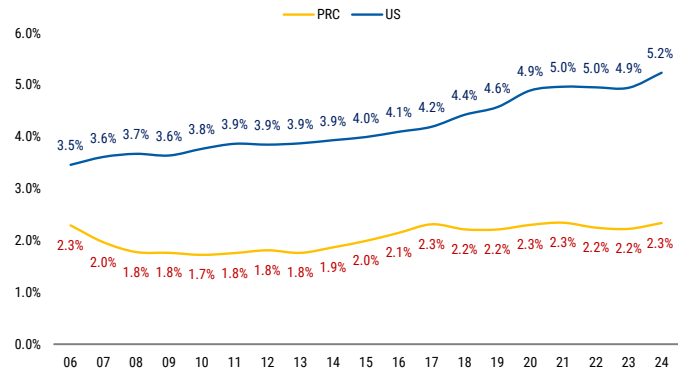
Open-source models and private deployment drive higher demand for hardware, such as AI all-in-one machines (a server equipped with AI chipsets, pre-installed AI models and customized AI applications). Among enterprises' AI budgets, we see the hardware proportion rising from 32% from 2024 to 34% in 2025, while the software proportion is expected to decline by 3ppt to 40% in 2025. This also implies limited monetization room for 2B AI applications, as it is difficult to charge recurring software revenue or pay-as-you-go software revenue from private deployment.

Exhibit 114: IT spending and nominal GDP in 2024: China vs. the US



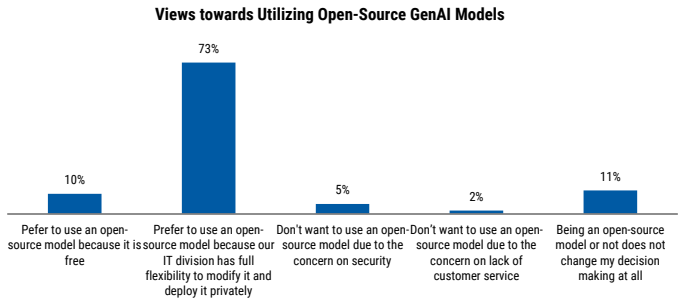
Source: IDC, FactSet

Exhibit 115: Historical IT spending as % of nominal GDP: China vs. the US



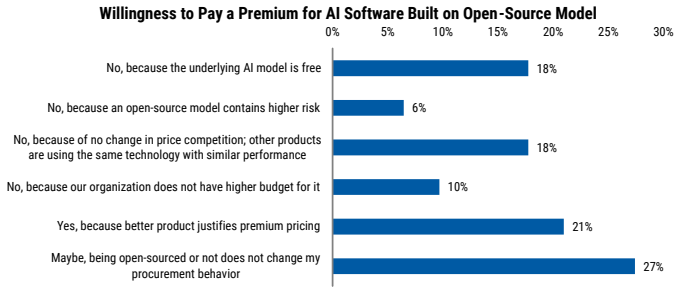
Source: IDC, FactSet

Exhibit 116: Enterprises prefer open-source AI models



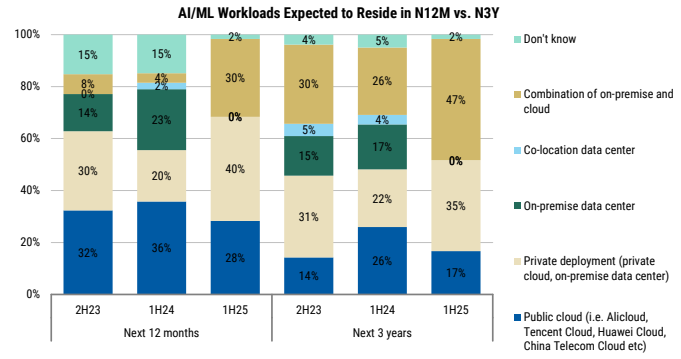
Source: AlphaWise China CIO Survey 1H25, Morgan Stanley Research

Exhibit 117: Few enterprises will pay a premium for open-source model-based software



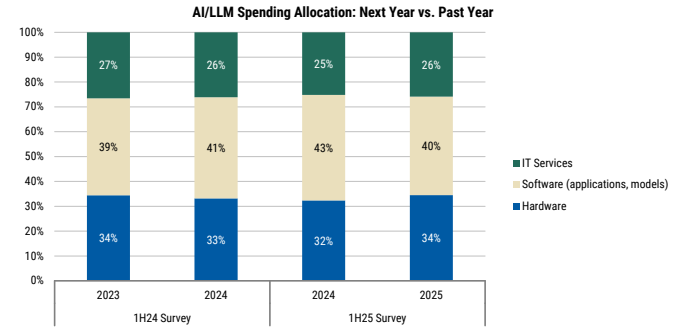
Source: AlphaWise China CIO Survey 1H25, Morgan Stanley Research

Exhibit 118: Enterprises prefer private deployment for AI



Source: AlphaWise China CIO Survey 1H25, Morgan Stanley Research

Exhibit 119: Hardware mix rising and software mix declining among AI budgets



Source: AlphaWise China CIO Survey 1H25, Morgan Stanley Research

We highlight HCM (Human Capital Management) leader Beisen (OW) as a pioneer in 2B AI applications because:

- Human capital management is a more straightforward scenario for enterprises to reach their AI adoption targets, which are to replace headcount, improve productivity and generate higher labor value. HCM players can generate incremental AI revenue by cannibalizing non-IT budgets, such as employee costs.
- Beisen's long history of a public cloud-based SaaS business model has accumulated a massive amount of proprietary data, which forms a deep moat in AI application performance.

Reference:

Beisen Holding Limited: Shining with AI - Management Meeting Takeaways (9 Apr 2025)

Beisen Holding Limited: Quantifiable AI Contribution; Raise PT (24 Feb 2025)

Monetization and ROIC

Key conclusions:

- **Ads: Likely to be the quickest to monetize AI, similar to the US. This has already been demonstrated by robust ads growth from Tencent with its AI ads-tech upgrade, which improved content targeting and eCPM from enhanced click-through rates.**
- **2C: To benefit from fast adoption with super apps. We expect most 2C AI applications to be free, while monetization will likely come from ads and an increase in transaction services driven by AI in the future.**
- **2B: Monetization may lag adoption. Enterprises spending will skew more towards in-house building of AI application with open-sourced AI models and self-owned hardware in early days and shift towards usage-based payment for third-party software vendors' AI application offerings in the longer-term.**
- **ROIC: We estimate the total return from AI uplift at Rmb417bn, delivering a 52% margin by 2030, mainly driven by an increase in e-commerce activities. We expect investments to breakeven by 2028e.**

AI Consumption Usage and Monetization Methods

Ads – the earliest and most visible monetization area: With AI ad tech upgrades, ads targeting and efficiency have been greatly enhanced, improving eCPM (effective cost per mille [1,000]). This is especially beneficial to platforms with enormous user data, such as Meta and Tencent. AI ads tech can better utilize and aggregate vast amounts of user data, analyze user behavior, and provide targeted recommendations. This improves user time spent and user stickiness, translating to better ads conversion.

AI ads tools improving merchant efficiencies: Ads merchants can now create content in a much more cost efficient way with AI tools. Most internet platforms now monetize via providing multimedia generation AI tools, such as Tongyi Wanxiang (Alibaba), Kling (Kuaishou), and Jimeng (Douyin), lowering the bar on ads content creation. These tools help merchants produce high quality ads content easily, thus improving merchants' efficiency.

Ads monetization from AI search: Many internet platforms have been integrating AI into search, such as Baidu (20%+AI search result mix) and WeChat search (DeepSeek integration). AI generated search results can provide customized and more comprehensive results according to user needs, and also provide recommendations that enable ads monetization potential. However, we also note the disruption of such to traditional search ads.

Applications (2C) "ads+VAS model" – We expect a different monetization model in China – "ads+VAS" model vs. "ads+subscription model" in the US. We expect most 2C applications to be free for now, but significant monetization upside will be on ads and transactions based. With a wide range of application scenarios via various super apps in China, we expect AI can improve user engagement and enable transactions more easily. App providers can monetize via transaction-based service fees (e-commerce, local service, OTA) or cross-sell within the platform (i.e., WeChat).

Applications (2B) subscription model – We believe that Chinese enterprises will mainly use a subscription-based model for professional purposes, such as text to video/image generation (Kling), online meetings (Tencent Meeting), AI coding (Lingma, Alibaba), among others. However, we don't expect to see meaningful subscription-based models, such as OpenAI.

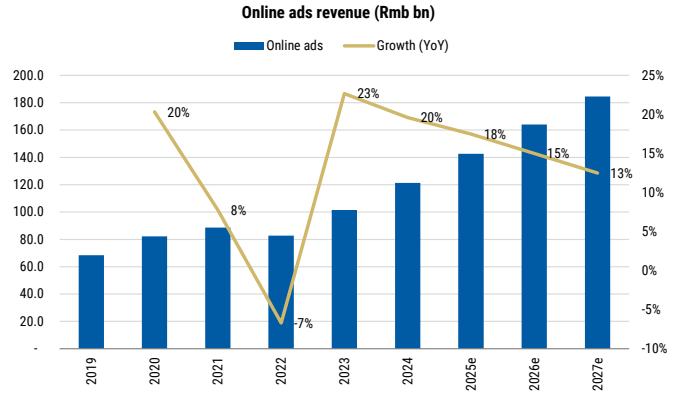
Tencent sees the highest visibility in 2C AI monetization

WeChat has the widest functionalities among all super apps, as well as the largest user base and highest user frequencies. The proprietary data that the WeChat ecosystem aggregates provides Tencent with a wide range of monetization opportunities, from improving ads targeting, to all sorts of transaction opportunities that can be potentially facilitated through AI assistants.

High ROI AI investments – On the core businesses front, we see robust ad growth of 17% in 4Q (accelerating from 3Q), demonstrating high ROIC from AI deployment. With continual AI ad tech upgrades, we believe Tencent's ads growth should be more durable than global peers given leverage from user data in mini programs and payments.

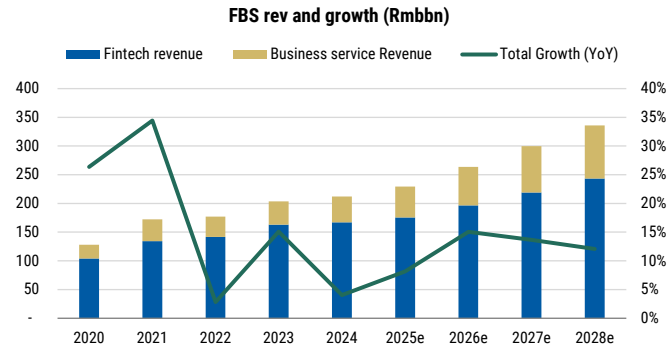
On the 2C front, Hunyuan model has been integrated into all Tencent products including ima.copilot, all WeChat verticals, games, QQ, Yuanbao, and so on; more customer-facing applications are expected, including AI agents to service various functions. We expect business service growth of 20%+ YoY in 2025.

Exhibit 120: Tencent online marketing revenue



Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 121: Tencent FBS revenue



Source: Company data, Morgan Stanley Research (e) estimates

2C AI strategies: Tencent has been focusing on ramping up Yuanbao, a standalone app that has high-quality data access from WeChat. Management has seen good retention, adoption and positioning of Yuanbao, with DAU up 20x from Feb-March to date. The WeChat ecosystem is unique with mini programs, e-commerce and transaction capabilities, thus providing wide opportunities in developing Agentic AI with no separate log in. WeChat has also aggregated enormous amounts of content, with AI integrated into WeChat search, providing a better user experience while enhancing monetization given the ad pool is big and growing.

AI Enterprise Usage and Monetization Methods

Enterprises can gain access to GenAI functions either through **building** applications based on open-source AI foundation models or **buying** applications from third-party software vendors that have been pre-built on AI foundation models.

