

TechGPT: Raising AI revenue forecast by 40%

TechGPT series:

How to position in AI with 15x revenue growth in 5 years?

January 2024 | Chief Investment Office GWM | Investment Research



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TechGPT: Raising AI revenue forecast by 40%

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Foreword



“It took more than 10 years for the smart device industry to grow its revenues by 15x. AI should take only five years, in our view.”

Dear reader,

Happy New Year!!

2023 ended on a solid note for global tech stocks in what has been an impressive turnaround for the sector. Fueled by the artificial intelligence (AI) rally, tech stocks recovered most of the drawdowns from 2022. And despite the strong growth trends seen so far, we believe we are only in the first innings of the AI story.

With visibility improving into how much firms are going to spend on AI, we are raising our revenue growth forecast for the industry by 40%. We now expect revenues to grow about 15x during 2022–27, expanding from USD 28bn in 2022 to USD 420bn in 2027—a 72% CAGR. In particular, we see much more infrastructure spending (50% CAGR during 2022–27, rising from USD 25.8bn to USD 195bn), driven by emerging trends like GPU cloud and AI edge-computing. Also, with broadening AI demand and rising monetization trends, we see solid growth for AI applications & models (152% CAGR, increasing from USD 2.2bn to USD 225bn).

As a result, we believe AI will remain the key theme driving global tech stocks again in 2024 and the rest of the decade. In 2024, the semiconductor and software industries are well positioned to ride the AI wave, with



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both industries expected to post solid double-digit profit growth and operating margins of more than 30%, in our view. The rise of AI should drive further consolidation in global tech, where we believe the “big will get bigger” trend will benefit industry leaders with deep pockets and first-mover advantages. While global tech’s valuation of around 25x P/E is not cheap, falling rates and our 16% EPS growth forecast for 2024 should be supportive.

If the launch of the ChatGPT application is the iPhone moment for the AI industry, the recent rollouts of numerous applications like copilots and features like Turbo and vision from OpenAI in 4Q23 mean the App Store moment for the AI industry has arrived, in our view. This should drive strong innovation in global tech in 2024, which could also revive tech’s prospects in the venture capital/private market space.

The strong turnaround in tech’s fortunes in 2023 was powered by the rising popularity of generative AI, which has taken the world by storm. Many people today, when they have questions about practically anything, approach a chatbot for answers. In the same spirit, to answer investors’ most frequently asked questions on technology and related topics, we introduced our “TechGPT” publication in June 2023.

While we expect strong mid-teen earnings growth for tech in 2024, uncertainties abound around regulations and geopolitics. So, investors likely have many questions about tech as they start to position for the year ahead. In this TechGPT report, we address the most pressing questions across four chapters and cover topics like our AI forecasts, opportunities in AI infrastructure, rising AI monetization trends, and AI’s risks and opportunities.

We hope you enjoy reading this report. And please continue to send in your questions regularly so that we can address them in our upcoming publications.



“The App Store moment for AI is here.”



“Regulations have always been and will always remain a risk in the tech sector—more so for AI today, as we expect faster-than-expected regulations ahead.”



Chapter 1:

Raising our AI forecast



“We expect AI industry revenues to grow 15x from USD 28bn in 2022 to USD 420bn in 2027E, or a CAGR of 72%.”

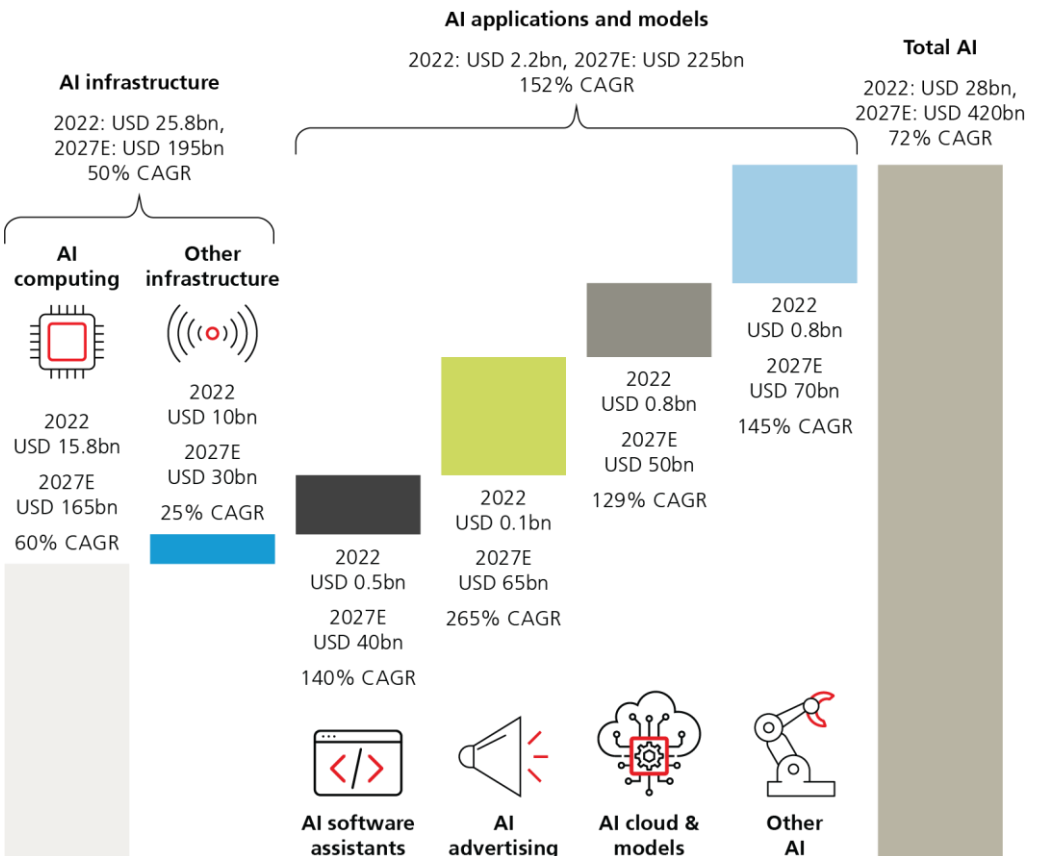
What is the revised AI opportunity?

Last year, we introduced our AI estimates, expecting the industry's revenues to grow from USD 28bn in 2022 to USD 300bn in 2027—a 61% CAGR. However, with improving visibility for AI infrastructure spending that should extend beyond the initial training and inferencing boom and amid broadening demand for AI applications and models, we have raised our revenue estimate for the industry by 40%. We now

expect AI industry revenues to grow 15x between 2022 and 2027, expanding from USD 28bn in 2022 to USD 420bn in 2027—a 72% CAGR. This will likely make AI one of the fastest-growing and largest segments within global tech and arguably the “tech theme of the decade,” as we don't see similar growth profiles elsewhere in tech.

Semiconductors and software are best positioned to ride the AI wave

15x growth expected in AI demand from 2022–27E based on our revised estimates, in USD bn



Source: Bloomberg Intelligence, UBS estimates, as of December 2023

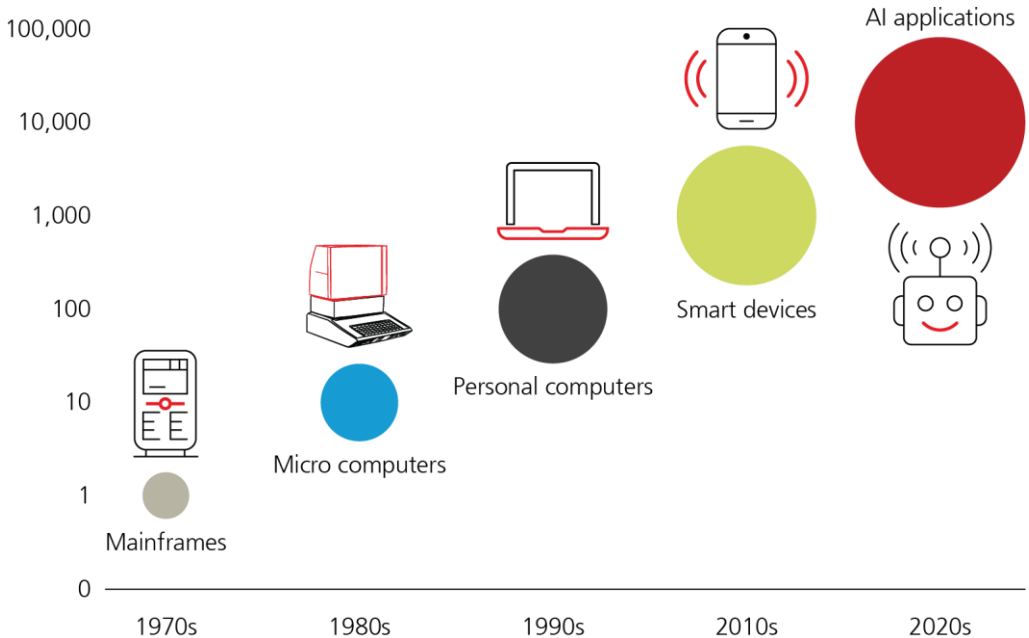
The strong upward revision in our revenue estimate is consistent with our playbook on the computing cycle, where investors have rewarded every cycle with strong returns thanks to solid growth prospects. The computing cycle has evolved in such a way that each one has lasted for at least 10–15 years, with a significant 10x or so expansion in annual shipments. Annual shipments for mainframes were only about 1mn units until the 1980s, when they ballooned to around 10mn as microcomputers became mainstream computing devices. This was followed by a sharp increase during the PC era, when annual PC shipments shot up to more than 100mn units, with PC shipments eventually reaching an annual run-rate of nearly 300mn. Smart devices, which include smartphones and tablet