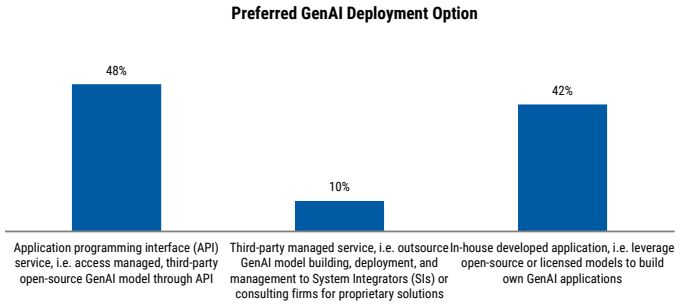
Building applications: This enable differentiated solutions and higher flexibility on customization for enterprises. But there are also higher risks of project failures and higher maintenance costs that enterprises need to bear by themselves.

- In-house development: In our 1H25 China CIO Survey, 42% of CIOs preferred this method. In this scenario, enterprises purchase AI hardware and utilize internal IT staff for AI application development. External monetization opportunities mainly go to hardware vendors (including chipset providers, server producers, data centers, among others) based on volume of hardware purchased.
- Third-party managed services: 10% of CIOs we surveyed preferred this method. In this scenario, enterprises outsource AI application development, deployment and management to third-party system integrators and consulting firms. In this scenario, external monetization opportunities are mainly shared by hardware vendors and IT services providers on project-based revenue model pricing upon hardware and labor/day costs.

Buying AI applications: As third-party software vendors bear the responsibility of developing, running and maintaining the AI application, the risk profile is lower and maintenance cost is also lower by sharing with other tenants. But the solution will be less tailored. In our survey, 48% of CIOs preferred this method. In this scenario, external monetization opportunities mainly go to software vendors, either through subscription or a pay-as-you-go revenue model.

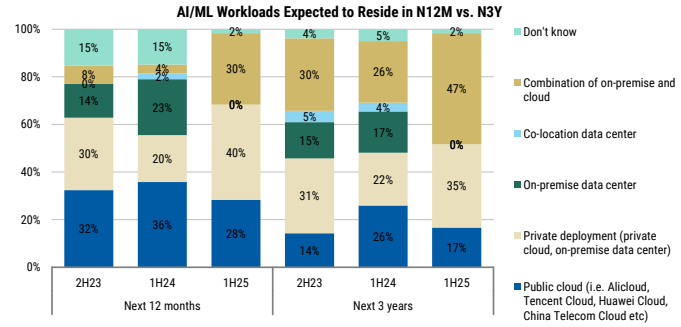
External monetization opportunities: Buying AI applications > third-party managed services > in-house application development. In the near term, enterprises will likely prefer building over buying AI applications in the early stage of GenAI, as it takes longer for software vendors to come up with matching solutions than in-house development or outsourcing to IT service vendors. However, in the long term, as the enterprise adoption of GenAI and usage of computing power surges with evolving AI application scenarios, we expect buying AI applications to gradually gain share, and the pay-as-you-go revenue model based on computing power consumed should also prevail. The enterprise AI monetization opportunity in China should also grow along with the trend.

Exhibit 122: Preferred AI application deployment option by CIOs



Source: AlphaWise 1H25 Chin CIO Survey, Morgan Stanley Research

Exhibit 123: AI workload distribution



Source: AlphaWise 1H25 Chin CIO Survey, Morgan Stanley Research

ROIC Analysis

We estimate a total return of Rmb806bn in 2030e driven by AI uplift from consumption and enterprise usage.

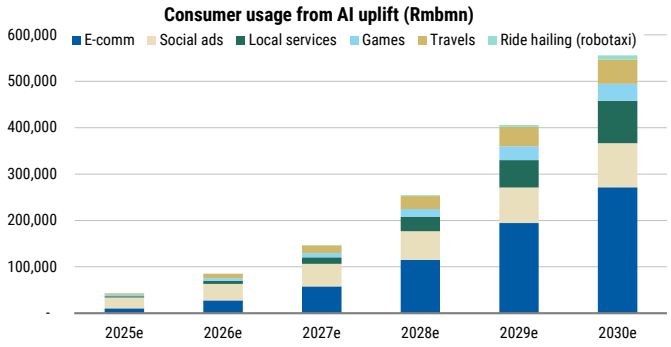
Consumption usage

We expect total consumer usage from AI uplift at Rmb556bn in 2030e, with the majority of the contribution from e-commerce at Rmb271bn, with ads coming in second at Rmb95bn and local services at Rmb91bn.

E-commerce

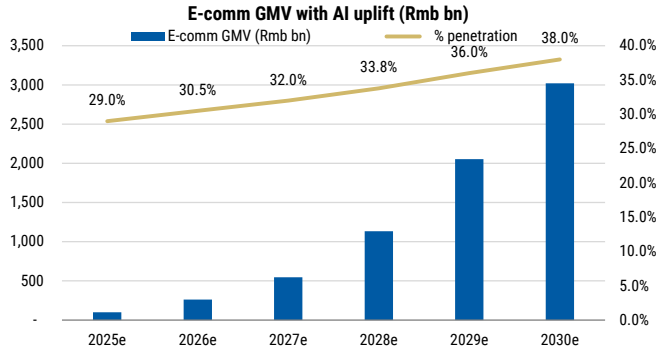
We expect GMV and revenue uplift from AI to reach Rmb3tn and Rmb271bn, respectively, in 2030. With better AI offerings and shopping experiences, we believe user engagement and time spent will improve, driving increasing e-commerce activities. We expect online penetration expansion to drive better GMV and an increase in take rate from better eCPM to drive revenue expansion. We expect AI uplift to drive 15% of GMV and 23% of revenue by 2030.

Exhibit 124: Consumer usage from AI uplift



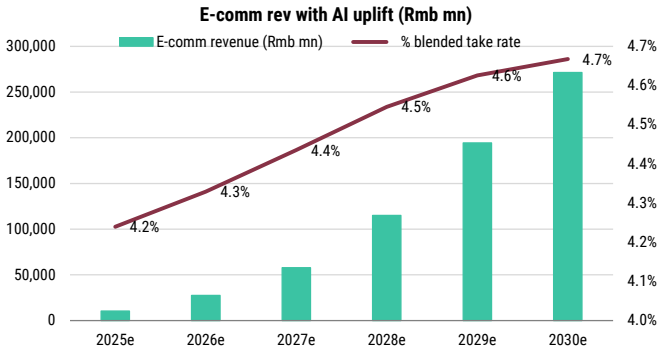
Source: Morgan Stanley Research (e) estimates

Exhibit 125: E-com GMV with AI uplift



Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 126: E-com revenue with AI uplift

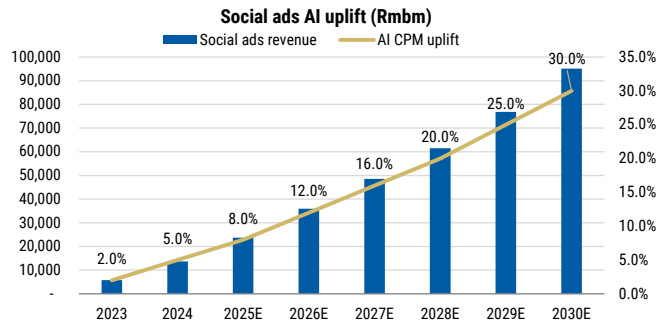


Source: Company data, Morgan Stanley Research (e) estimates

Social ads

We expect social ads revenue uplift from AI to reach Rmb95bn. With the AI ad-tech upgrade, we expect ads targeting, efficiency and conversion to improve. We expect higher time spent and CPM to be key drivers, translating to 26% of social ads revenue AI uplift by 2030.

Exhibit 127: Social ads revenue from AI uplift

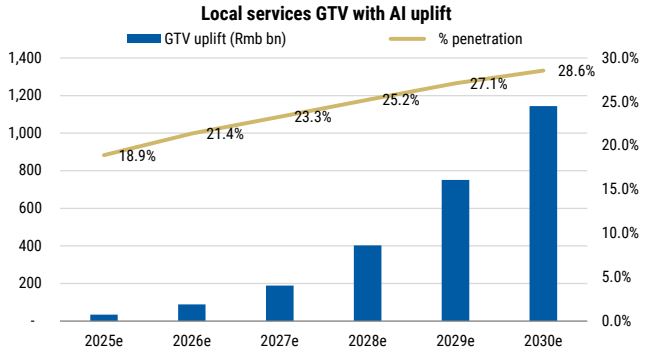


Source: Company data, Morgan Stanley Research (E) estimates

Local services

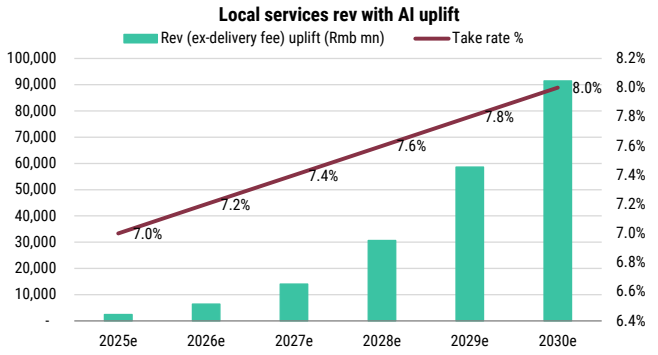
We expect local services GTV and revenue to reach Rmb1.1tn and Rmb91bn in 2030, respectively, which include food delivery and in store services (ex-hotels). We expect AI adoption to ramp-up transaction-based services with wider use cases and application scenarios, driving an increase in local services consumption. We expect online penetration expansion to be a key driver, driving a 5% of GTV by 2030e.

Exhibit 128: Local service GTV with AI uplift



Source: Company data, Morgan Stanley Research (e) estimates

Exhibit 129: Local service revenue with AI uplift

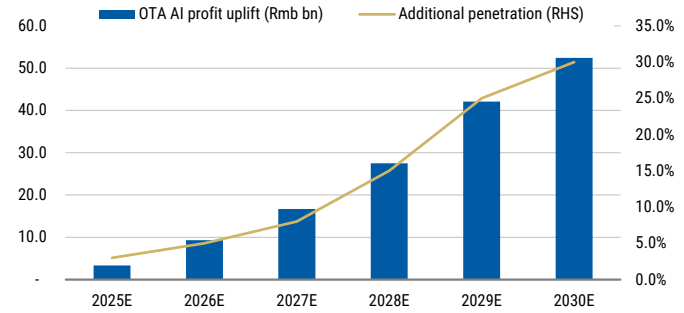


Source: Company data, Morgan Stanley Research (e) estimates

Travel

We expect OTA revenue and incremental profit uplift from AI to reach Rmb30bn and Rmb52bn by 2030e, respectively. This is mainly driven by higher OTA penetration in the accommodation market thanks to AI agents as well as lower S&M due to a higher cross-selling ratio driven by AI adoption.

Exhibit 130: OTA AI uplift forecasts

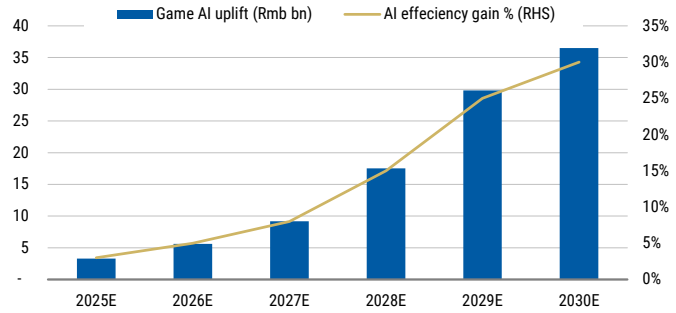


Source: Company data, Morgan Stanley Research (E) estimates.

Games

We expect games to generate Rmb36bn of cost savings by 2030e, representing 11% of the total game TAM as of 2024. We forecast the main cost savings to come from a core R&D engineers reduction, which we project to be 60% of total employees in gaming companies. We expect a 30% efficiency gain by 2030e.

Exhibit 131: Game AI uplift forecasts

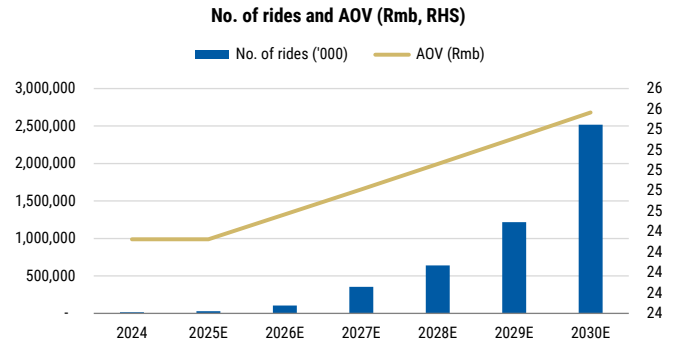


Source: Company data, Morgan Stanley Research (E) estimates.