PCs, crossed 1bn shipments during the mid-2010s. Currently, annual shipments are close to 1.5bn units. With AI, we expect this 10x growth trend to continue, with annual AI chatbots and applications potentially crossing 10bn units.

In this report, we provide a detailed breakdown of our bottom-up assumptions behind the strong upward revision. Even on a top-down basis, our forecast of USD 420bn in revenues in 2027 is conservative at 0.3–0.4% of global GDP given the significant cost savings and new business opportunities AI offers. Meanwhile, our confidence in strong end-demand for AI stems from improving visibility for the infrastructure segment and broadening demand for AI applications and models.

We are in the early innings of the AI growth cycle

Evolution of computing devices and size of annual addressable markets, in millions



Source: UBS, as of December 2023

AI infrastructure mainly includes spending to train and run the AI models and applications. These include spending on computing, like graphics processing units (GPUs) and other chips, and other infrastructure spending on hardware, including networking, edge AI devices, etc. On a consolidated basis, we expect the AI infrastructure segment to grow from USD 25.8bn in 2022 to USD 195bn in 2027—a 50% CAGR, much higher than our previous estimate of a 38% CAGR. The stronger outlook is also consistent with the guidance from leading AI suppliers in Asia, where we see additional drivers like GPU cloud, AI edge-computing, etc. on top of strong demand for training and inferencing.

Meanwhile, we believe the recent strong rollouts of AI applications and models underscore the view that the App Store for the AI industry has arrived. Many industry pundits claim ChatGPT is the “iPhone moment” for AI, stimulating strong user adoption. However, there are many bears out there who are still not convinced about

AI monetization, and they are waiting for tangible evidence. The availability of many AI products like copilots, AI vision, etc. since 4Q23 gives us more confidence about AI monetization. These developments are akin to the “App Store moment” for the smart device industry, which attracted millions of developers to build apps and in turn users to embrace smart devices by replacing traditional PCs and other consumer electronics. Against this backdrop, we believe increased AI applications in the next few months should drive significant user adoption. We now expect the AI applications and models segment to snowball, albeit due to a low base, from USD 2.2bn in 2022 to USD 225bn in 2027—that’s more than 100x and a 152% CAGR (versus our previous estimate of 139% CAGR).

We provide more details about our assumptions in the next few chapters. But broadly speaking, we believe the semiconductor and software segments are well positioned to ride the near- to medium-term AI wave, with internet also standing to benefit in the medium to long term.



“The boom in AI computing clearly caught many investors by surprise in 2023 given the continuous upward revisions to consensus earnings and revenue estimates for leading AI computing companies.”



Chapter 2:

Extending visibility in AI infrastructure



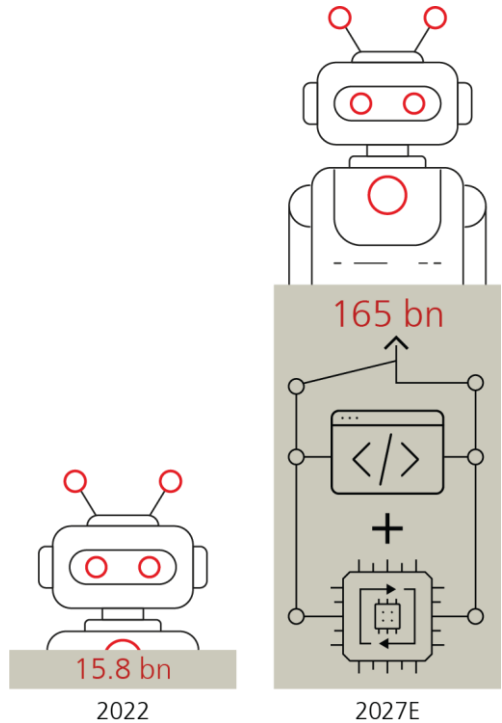
“The computing cycle has evolved in such a way that each one has lasted for at least 10–15 years with a significant 10x expansion in annual shipments.”