Robotaxi

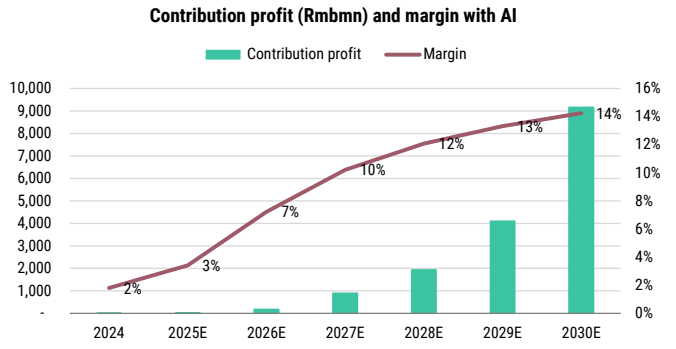
We expect AI to accelerate the development of robotaxi services, generating 2.5bn rides with a total GTV of Rmb64bn by 2030e. We expect cost savings from a reduction in the number of safety monitors per fleet with AI. We estimate contribution profits of Rmb9.2bn and a margin of 14% in 2030e.

Exhibit 132: No. of rides and AOV



Source: Company data, Morgan Stanley Research (E) estimates

Exhibit 133: Robotaxi contribution profit and margin



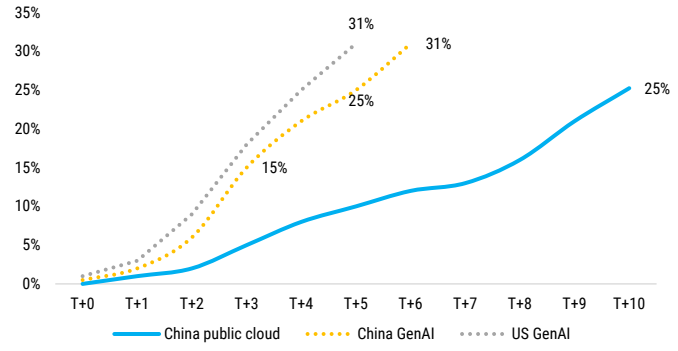
Source: Company data, Morgan Stanley Research (E) estimates

Enterprise usage revenue

As enterprises adopt GenAI to improve labor productivity and save on labor costs, we believe 2B AI application revenue generation will be evaluated by labor value creation. We have adopted the same methodology as our US team to calculate China's AI software spend, by multiplying the below assumptions:

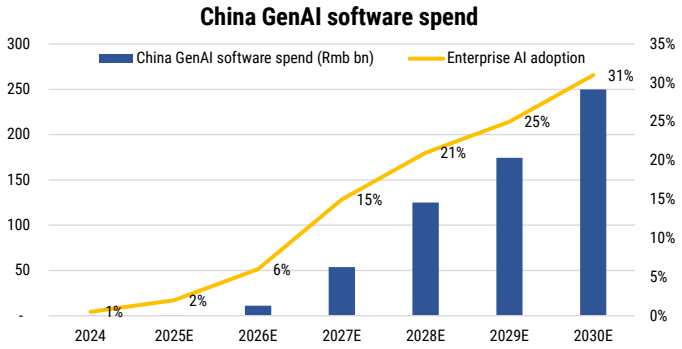
- **Potential AI China labor impact:** We used the urban employee count and their average annual wages to calculate the base economic value of labor that will be affected by AI. We ruled out rural labor because we see a low likelihood for them to be affected by AI.
- **Software take rate:** Software take rate stands for the percentage of the potential labor value impacted by AI to be taken by enterprise software. We assumed a lower software take rate for China versus the US, given the lower digitization penetration of China and lower willingness for Chinese enterprises to pay for software compared to the US.
- **Enterprise adoption:** Enterprise adoption is evaluated by workload penetration of AI on the enterprise side – how much labor value will enterprises eventually decide can be created by 2B AI software. We assume it will only take Chinese enterprises half of the time that public cloud took to reach similar workload penetration rates for GenAI. From mass adoption in 2025 (T+1), we estimate China to reach 15% GenAI workload penetration in 2027 (T+3), 25% in 2029 (T+5), and 31% in 2030 (T+6). Our US research team estimates the US GenAI workload penetration rate to reach 31% in 2029 (T+5). Our estimate also implies that China's adoption of GenAI will lag US for about 12 months before reaching a similar level.

Exhibit 134: Enterprise adoption rate assumption



Source: Morgan Stanley Research estimates; enterprise adoption rate is evaluated by workload penetration

Exhibit 135: China GenAI enterprise software spend



Source: Company data, Morgan Stanley Research (E) estimates

Exhibit 136: Calculation of China GenAI enterprise software spend

	2023	2024	2025E	2026E	2027E	2028E	2029E	2030E
China Software Spend Build		***T+0***	***T+1***	***T+2***	***T+3***	***T+4***	***T+5***	***T+6***
Urban employees in China (mn)		473	478	483	488	493	498	503
(x) % Employment Impacted		0%	5%	20%	30%	40%	45%	50%
(x) Weighted average annual urban wages (Rmb th)		90	92	95	98	101	104	107
(=) Potential AI China Labor Impact (Rmb tn)		-	2.2	9.2	14.3	19.9	23.2	26.9
(x) Software Take Rate		1%	2%	2%	3%	3%	3%	3%
(=) China Software GenAI TAM (Rmb bn)		**-**	**33**	**184**	**358**	**596**	**697**	**806**
(x) Enterprise Adoption		1%	2%	6%	15%	21%	25%	31%
(=) China GenAI Software Spend (Rmb bn)		**-**	**1**	**11**	**54**	**125**	**174**	**250**

US Software Spend Build	***T+0***	***T+1***	***T+2***	***T+3***	***T+4***	***T+5***
% Employment Impacted	25%			44%		
Potential AI US Labor Impact ($tn)	2.1	2.6	3.3	4.1	5.1	6.4
(x) Software Take Rate	5%	5%	5%	5%	5%	5%
(=) US Software GenAI TAM ($bn)	**105**	**131**	**164**	**205**	**256**	**320**
(x) Enterprise Adoption	1%	3%	9%	18%	25%	31%
(=) US GenAI Software Spend ($bn)	**1**	**4**	**15**	**37**	**64**	**100**
Software GenAI TAM: China as % of US		0%	3%	13%	20%	26%
Software GenAI Spend: China as % of US		0%	1%	4%	12%	17%

**Assume USD to CNY: 7.2*

Source: Company data, Morgan Stanley Research (E) estimates

Return on AI

We estimate total costs from depreciation, power and server rental costs to be Rmb389bn by 2030. We estimate the total return from AI uplift at Rmb417bn, delivering a 52% margin by 2030. We expect investments to breakeven by 2028e.

Exhibit 137: China AI contribution margin calculation

Rmbmn AI demand drivers		2023	2024	2025e	2026e	2027e	2028e	2029e	2030e
Consumer usage		**5,801**	**13,645**	**43,127**	**84,930**	**147,258**	**254,236**	**405,795**	**555,975**
E-comm				10,348	27,431	57,904	115,130	194,366	271,335
Social ads		5,801	13,639	23,667	35,961	48,563	61,472	76,840	95,090
Local services				2,417	6,424	14,018	30,638	58,604	91,488
Games				3,305	5,618	9,169	17,535	29,810	36,488
Travels				3,366	9,312	16,704	27,524	42,072	52,405
Ride hailing (robotaxi)			6	24	184	901	1,936	4,101	9,170
Enterprise usage	GenAI software spend	**-**	**-**	**662**	**11,011**	**53,693**	**125,120**	**174,325**	**249,860**
Total Return		**5,801**	**13,645**	**43,789**	**95,940**	**200,952**	**379,356**	**580,119**	**805,835**
YoY			135%	221%	119%	109%	89%	53%	39%
Top 6 internet capex			**230,014**	**373,334**	**382,148**	**383,768**	**383,768**	**383,768**	**383,768**
GPU capex			**115,007**	**224,000**	**248,396**	**268,638**	**276,313**	**287,826**	**287,826**
2024	server depreciation		11,501	23,001	23,001	23,001	23,001	11,501	-
2025			-	22,400	44,800	44,800	44,800	44,800	22,400
2026			-	-	24,840	49,679	49,679	49,679	49,679
2027			-	-	-	26,864	53,728	53,728	53,728
2028			-	-	-	-	27,631	55,263	55,263
2029			-	-	-	-	-	28,783	57,565
2030			-	-	-	-	-	-	28,783
Depreciation			**11,501**	**45,401**	**92,641**	**144,345**	**198,840**	**243,753**	**267,417**
Power cost			**5,006**	**14,755**	**26,546**	**38,617**	**52,682**	**61,697**	**64,863**
Server rental cost			**3,997**	**11,823**	**21,603**	**32,181**	**44,615**	**53,557**	**56,305**
Operating Costs (incl. Depreciation)			**20,504**	**71,979**	**140,791**	**215,143**	**296,136**	**359,006**	**388,585**
Return			**(6,858)**	**(28,190)**	**(44,851)**	**(14,191)**	**83,220**	**221,113**	**417,250**
Margin			-50%	-64%	-47%	-7%	22%	38%	52%

Source: Morgan Stanley Research (e) estimates.

China's AI Hardware and Computing Ecosystem

China's AI computing has advanced despite US chip restrictions: With advanced GPUs largely out of reach for Chinese technology platforms and start-ups, hardware availability will become an increasing challenge for Chinese firms. We believe that Chinese LLM developers currently have access to enough advanced computing power, based on their accumulated inventory buffer of H20 and legacy A100, H100, A800, and H800 GPUs, along with a mix of domestic GPUs from producers such as Huawei, Biren Technology, and Moore Threads, to be able to train most models.

Over the long term, the lack of steady GPU volumes is driving Chinese semiconductor firms to innovate at a faster pace to close the performance gap with their US counterparts, as well as finding more ways to drive AI performance with less hardware.

AI in a box? Huawei's Atlas 900 Supercluster, consisting of thousands of Ascend 910s, can train foundation models with over 1 trillion parameters and is intended to be a direct competitor to similar systems offered by NVIDIA. Huawei's AI-in-a-box offering also allows AI start-ups to own AI systems (mainly private cloud and data security installations) that include the AI start-ups' LLMs, which are used by enterprises. These systems can support both training and inference.

China's ability to ramp up production of leading-edge chips and incorporate advanced HBM and packaging remains unclear. Domestic foundry leader SMIC is capable of manufacturing advanced AI chips using a 7nm process for the production of Huawei's Ascend GPUs, but its scaling is limited by US export controls on critical WFE (wafer fabrication equipment) tools such as EUV (extreme ultraviolet lithography). The company is working more closely with domestic tool makers and leveraging Huawei's extensive experience with design and manufacturing.

China is well positioned to benefit from multi-modal models for video and images as text-based LLMs are reaching a peak in terms of their ability to leverage more training data. Multi-modal models may not need to be as big as or use as much computing power as LLMs, benefiting companies such as ByteDance, Kuaishou, and Tencent, which have access to rich volumes of video and image content, providing advantages in training multi-modal models.

- Tencent launched a new AI assistant in May 2024 based on Hunyuan – Yuanbao – that can summarize documents, and generate text and images.
- Kuaishou officials claimed that their KwaiYii LLM had surpassed GPT-3.5 in overall performance and was approaching GPT-4 in some areas. The firm said its KeTu text-to-image model had exceeded some benchmarks achieved by MidJourney 5, an image generation service released by MidJourney a year ago.

China's AI development stack

The development stack, and the ability to access advanced GPUs, goes beyond hardware: AI development toolkits globally are open-source development environments, such as NVIDIA's CUDA libraries running on NVIDIA GPUs, or ASIC chips running on PyTorch and TensorFlow. Huawei and Baidu have alternatives such as MindSpore and PaddlePaddle. Huawei is well positioned to develop as an alternative to NVIDIA for China with its leading AI-focused Ascend chips that may be on par at this stage with the NVIDIA A100 GPU's performance. This could create a hardware-software stack development platform for programmers. Currently, we believe that PyTorch and TensorFlow are the most widely used frameworks in China, followed by MindSpore.

Key challenges

US sanctions are still one of the largest risks to China's AI development: The Trump Administration is eying stricter chip export curbs on China, including:

1. Potentially restricting Tokyo Electron and ASML engineers from offering maintenance services for semiconductor equipment in China;
2. Stricter export restrictions on AI chips to China, extending the ban to include NVIDIA's H20 chip;
3. Banning CXMT from acquiring American technology.

Tightening advanced chip export controls remains a near-term headwind for China's AI development…: China's DeepSeek training relies on NVIDIA's chips, which are superior in performance to local GPUs. However, over the long term, we think China's foundry yield could improve and local equipment performance could catch up, while restrictions could stimulate more localization demand, limiting the impact. We estimate China's GPU localization rate was around 34% in 2024 given the technology barriers – but we are seeing new supplies emerging from domestic vendors, such as Huawei, Cambricon, Biren, and so on, helping China to catch up on self-sufficiency progress.

…while opportunities emerging. Huawei has introduced a new AI computing rack system, CloudMatrix 384 Supernode, that it believes can rival the world's best AI infrastructure technology. This could allow China to address its computing power bottleneck, train its own models without relying on the West, and power its next wave of AI innovation. Competition could allow China to capitalize on the adoption of homegrown chips and sufficient power capacity support, and provide developers with more options for training and deploying their models. This new development exemplifies a broader shift toward self sufficiency and competitive diversity in the global AI chip market. For enterprise AI deployments, these developments suggest more choice and a potential recalibration of vendor relationships in the AI race.

We estimate China's AI GPU self-sufficiency ratio at 34% in 2024 and expect it to reach 82% in 2027. We estimate the global cloud AI TAM to grow at 28% CAGR (2024-27e) to US$239bn in 2027, and China to account for 20% of the total, at around US$48bn in 2027, given strong demand of inference compute after the DeepSeek launch. Huawei is the key local GPU supplier, followed by Cambricon. Their chips are fabricated mostly by local foundry leader SMIC, via a leading-edge process (7nm, or N+2 node). We believe there are still some bottleneck issues for capacity expansion. Whether SMIC can further expand 7nm and 5nm capacity in 2027 and onward, after it runs out of the previous DUV tool inventory, remains to be seen. We estimate SMIC could allocate 26k wpm capacity for its largest GPU customer; assuming 30-50% yield, we expect China local GPU self-sufficiency to be 82% in 2027.

See more details:

- *Tech Bytes – Can China Do Without US Chips?*
- *Tracking China's Semi Localization: Gauging domestic AI GPU self-sufficiency*

Exhibit 138: China's semiconductor self-sufficiency rate in the semiconductor value chain

	Upstream		Memory		Logic Semi						Power Semi	
	Equipment	EDA	DRAM	NAND	CPU	GPU	Display Driver	RF	Image Sensor	MCU	Analog	Power discrete
2018	4%	6%	0%	0%	0%	0%	0%	0%	5%	4%	0%	3%
2019	5%	8%	0%	1%	0%	0%	26%	15%	6%	11%	6%	13%
2020	6%	11%	2%	4%	1%	0%	31%	23%	11%	10%	8%	15%
2021	8%	14%	4%	12%	4%	11%	34%	27%	56%	20%	18%	26%
2022	12%	15%	5%	22%	6%	20%	37%	23%	65%	19%	18%	26%
2023	11%	15%	8%	19%	7%	24%	84%	33%	55%	17%	23%	24%
2024	13%	16%	18%	27%	10%	34%	79%	31%	76%	17%	24%	32%
2025e	21%	18%	23%	43%	12%	58%	83%	34%	83%	21%	24%	36%
2026e	28%	20%	25%	47%	15%	71%	84%	36%	91%	21%	27%	39%
2027e	35%	22%	26%	48%	18%	82%	80%	37%	91%	21%	29%	41%

Source: Gartner, WSTS, Morgan Stanley Research (e) estimates.

Exhibit 139: DeepSeek R1 DRAM requirements

DeepSeek R1 DRAM requirements:		
Inference	CPU-based	GPU-based
Minimum	16GB Graphics DRAM (for lightweight models/small-scale tasks)	12GB Graphics DRAM (NVIDIA RTX 3060 or equivalent)
Recommended	32GB Graphics DRAM (for handling moderate workloads)	24GB Graphics DRAM (VIDIA RTX 4090 or A100 for larger models)
Training	Single-GPU	Multi-GPU
Minimum	32GB DRAM (for smaller datasets and batch sizes)	64GB DRAM (for multi-GPU setups with distributed training)
Recommended	64GB DRAM (for medium-sized datasets)	128GB+ DRAM (for large-scale training and dataset processing)
GPU HBM	24GB+ (A100, RTX 4090 or H100)	40GB+ (such as NVIDIA A100 40GB or H100 80GB)
Cloud-based deployment	AWS EC2 Instances	Google Cloud (GCP)
Minimum	g5.2xlarge (8vCPUs, 32GB RAM, NVIDIA A10G)	A2-standard-16 (16 vCPUs, 64GB RAM, 1x A100)
Recommended	p4d.24xlarge (96vCPUs, 1.1TB RAM, 8x A100 GPUs)	A2-ultragpu-8g (96 vCPUs, 1.3TB RAM, 8x A100 GPUs)

Source: Company data, Morgan Stanley Research estimates

Exhibit 140: China – domestic GPUs – industry landscape

Company	Ticker	Background Information	GPU Product	Node	TOPS	Applications
Cambricon 寒武纪	688256-SS	Founded in 2016, the company is a spinoff from Chinese Academy of Sciences. The company designs AI traning and inference accelerators.	MLU 370, MLU 290, MLU 270	7nm	MLU370 at 256TOPS (INT8)	AI server (training & inference)
			MLU220	16nm	128TOPS (INT8)	Graphics
HYGON	688041-SS	Founded in 2014, Hygon is a fabless company designs and sells CPU and GPGPU. Hygon formed two JV with AMD and have access to its IPs since 2016. AMD can no longer license additional IPs after June, 2019 due to US Sanctions.	DCU	7nm FinFET	DCU #3 at 392 TFLOPS (INT8)	AI server (training)
景嘉微 JINGJIA MICRO	300474-SZ	Founded in 2006, Jiangjia Micro designs and sells products such as GPUs for graphics rendering, SiP, and small radars.	JM5, JM7, JM9, JM11	NA	NA	Graphics
壁仞科技 BIREN TECHNOLOGY	Currently under A-share listing conseling process	Founded in 2019, Biren Technology is a fabless company designs and sells GPUs for AI training and cloud platforms.	BR100	7nm	1024TOPS (INT8)	AI server (training)
摩尔线程 MOORE THREADS	Currently under A-share listing conseling process	Founded in 2020, Moore Threds designs and sells GPUs for both desktop PCs and workstations as well as for general and AI servers.	MUSA MTT S70, S80	S80 at 7nm	14.4 TFLOPS	Graphics
			MUSA MTT S3000, S4000	NA	S4000 at 25TFLOPS (FP32)	AI server (training & inference)
Enflame 燧原科技	Currently under A-share listing conseling process	Founded in 2018, Enflame is a fabless company that designs and sells cloud AI training and inference GPUs.	S60, i20,T20,T21	NA	T21/i20 at 256TOPS	AI server (training & inference)
METAX 沐曦	Currently under A-share listing conseling process	Founded in 2020, MetaX is committed to providing full-stack GPU chips and solutions for heterogeneous computing.	MXN100	7nm	MXN100 at 160TOPS (INT8)	AI server (inference)
			MXC series; MXG series	7nm	MXC500 at 15TFLOPS(FP32)	MXC series for general server; MXG series for graphics
GLENFLY	Currently under A-share listing conseling process	Founded in 2020, Glenfly provides software and hardware solutions on graphics and AMOLED driver solutions.	Arise-GT10C0	28nm	1.5TFLOPS (FP32)	Graphics
HUAWEI	Private	Huawei Ascend is Huawei's businesss segment that focuses on R&D on AI ceelerators, Atlas software infrastructure and AI solutions	910C, 910B	7nm N+2	910B at 640 TOPS (INT8)	AI server (training)
T-HEAD	Private	Founded in 2018 by Alibaba Group, T-head possesses the edge-to-cloud integrated full stack product series such as Data Center Chip, IoT Chip, etc., covering end-to-end chip design process.	Hangguang 800	12nm	825TOPS (INT8)	AI server (inference)
昆仑芯 KUNLUNXIN	Private	Founded in 2021 by Baidu, Kunlunxin processes FPGA AI accelerators, XPU,	Kunlun sereis	Kunlun 2 at 7nm	Kunlun 3 peak performance at 256TFLOPS	AI server (training & inference)
天数智芯 Iluvatar CoreX	Private	Founded in 2015, Iluvatar CoreX develops GPGPUs for use in the filed of AI.	TianGai-100 series, Zhikai-100 Series	7nm	Zhikai-100 at 384TFLOPS (INT8)	AI server (training & inference)
登临科技	Private	Founded in 2017, DenglinAI focuses on design and sells of edge-to-cloud integrated solutions with a focus on GPGPU products.	Goldwasser UL, L, and XL	NA	Goldwasser XL at 512TOPS (INT8)	AI server (training & inference)
砺算科技 LISUAN TECH	Private (37.88% Share owned by DoSilicon)	Founded in 2021, Lisuan Tech, is a Chinese domestic company focusing on high-performance GPU solutions with a focus on graphics rendering.	G100	6nm	NA	Graphics

Source: Company data, Morgan Stanley Research

RISC-V open source chip design alternatives: According to Reuters (link), China plans to issue guidance to encourage the use of open-source RISC-V chips nationwide for the first time, as Beijing accelerates efforts to curb the country's dependence on Western-owned technology. ARM and RISC-V are both under the RISC design architecture. ARM is maintained and licensed by the company itself. RISC-V, on the other hand, is a free and open source architecture, mainly governed and maintained by RISC-V International, which does not do commercial business, such as chip design, but only oversees and maintains the ISA.

Alibaba is currently the largest for-profit IP holder of RISC-V. Alibaba Cloud revealed a new RISC-V chip development platform, Wujian 600, in 2022; it is an entire computing system that incorporates the CPU, GPU, memory, NPU, and audio: Wujian 600 is open for licensing; it can help the progress of RISC-V chip development and minimize the risks and costs. Wujian 600 is built by T-Head, Alibaba's RISC-V focused subsidiary. The team has finished the design of the custom high performance SoC, the TH1520 processor, on the Wujian 600 platform. The platform has been certified by RISC-V International, and it also supports Linux and XuanTie processors on Android.

Exhibit 141: RISC-V is more flexible and less expensive than ARM and x86 ISAs

	Proprietary ISA		Open-source ISA
	x86	**ARM**	**RISC-V**
Design principle	CISC	RISC	RISC
Major adopters	Intel, AMD	Qualcomm, MediaTek, Apple	Western Digital, Renesas, NVIDIA
Design ecosystem	Limited and complicated	Limited and complicated	Growing rapidly; Numerous extensions; Open-sourced/proprietary cores
Software ecosystem	Well-established	Mature but extensive	Nascent
Major end markets	PC, Server	Smartphone	IoT, MCU
Power consumption	High	Low	Low
Advantages	Mature/stable ecosystem; High computational performance	Comprehensive software/hardware ecosystem	Simple, modular, clean slate designs; Flexible for extendibility/specialization
Concerns	Lack of flexibility; Low energy efficiency	Hard to customize; Expensive to license	Fragmented eco-systems; Lack of security and graphics elements

Source: RISC-V International, Morgan Stanley Research

EDA represents a key input to designing semiconductors: China's weakness in Electronic Design Automation (EDA) has historically hampered its semiconductor design firms. Will Semi is the only Chinese fabless design company that ranked in the top 10 in terms of revenue in 2024; the rest of the market is predominantly US companies. Nevertheless, the industry has rapidly increased in size with the widespread availability of capital, government support, a desire to localize the industry, demand growth, the acquisition of foreign firms, and downstream users designing their own semiconductors. The number of semiconductor design firms in China has doubled to 3,626 in the past five years.