Is the AI computing boom set to continue?

The boom in AI computing clearly caught many investors by surprise in 2023 given the continuous upward revisions to consensus earnings and revenue estimates for leading AI computing companies. This was particularly true for segments like GPUs and other chips used to train and infer large language models (LLMs). We expect the GPU and chip segment to be the best near-term beneficiary of strong AI spending, as we expect 60% CAGR between 2022 and 2027, with industry revenues expected to grow from USD 15.8bn in 2022 to USD 165bn in 2027—a jump of more than 10x in annual revenues. While most platform and semiconductor companies don't provide a breakdown of AI chips' end-usage, we believe inferencing accounted for less than 10% of AI computing chip demand in 2023, versus 90% for training. With the increased usage of generative AI and the rising number of queries per user, we expect inferencing's share to increase to over 20% by 2025.

10x jump in AI computing revenues to disproportionately benefit GPU supply chain and other semiconductors

Industry revenues forecast for GPU and chip segment, in USD



Source: Bloomberg Intelligence, UBS estimates, as of December 2023



“The ability to process data locally without getting exposed to external data security risks could force many consumer electronics companies to explore AI edge-computing in devices like smartphones and PCs.”

With strong AI spending continuing from leading tech platforms and potentially rising contribution from AI startups and incumbents in other sectors, we expect spending on AI computing to remain robust, with emerging trends like GPU clouds, sovereign clouds, and AI edge-computing (see the next question) as additional drivers on top of already strong chip demand for training and inferencing. Additionally, given the tight supply, pricing

power for AI computing chips is likely to remain robust, driving strong margins. Hence, boosted by strong end-demand and higher margins, AI computing as a segment should continue to drive solid growth, benefiting the logic and foundry suppliers in the semiconductor industry. See the table below for a comparison of the margins for the two most advanced GPU products currently, H100 and MI300X, based on our calculations.

Driven by tight near-term supply, GPUs should enjoy strong pricing power and higher margins

Our cost assumptions for advanced chips

Technology	4 nm	5 nm
Number of packages per wafer (a)	28	56
Wafer cost from foundry in USD (b)	17000	15000
GPU die cost in USD (c=b/a)	607	268
HBM memory size per unit	96 GB	192 GB
Memory cost per unit in USD (d)	1260	2520
Other costs in USD (e)	1500	3000
Final cost in USD (f=c+d+e)	3367	5788
Price per unit in USD (g)	25000	15000
Gross profit per unit in USD (g-f)	21633	9212
Gross margins	86.50%	61.40%

Source: Company reports, UBS estimates, as of December 2023

Is AI edge-computing set to take off?







While we believe the majority of near-term spending in generative AI computing will focus on data center investments, which are GPU intensive, end-device AI chips, and AI edge-computing that can provide low latency and personalized generative AI services. For instance, some basic image generation and translation services may not need a model with trillions of parameters and may require training only a few billion parameters. Today, there are many smaller, dedicated AI chipsets that can perform these kinds of tasks and can be easily integrated inside end-devices like smartphones and PCs and other segments like autos and Internet of Things (IoT) devices.

We believe the ability to process data locally without getting exposed to external data security risks could force many consumer electronics companies to explore such opportunities, as they can still participate in the generative AI opportunity through integrating AI edge-computing chips in end-devices. In certain

situations, the ability of edge devices to offload some basic computation from the GPU-intensive cloud-based computation can come in handy.

While the table below shows some examples of existing AI edge-computing chips, we see smartphones and PCs as low-hanging fruit. In these consumer devices, we see significant pick-up in the penetration of dedicated AI chips. In the medium to longer term, other consumer and industrial devices, including autos, should integrate AI edge-chips to take advantage of the proliferation of generative AI applications. As a result, we believe the revenue from AI edge-computing devices has the potential to reach USD 30bn in 5–10 years, which is still only a low-single-digit share of overall semiconductor industry revenues and hence may prove to be conservative. We will provide more insights on this emerging segment in future reports as more consumer products start rolling out integrating AI edge-chips.