Lithography represents a crucial step in the chip-making process: A chip wafer gets inserted into a lithography machine and exposed to deep ultraviolet or extreme ultraviolet light, and a pattern is printed onto a chip's resist layer through a photomask. As such, catching up in lithography has long been a central focus of China's chip aspirations, with efforts going back to China's "Project 02", launched in 2008. Shanghai Micro Electronics Equipment Group (SMEE), China's leading lithography developer, claimed in December 2023 to have successfully developed a 28nm lithography machine, the SSA/800-10W. However, analysts question SMEE's ability to produce 28nm lithography equipment at scale. Overall, the domestic market share of Chinese producers of wafer-fabrication tools rose from 4% in 2019 to 14% in 2023.

Bottom line: China is by far the largest market for semiconductors, accounting for over a third of global demand, but it accounts for only a tiny fraction of supply. Chinese semiconductor companies have relatively limited market shares, in lower-value stages of the production process – namely, outsourced assembly and testing. Some companies also compete in chip manufacturing (foundry) but with even lower market shares. The higher end of the value chain, the equipment makers, is dominated by US and Japanese players, and no Chinese firm can be found among the top players.

High barriers to entry, as well as increasingly tight scrutiny from other countries regarding potential foreign acquisitions, means that achieving significant breakthroughs will take time and effort. However, helped by often highly supportive policy measures, Chinese companies have made considerable efforts to move up the value chain towards semiconductor manufacturing and the development of an indigenous semiconductor ecosystem, with the aim of creating globally competitive semiconductor firms.

China – AI: Sector Preference – Energy, Autonomous Driving, Humanoids

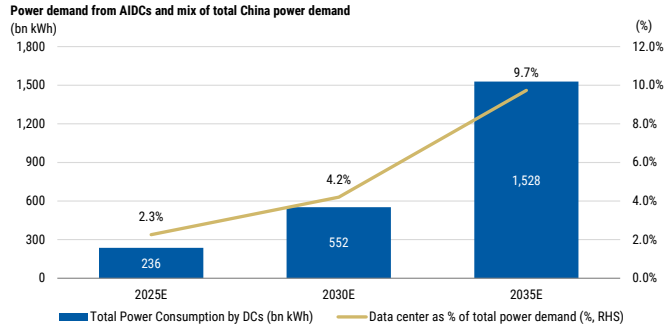
Eva Hou

Utilities & Renewable Energy

AI data centers have emerged as one of the key power demand growth drivers in China: According to China Electricity Council (CEC), power demand from the information transmission, software, and IT services sectors reached ~165bn kWh in 2024, up 11.9% yoy, accounting for ~2% of total power demand in China. Within this group, driven by rapid growth in mobile Internet, big data, and cloud computing, power demand from Internet-related services (particularly tied to data centers) were up 21.9% yoy, with Internet data services alone surging 30.9% yoy in 2024. All these growth rates significantly exceeded the national power demand growth of 6.8% yoy in the same period.

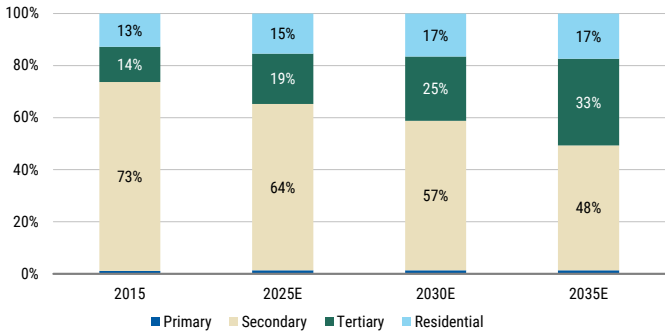
Data centers to contribute ~10% of China's power demand by 2035: We expect GenAI and data center demand will move the needle for China's power market over the next 5-10 years. Accordingly, we expect electricity consumption from tertiary industries (mainly service sectors) to rise from 19% in 2024 to 33% in 2035, with AIDC power demand up from 2% in 2024 to 10% in 2035 in our base case. In contrast, we project power consumption from secondary/industrial industries to decline from 68% to 48% from 2024 to 2035. We expect power consumption growth to reaccelerate from 2031-35 with a 22% CAGR (vs. 19% from 2025-30), as chips' efficiency reaches potential physical limits while computing power keeps growing notably.

Exhibit 142: Data center power demand as a share of China's power demand – base case



Source: Morgan Stanley Research (E) estimates

Exhibit 143: Power demand from tertiary industries to surge in the long term



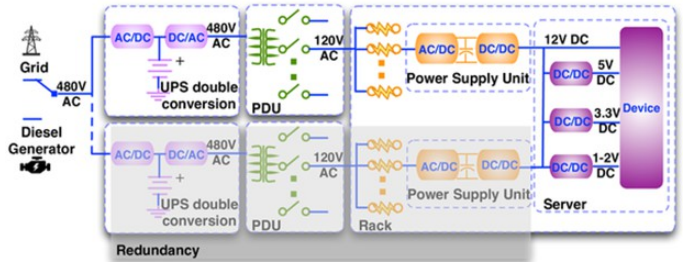
Source: National Energy Administration, Morgan Stanley Research (E) estimates

Green power to fuel AIDCs' power demand to reduce carbon emissions: The government has newly classified AIDCs as an energy-intensive industry, alongside power generation, iron and steel, building materials, non-ferrous metals, chemicals, petrochemicals, pulp and paper, and civil aviation. The energy-intensive industries are key targets for emission reduction efforts. As a result, China is actively promoting emission reductions and more adoption of green power across the computing sector. China is requiring data centers to be supplied 30% by green power by 2025, 50% by 2027, 75% by 2030, and 100% by 2032. The newly built national hub data centers should be supplied with over 80% green power in 2025.

New power system to smooth out the intermittent renewable power supply: The general concern over green power is its intermittency; the intermittent power generation loads of solar and wind power are struggling to cater to the 24/7 stability requirements of data centers.

We expect Energy Storage and Delivery (ESD) and micro grids to collectively mitigate the stability issue. ESD, containing Uninterruptable Power Supply (UPS) systems, serves as the physical storage solution to absorb excess energy when green power generation is high and release stored power when generation is low

Exhibit 144: Power delivery architecture of a traditional data center with the centralized ESD structure – subject to higher energy losses

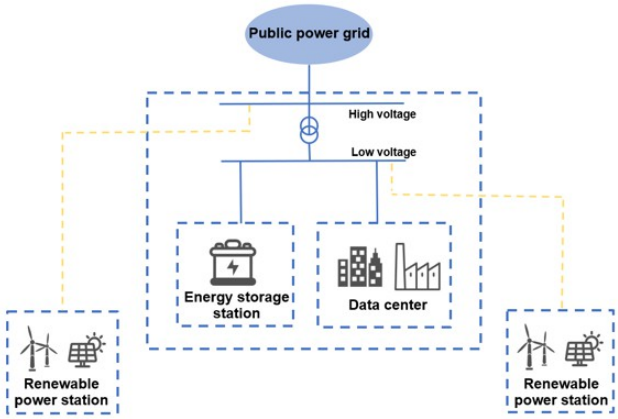


Source: "Hierarchical and hybrid energy storage devices in data centers: Architecture, control and provisioning" by Mengshu Sun, Yuankun Xue, Paul Bogdan, Jian Tang, Yanzhi Wang, and Xue Lin

Micro grid systems can help mitigate the intermittency of renewable power by coordinating local generation, energy storage, and smart load control. Through real-time control and energy balancing, micro grids can collectively help ensuring stable power delivery of renewables with energy storage systems.

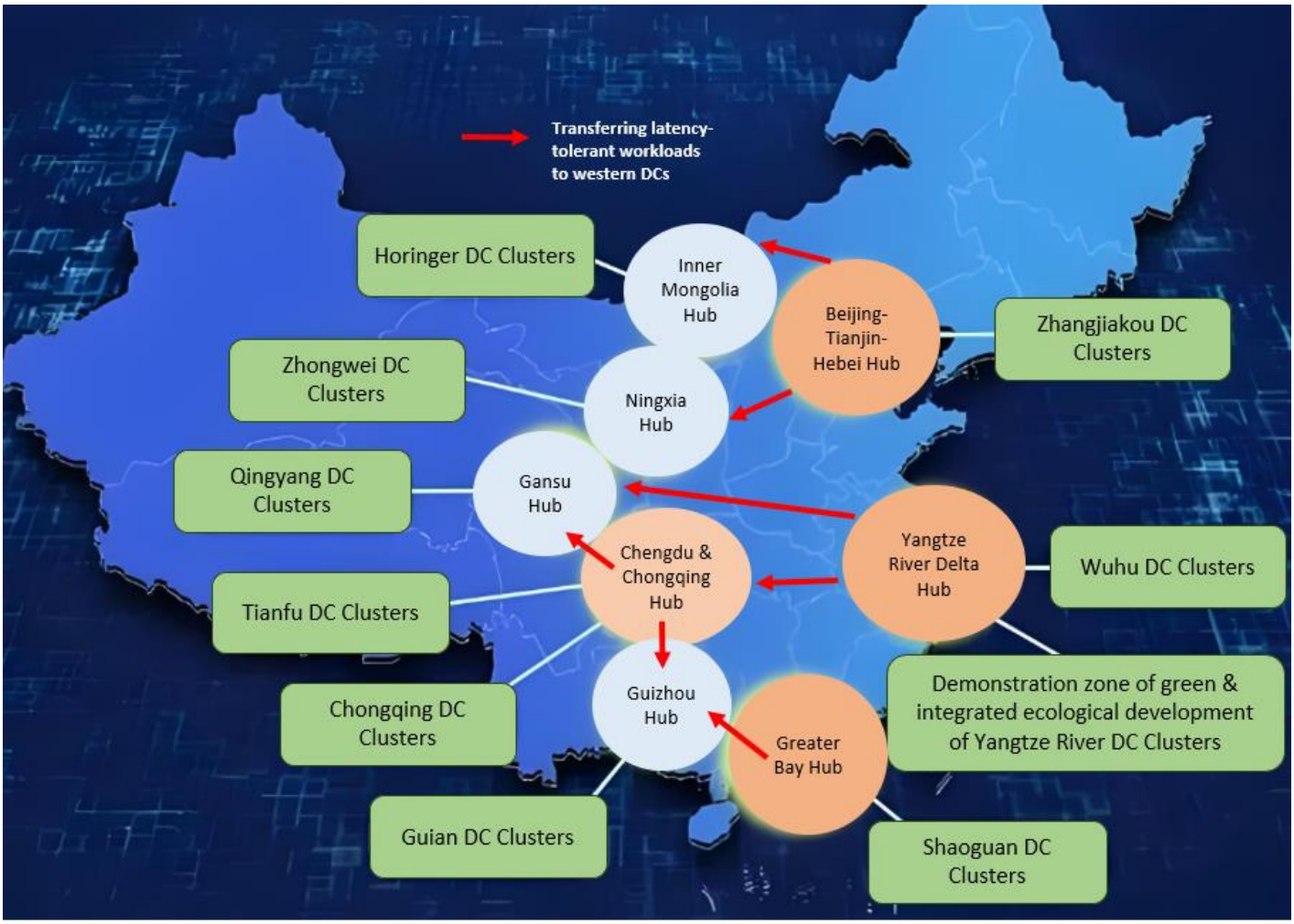
"East Data, West Computing" (EDWC) is the macro strategy to address regional green power imbalances: EDWC policy emerged from growing concern over eastern China's energy shortages and oversupply of renewable energy from western China. The relevant policies were progressively rolled out through 2021-22 by the NDRC and MIIT, aiming to shift non-real-time, energy-intensive computing workloads to western China in order to address the uneven renewable energy resources. The government has designated 10 national computing clusters and eight major data hubs across regions to complement this initiative, which will enhance grid flexibility and cross-regional dispatch, enabling the delivery of renewable energy from western regions to eastern data centers. It will also support the power balance by allocating real-time, latency-sensitive workloads to the eastern hubs.

Exhibit 145: Micro grid system model



Source: China Electricity Council, Morgan Stanley Research

Exhibit 146: EDWC with geographical distribution of data center clusters in China

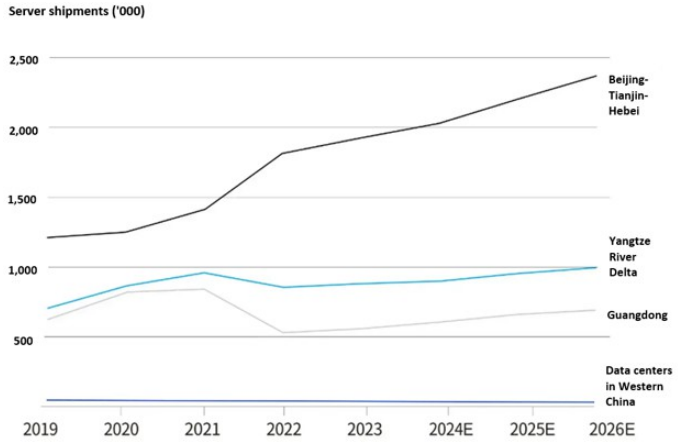


Source: National Development and Reform Commission, Morgan Stanley Research

More data centers to disperse towards the West: We expect more data centers to be built in western China to leverage abundant green power and favorable climate conditions, which should help to optimize power usage effectiveness (PUE). To illustrate, current policies require stricter PUE targets to reduce energy waste. Yet PUE for data centers in the western region is usually lower because of cooler weather conditions. Therefore, DCs in western China do not necessarily need to ramp up their capex to attain lower PUEs (e.g., eastern DCs may still need to spend more on liquid cooling to have lower PUEs). In addition, we have started to see major telecom operators (including China Mobile) relocate non-real-time/latency-tolerant workloads, such as model training tasks, to western regions and keep the latency-sensitive tasks near the majority of customers in eastern China.

We have already seen a regional shift with the PUE improvement of newly built data centers in 2H24, yet we believe further PUE improvement will mainly stem from improvements in and the adoption of liquid cooling, IEC (Indirect Evaporative Cooling), and AI temperature control. Moreover, western regions have a clear low power tariff advantage (Exhibit 148) compared to eastern regions. Thus, we expect more hyperscalers to transfer computing demand to the west because it can effectively lower computing costs.

Exhibit 147: Divergence of DC server shipments between eastern and western China



Source: Ministry of Industry and Information Technology, Morgan Stanley Research

Exhibit 148: Western regions have significantly lower power tariffs than eastern regions

Coal benchmark on-grid tariff			
Western Region		**Eastern Region**	
Ningxia	0.26	Beijing	0.36
West IM	0.28	Jiangsu	0.39
East IM	0.30	Zhejiang	0.42
Gansu	0.31	Shanghai	0.42
Shanxi	0.33	Guangdong	0.45
Guizhou	0.35		
Chongqing	0.40		
Sichuan	0.40		

Source: Municipal governments, Morgan Stanley Research. Note: IM represents Inner Mongolia

Tim Hsiao

Greater China Autos

AI is reshaping China's auto industry: Despite ongoing macro and geopolitical uncertainties, we believe AI and autonomous driving will continue to take center stage in China's auto industry, as reflected in:

1. Faster tech iteration empowered by end-to-end models;
2. Superior in-car human-machine interfaces (HMI) powered by DeepSeek;
3. Potential liberation from computing constraints.

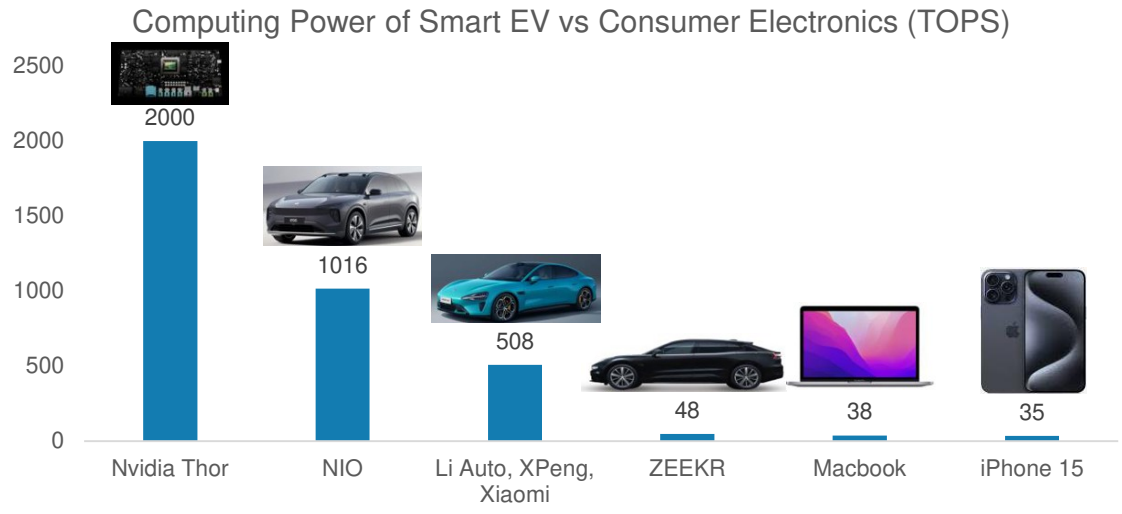
Consequent tech iteration and competition to expedite L2+ adoption: We now look for L2+ AD penetration to reach 25% in 2025, up from 15% in 2024, implying 5.5-6mn units of cars adopting advanced smart driving features this year. Overall ADAS+AD (advanced driver-assistance systems + automated driving) take-up rate in China will reach 80% (vs. 60% in 2024), in our view. We see AI democratization, Tesla's rollout of FSD in China, and BYD's recent smart driving event as meaningful triggers of industry-wide smart driving growth, with all major OEMs advancing the launches of their L2+ capable models by 1-2 quarters.

Value content upgrade opportunities: We see OEMs upgrading their sensor suites to stay pre-emptive in the AD race. We expect the Rmb100-200k segment (50% of PV volume) to be the key area, in which flagship models could quadruple computing power to support L2+ multi-scenario NOA (navigate on autopilot); running on five radar and 8-12 cameras is becoming mainstream, with LiDAR (light detection and ranging) as a preferable option.

DeepSeek set to accelerate smart cockpit adoption: The rise of DeepSeek should enable car makers to introduce AI functions at a much lower cost. We have already seen OEMs such as BYD, Great Wall, Geely, Chang'an, Chery, SAIC, GAC, and Dongfeng, announce that they will plug DeepSeek into their upcoming new models. Facilitated by an AI LLM, the machine can better understand what the driver/passenger says and further enhance the user experience.

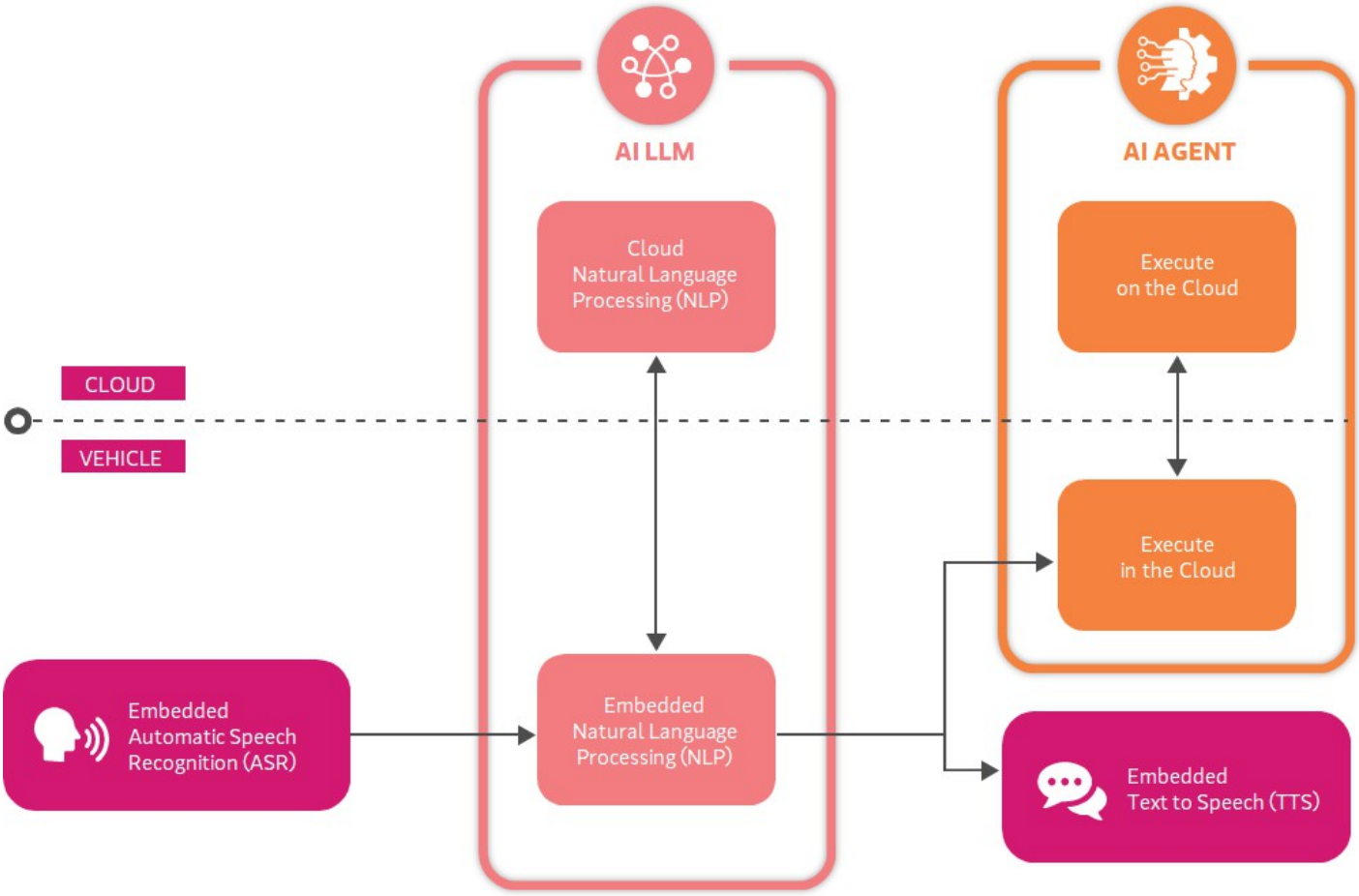
AI agent the next step for smart cockpits: In future, if a cockpit is fully integrated, then an AI agent will likely be able to help a driver/passenger execute some non-driving-related tasks, e.g., find a restaurant within 30-minute driving range and book a table, find the nearest movie theater and book a ticket, etc.

Exhibit 149: Smart EVs becoming the edge device that carry highest computing power



Source: Morgan Stanley Research

Exhibit 150: AI can enhance auto cockpits via natural language processing and agent execution

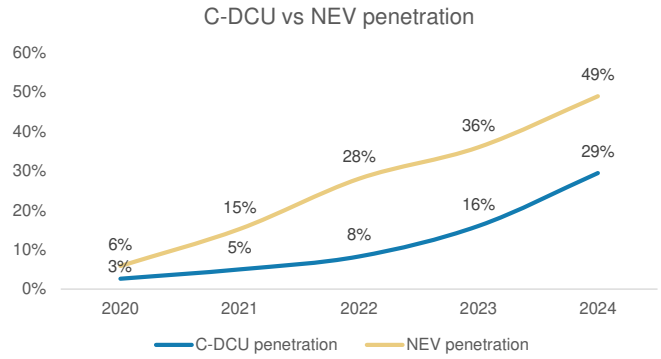


Source: Morgan Stanley Research

More powerful domain controller: Although OEMs may switch AI vendors from time to time, we think centralized cockpit domain control units (C-DCU) will be a key beneficiary of an AI-enabled cockpit, alongside smart cockpit chips, such as Qualcomm's 8155 / 8255 / 8295. Based on Gasgoo data, C-DCU penetration has increased from 3% in 2020 to nearly 30% in 2024, as OEMs leverage smart cockpit features (infotainment systems, heads-up displays, voice control, among others) to better differentiate against their peers.

Large upside potential for C-DCU penetration: Compared to NEV penetration in China, which hit 49% in 2024 and is likely to surpass 55% in 2025 per our estimate, C-DCU penetration was still much lower at 29% in 2024. As vehicles become 'smarter', we see ample upside potential for further increases in C-DCU penetration in the coming years.

Exhibit 151: Smart cockpit penetration has surged from 3% in 2020 to 29% in 2024



Source: Gasgoo, CAAM, Morgan Stanley Research

Sheng Zhong

China Industrials

Why humanoids? Many investors still ask the question "why do we need robots shaped like humans?" There are indeed strong arguments for robotics to take many highly specialized forms (robot arms, snake-shaped robots, robot dogs, robotic dust – as many form factors as you can imagine). However, many robot and AI experts say the strongest argument for robots in a human form factor is that in a world already created for humans, the environment is already "brownfielded" for humanoids.

NVIDIA CEO Jensen Huang explained, "The easiest robot to adapt into the world are humanoid robots because we built the world for us. We also have the most amount of data to train these robots than other types of robots because we have the same physique."

China estimated to own 30% of the world humanoid stock

Morgan Stanley estimates that the global humanoid TAM will reach US$5 trillion in annual revenue and 1 billion in humanoid stock by 2050e. For China, we expect China humanoid stock to reach 252k/61mn/302mn units by 2030e/40e/50e, representing ~30% of the world humanoid stock by 2050. Breaking down by adoption, we think commercial humanoid annual sales volumes will reach 114k/22mn/51mn units by 2030e/40e/50e, while household humanoids will take time to ramp up, with sales volume to reach 4mn in 2050e.

- *For a copy of the Morgan Stanley Global/US/China Humanoid Model, please contact your Morgan Stanley sales representative.*

We expect 2025 will be a milestone year in humanoid robot history, marking the beginning of mass production of humanoid robots. We see significant potential for humanoid robot growth in China, with strong government support, and solid supply chain and technology foundations:

- **Increasing number of government initiatives to support industry development:** Since China's Ministry of Industry and Information Technology (MIIT) issued its "Guiding Opinion on the Innovative Development of Humanoid Robots" in Nov. 2023, a number of policies and initiatives have been established at the national, provincial and municipal levels, which help share institutional expertise (akin to open-source programs), promote downstream applications and collaboration, and boost confidence on overall development.
- **Sufficient capital attracts more players, helping to accelerate the industry cycle:** China recorded Rmb7bn+ in financing activities related to humanoid robots in 2024 (vs. Rmb5.4bn globally in 2023), according to GGII, and the number of funding activities in China has continued to increase since the start of 2025. Increasing numbers of players and amounts of capital are fostering more trial-and-error opportunities, expediting advancements in the industry/technology.
- **Chinese companies have the technology foundation/know-how to develop humanoid robots:** The humanoid industry shares similarities with the new energy vehicles segment, in terms of both hardware and software. As a result, China, as the world largest EV manufacturer, already has a technology foundation that should also help promote leadership in the humanoid robot industry. In fact, several auto parts manufacturers plan to develop humanoid-related capacity, which should further help support the humanoid robot industry's long-term development.
- **Supply chain foundation:** China has almost achieved supply chain independence in various humanoid components (most of China's humanoid models have already reached a 90%+ localization rate), which fosters closer up/downstream collaboration, faster product cycles, and lower manufacturing costs – and which brings significant opportunities to upstream manufacturers.

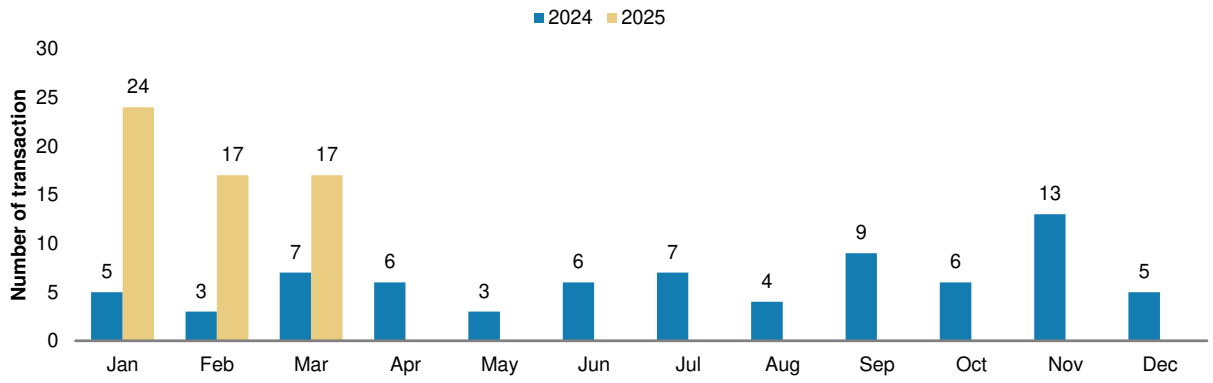
Exhibit 152: China national/provincial/municipal governments have launched a series of policies to support humanoid/embodied AI development.

Announced Date	Policy/Government Plan	Region	Goals
Dec-21	14th Five-Year-Plan Robotics Industry Development Plan	Nationwide	To boost industry innovation, breakthrough industry's bottleneck, focus on high-end and extend applications
Jan-23	17 govt. departments issued Robot+ application action plan	Nationwide	Robot+ application action plan, aiming to achieve 100 breakthroughs in robotics technologies and 200 innovative applications by 2025
Feb-23	MIIT's Guiding Opinion on Humanoid Innovative Development	Nationwide	Humanoid to become a key engine for economic growth
Apr-24	Jiangsu Robotics Industry Innovation Development Action Plan	Jiangsu	The scale of the core robotics industry reaches more than Rmb25bn, robot density in key manufacturing sectors more than 500units/10,000
May-24	Shandong Implementation Plan for Humanoid Industry Development 2024-2027	Shandong	To develop 10 core companies with production value of each exceeding Rmb100mn
May-24	Anhui Action Plan for Humanoid Industry Development 2024-2027	Anhui	To establish humanoid industry ecosystem in 2027
Sep-24	Zhangjiang Implementation Plan for Humanoid Industry Development 2024-2027	Zhangjiang	Production to reach 20k units in 2027, value of core value chain to reach Rmb20bn
Dec-24	Chongqing supporting policies for embodied intelligence industry	Chongqing	To breakthrough key technologies, provide necessary capital supports
Feb-25	Beijing Action Plan for Embodied Intelligence Innovation and Industry Development 2025-2027	Beijing	To develop at least 50 key companies across value chain with at least 50 mass production product
Mar-25	Shenzhen Action Plan for Embodied Intelligence Innovation and Industry Development 2025-2027	Shenzhen	To develop 10 core companies with annual revenue exceeding Rmb10bn, and total industry size reaching Rmb100bn
Apr-25	Establishing national standards	Nationwide	To establish national standards for humanoid, cover dexterous operations, multi-robot collaboration, etc.

Note: Includes all notable funding disclosed based on our knowledge and research. However, there may still be some not captured.

Source: Government Announcements, Morgan Stanley Research

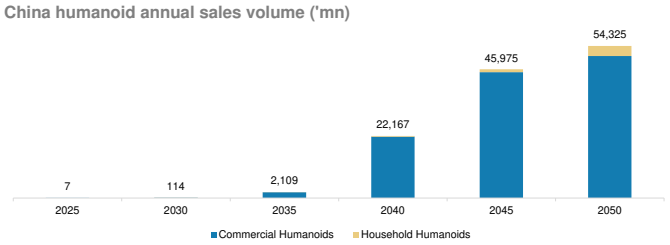
Exhibit 153: Monthly China Humanoid Company Funding Activity



Note: Includes all notable funding disclosed based on our knowledge and research. However, there may still be some not captured. We have updated number of transaction January and February with transaction announced after our published previous Humanoids Horizon.

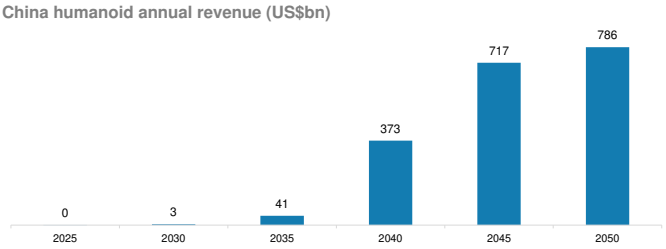
Source: Company announcement, Morgan Stanley Research

Exhibit 154: We expect China's annual humanoid demand to rise at a CAGR of 78% in 2025e-35e and 24% in 2036e-50e...



Source: Morgan Stanley Research estimates

Exhibit 155: ...implying a market size of US$41bn/US$373bn/US$786bn market in 2035e/40e/50e



Source: Morgan Stanley Research estimates
Note: Assuming RMBUSD = 0.14

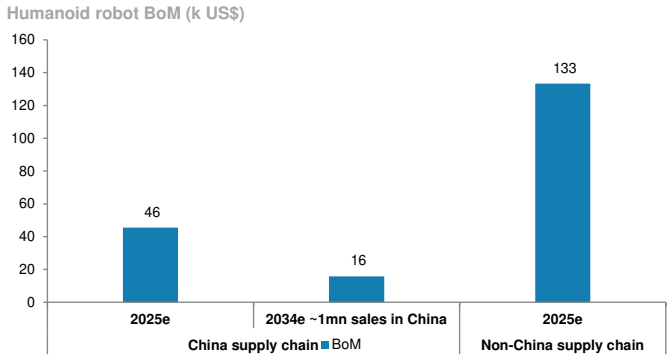
Great potential in humanoid robot cost reduction, especially in China's supply chain

BoM cost reduction potential for humanoid robots is high, but varies across different components. Based on our structure assumption of Tesla's Optimus (Gen 2 body part + Gen 3 dexterous hand), we estimate humanoid robot BoM using a China supply chain is ~US$46k in 2025, which we expect to fall by a CAGR of 11% to US$16k when humanoid robot annual sales reach ~1mn units in China in 2034. This ~US$46k BoM cost from a China supply chain is roughly one third of the estimated BoM using a global (non-China) supply chain at US$133k in 2025. Key components such as screws, reducers and sensors will likely see significant cost reductions at scale as equipment localization and manufacturing processes are improved, while motors and bearings are mainly influenced by material prices. Specifically, **we expect 6 axis force/torque sensors, planetary roller screws and reducers to see faster cost reduction** in the China supply chain by 2034 when we estimate China annual demand to reach ~1mn humanoid robots.

Hardware technology trajectory diversified but converging towards high integration, lightweighting and intelligent control... Over the past 1-2 years, we have seen highly diversified humanoid robot designs mushroom, catering for different application requirements in fragmented downstream scenarios. However, the hardware solutions have been showing gradual convergence rather than diversification, e.g., overall robot design focus on linear + rotary actuator or full rotary actuator; planetary roller screws/ball screws for linear actuators; harmonic/planetary reducers for rotary actuators; and tendon/linkage/gears for dexterous hands.

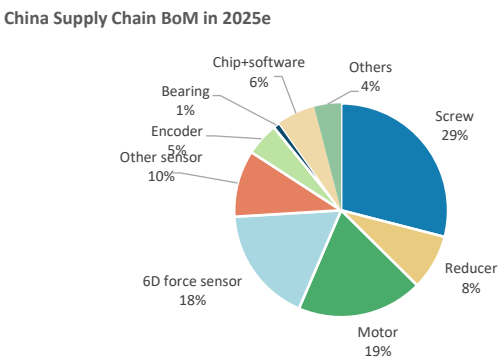
...yet we think investors should be open-minded about new hardware design/material/manufacturing processes that could bring new opportunities and competition to the supply chain. Despite China having a significant cost advantage vs. non-China supply chains, we see a clear disparity between China and non-China suppliers in terms of precision, lifespan, and stability. Currently all China supply chain players are actively working on different solutions to further improve the performance level of their components, largely via new design structures, new materials, refined manufacturing processes and AI algorithms to compensate for the precision gap.

Exhibit 156: We expect BoM cost with China supply chain to achieve ~11% CAGR decline to US$16k when humanoid robot sales reach ~1mn in China in 2025



Source: Morgan Stanley Research

Exhibit 157: Highest value components are screws (~29% of BoM), sensors (~28%), motors and harmonic reducers



Source: Morgan Stanley Research

Appendix: China AI 60

Exhibit 158: China AI 60 Valuation Table

Company name	Ticker	MS	Share Price (Local Curr)	Price Target (Local Curr)	Upside (%)	Mkt Cap ($ mn)	P/E 2025E	P/B 2025E	EV/EBITDA 2025E	ROE 2025E	Div Yield 2025E	Coverage Analyst
Infrastructure												
Semis/Hardware												
SMIC	0981.HK	EW	43.00	40.00	-7%	38,959	40.2	2.0	12.7	5%	0%	Chan, Charlie
Advanced Micro-Fabrication Equipment Inc	688012.SS	OW	181.70	250.00	38%	15,660	45.1	5.1	44.0	13%	0%	Chan, Charlie
NAURA Technology Group Co Ltd	002371.SZ	OW	440.85	515.00	17%	32,429	31.0	6.7	25.4	26%	1%	Chan, Charlie
ACM Research Inc	ACMR.O	OW	22.19	30.00	35%	1,313	11.1	1.3	2.3	12%	2%	Chan, Charlie
MediaTek	2454.TW	OW	1,325.00	1,888.00	42%	68,683	16.3	4.9	13.1	32%	8%	Chan, Charlie
Montage Technology Co Ltd	688008.SS	OW	76.69	88.00	15%	12,097	39.9	6.6	35.9	19%	0%	Yen, Daniel
ASMedia Technology Inc	5269.TW	EW	1,815.00	1,415.00	-22%	4,212	28.5	3.4	26.9	14%	2%	Yen, Daniel
Empyrean Technology Co Ltd	301269.SZ	EW	120.06	115.00	-4%	9,008	181.4	12.3	190.5	7%	0%	Dai, Daisy
Chroma Ate Inc.	2360.TW	OW	318.00	400.00	26%	4,479	19.3	4.6	14.7	28%	3%	Yang, Derrick
Foxconn Industrial Internet Co. Ltd.	601138.SS	OW	18.69	24.20	29%	48,505	12.8	2.2	7.7	19%	4%	Shih, Sharon
Luxshare Precision Industry Co., Ltd.	002475.SZ	OW	32.08	38.50	20%	31,034	15.5	2.3	8.0	18%	0%	Shih, Sharon
Shennan Circuits Co Ltd	002916.SZ	EW	115.08	104.00	-10%	7,782	32.3	3.6	32.0	12%	1%	Kao, Howard
Inspur Electronic Information	000977.SZ	EW	51.29	50.00	-3%	10,304	26.9	3.3	30.9	14%	0%	Kao, Howard
Shengyi Technology Co Ltd.	600183.SS	EW	25.33	22.00	-13%	7,994	25.8	3.4	19.4	14%	2%	Kao, Howard
Lenovo	0992.HK	OW	9.29	10.00	8%	14,350	11.8	2.5	5.7	25%	4%	Kao, Howard
Zhen Ding	4958.TW	EW	103.00	89.00	-14%	3,223	12.2	0.6	4.4	5%	5%	Kao, Howard
Datacenters												
GDS Holdings Ltd	GDS.O	OW	25.45	39.00	53%	4,860	NM	1.6	14.6	-3%	0%	Liu, Yang
VNET Group Inc	VNET.O	OW	5.96	10.00	68%	1,731	99.8	1.5	11.1	2%	0%	Tang, Tom
Power												
Shenzhen Envicool Technology Co Ltd	002837.SZ	OW	33.47	33.00	-1%	3,421	35.7	7.5	27.1	24%	1%	Wang, Chelsea
WeiChai Power	000338.SZ	OW	15.00	20.00	33%	17,783	10.2	1.4	3.3	15%	5%	Zhong, Sheng
Platform												
Tencent Holdings Ltd.	0700.HK	OW	494.60	630.00	27%	595,402	19.7	3.7	11.3	22%	1%	Yu, Gary
Alibaba Group Holding	BABA.N	OW	125.33	180.00	44%	292,115	15.9	2.2	9.5	15%	NA	Yu, Gary
Baidu Inc	BIDU.O	EW	86.86	100.00	15%	30,092	9.6	0.7	(1.7)	9%	NA	Yu, Gary
iFlytek Co Ltd	002230.SZ	EW	47.47	44.60	-6%	13,686	103.8	5.8	53.5	6%	1%	Shih, Sharon
Applications												
Internet/Software												
Meituan	3690.HK	OW	144.50	200.00	38%	115,652	20.6	3.8	11.2	23%	NA	Yu, Gary
Meitu Inc	1357.HK	OW	5.32	6.00	13%	3,152	26.5	4.0	22.7	17%	2%	Lin, Lydia
Trip.com Group Ltd	TCOM.O	OW	61.45	73.00	19%	42,321	16.5	2.0	11.0	13%	0%	Liu, Yang
Kuaishou Technology	1024.HK	EW	55.20	58.00	5%	31,253	12.8	2.7	6.9	28%	0%	Liu, Yang
Kingdee International Software Group	0268.HK	EW	13.24	13.00	-2%	6,065	212.8	5.3	97.0	3%	0%	Liu, Yang
NetEase, Inc	NTES.O	OW	103.44	117.00	13%	66,700	15.4	3.1	9.6	22%	0%	Liu, Yang
Beijing Kingsoft Office Software Inc	688111.SS	UW	298.08	185.00	-38%	19,111	82.8	10.8	82.0	15%	0%	Liu, Yang
KE Holdings Inc	BEKE.N	OW	19.84	27.00	36%	23,492	17.0	1.9	8.8	12%	0%	Wang, Eddy
PDD Holdings Inc	PDD.O	OW	116.38	150.00	29%	148,623	10.8	2.5	4.5	37%	0%	Wang, Eddy
JD.com, Inc.	JD.O	EW	36.05	41.00	14%	56,671	7.6	1.4	5.3	20%	0%	Wang, Eddy
Kanzhun Ltd	BZ.O	OW	17.81	22.00	24%	8,097	17.5	3.0	10.4	20%	0%	Wang, Eddy
Electronics												
Xiaomi Corp	1810.HK	OW	50.60	62.00	23%	165,883	37.6	5.4	33.9	17%	0%	Meng, Andy
Tuya Inc.	TUYA.N	OW	2.57	4.20	63%	1,526	43.2	1.5	NM	4%	5%	Liu, Yang
Auto												
Horizon Robotics	9660.HK	OW	7.20	10.50	46%	12,061	NM	NM	NM	NM	NA	Hsiao, Tim
XPeng Inc.	9868.HK	OW	75.20	101.00	34%	16,830	NM	4.4	NM	-10%	0%	Hsiao, Tim
BYD Company Limited	1211.HK	OW	387.00	438.00	13%	145,384	20.5	4.1	6.9	29%	1%	Hsiao, Tim
NIO Inc.	9866.HK	OW	30.55	45.80	50%	13,427	NM	17.4	(8.0)	-98%	0%	Hsiao, Tim
Zeekr Intelligent Technology Holding Ltd	ZK.N	OW	28.09	36.00	28%	6,930	321.6	NM	27.8	NM	NA	Hsiao, Tim
Li Auto Inc.	2015.HK	OW	103.80	124.00	19%	26,260	17.7	2.3	3.9	15%	0%	Hsiao, Tim
Transportation												
S.F. Holding Co Ltd	002352.SZ	EW	43.15	47.20	9%	28,930	19.2	2.1	5.7	12%	2%	Fan, Qianlei
Healthcare												
Mindray Bio-Medical	300760.SZ	OW	224.00	260.00	16%	37,631	23.2	6.8	17.2	33%	3%	Yan, Alexis
Fosun Pharmaceutical	600196.SS	EW	23.52	24.00	2%	7,394	20.3	1.3	7.4	7%	2%	Tao, Yanru
Alibaba Health Information Technology	0241.HK	OW	4.98	5.00	0%	10,302	44.8	4.3	32.5	11%	0%	Yan, Alexis
Dian Diagnostics Group Co Ltd	300244.SZ	EW	14.27	12.80	-10%	1,236	16.6	1.2	6.4	8%	1%	Yan, Alexis
Shanghai United Imaging Healthcare Co	688271.SS	EW	136.68	145.00	6%	15,567	57.8	5.2	38.0	10%	0%	Yan, Alexis
Gushengtang Holdings Ltd	2273.HK	OW	32.35	55.00	70%	1,001	18.9	2.6	9.8	17%	0%	Yan, Alexis
Education												
TAL Education Group	TAL.N	OW	9.42	12.00	27%	1,915	17.7	0.7	(9.5)	4%	NA	Wang, Eddy
Financials												
Bairong Inc.	6608.HK	OW	8.18	13.00	59%	500	9.1	0.7	4.1	9%	NA	Xu, Richard
Consumer												
Midea Group Co Ltd.	000333.SZ	OW	75.80	95.00	25%	80,458	12.7	2.5	7.4	20%	5%	Lou, Lillian
Haier Smart Home Co Ltd	6690.HK	EW	22.80	28.20	24%	31,517	9.4	1.6	5.5	19%	5%	Lou, Lillian
Beijing Roborock Technology Co Ltd	688169.SS	OW	203.40	281.00	38%	5,196	13.8	2.6	8.8	21%	3%	Ling, Hildy
Ecovacs Robotics Co Ltd	603486.SS	EW	54.03	61.00	13%	4,314	19.8	3.5	11.3	20%	2%	Ling, Hildy
Gree Electric Appliances Inc of Zhuhai	000651.SZ	OW	47.00	54.00	15%	35,840	7.5	1.7	3.3	25%	7%	Lou, Lillian
Yum China Holdings Inc.	YUMC.N	OW	46.11	57.00	24%	17,440	18.8	3.2	9.6	16%	2%	Lou, Lillian
Pop Mart International Group	9992.HK	OW	191.10	204.00	7%	32,993	37.9	15.1	24.4	59%	0%	Wei, Dustin
Giant Biogene Holding Co Ltd	2367.HK	OW	78.05	85.00	9%	10,051	28.3	8.9	21.7	36%	2%	Wei, Dustin

Source: Company data, Morgan Stanley Research (E) estimates

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(as of April 30, 2025)
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	Coverage Universe		Investment Banking Clients (IBC)			Other Material Investment Services Clients (MISC)	
Stock Rating Category	Count	% of Total	Count	% of Total IBC	% of Rating Category	Count	% of Total Other MISC
Overweight/Buy	1501	40%	377	46%	25%	691	40%
Equal-weight/Hold	1667	44%	375	45%	22%	796	46%
Not-Rated/Hold	3	0%	0	0%	0%	1	0%
Underweight/Sell	603	16%	76	9%	13%	229	13%
Total	3,774		828			1717	

Data include common stock and ADRs currently assigned ratings. Investment Banking Clients are companies from whom Morgan Stanley received investment banking compensation in the last 12 months. Due to rounding off of decimals, the percentages provided in the "% of total" column may not add up to exactly 100 percent.

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Fadu Inc (440110.KQ)	E (11/09/2023)	W11,910
Hanmi Semiconductor Co. Ltd. (042700.KS)	O (08/16/2024)	W81,000
HD Hyundai Electric Co Ltd (267260.KS)	O (03/25/2025)	W341,000
Isu Petasys Co. Ltd. (007660.KS)	O (02/03/2025)	W41,100
L&F Co Ltd (066970.KS)	E (04/03/2025)	W64,500
Leeno Industrial Inc. (058470.KQ)	O (04/03/2025)	W40,400
Lotte Energy Materials Corp (020150.KS)	U (04/03/2025)	W22,350
LS Electric (010120.KS)	E (03/25/2025)	W234,500
POSCO FUTURE M (003670.KS)	U (04/03/2025)	W120,100
SK IE Technology (361610.KS)	U (04/03/2025)	W22,750
Wonik IPS Co Ltd (240810.KQ)	E (04/03/2025)	W22,850
Shawn Kim		
LG Display (034220.KS)	U (04/07/2025)	W8,670
LG Electronics (066570.KS)	E (04/07/2025)	W73,000
LG Innotek (011070.KS)	E (03/12/2025)	W153,200
Samsung Electro-Mechanics (009150.KS)	E (04/07/2025)	W126,000
Samsung Electronics (005935.KS)	O (11/18/2019)	W47,000
Samsung Electronics (005930.KS)	O (11/18/2019)	W56,900
Samsung SDI (006400.KS)	E (12/18/2024)	W170,900
Seoul Semiconductor (046890.KQ)	U (04/04/2018)	W6,780
SK hynix (000660.KS)	E (03/19/2025)	W198,500

Stock Ratings are subject to change. Please see latest research for each company.
* Historical prices are not split adjusted.

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