A few examples of how edge AI chips are accelerating AI adoption in both industrial & consumer devices

Company	Chip name	AI feature	
Alphabet	Edge TPU	Predictive maintenance	
Mediatek	Genio 1200	Computer vision	
Tesla	NPU	Simulations	
Google	Tensor G2	Translation	
Qualcomm	Snapdragon 695	Echo cancellation	
Apple	A17 Pro	Face recognition	

Source: Company reports, UBS, as of December 2023



Chapter 3:

Broadening AI monetization trends

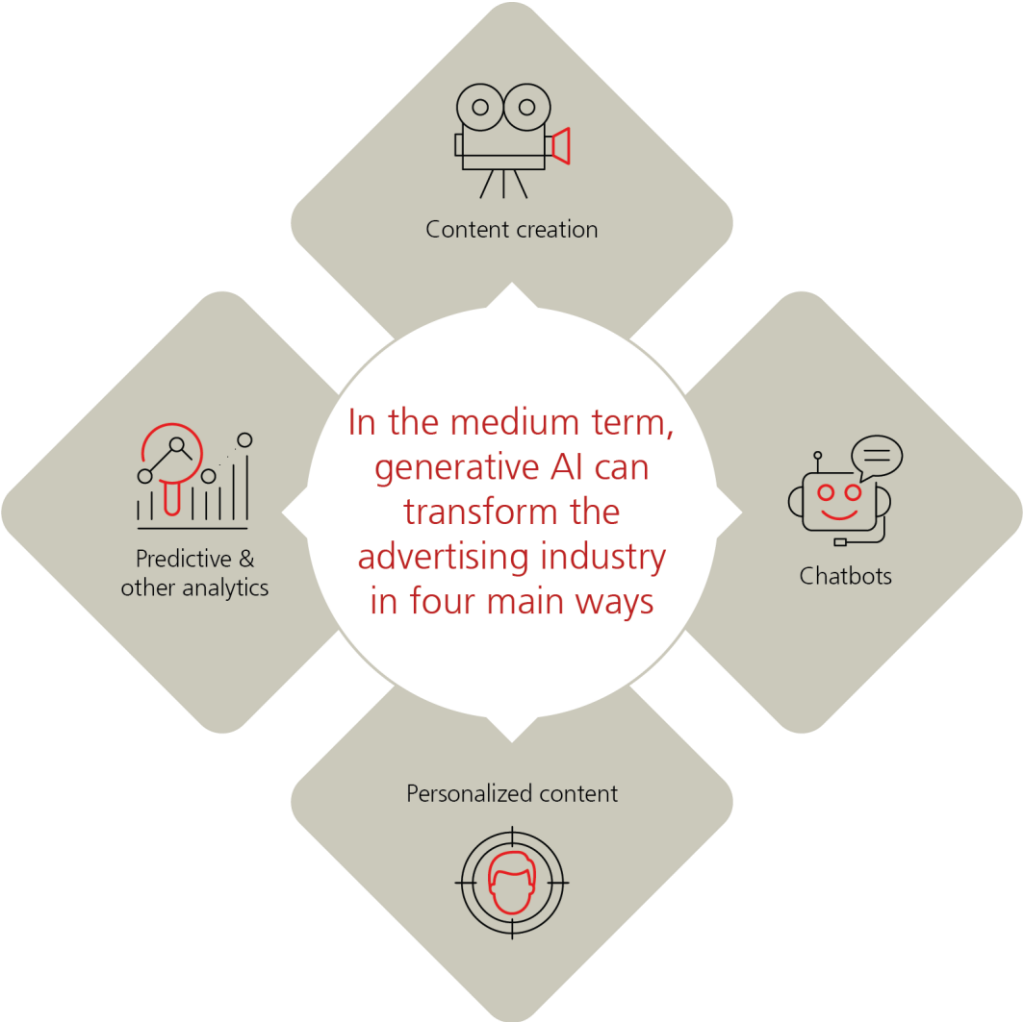


“The four segments that address applications and models should grow from USD 2.1bn in 2022 to USD 160bn in 2027, a 138% CAGR.”

How can the internet industry benefit from AI?

Unlike semiconductors and software that have clear near-term visibility from generative AI, the internet segment didn't have the same first-mover advantage. However, in the medium to long term, AI should help grow revenues: With a conservative estimated penetrate rate of 8–10%

of global advertising industry revenues, we expect the internet AI segment to report USD 65bn in revenues in 2027. While the AI monetization trends for the internet industry will likely evolve, there are four broad ways how internet companies can monetize AI.



Source: UBS, as of December 2023

The first way is via content creation, as we believe generative AI can help create new content across texts, images, videos, and other multi-media formats that can maximize revenues for internet companies. Early trends already indicate how AI-generated articles are being used by media companies and how AI-created images and videos are being used to display advertisements. Second, chatbots, which can provide nice subscription revenue streams, can be used to improve customer service and as a personal buddy/assistant (Character AI is one such popular paid chatbot today in the market). The third way is via personalized content, which can be used by streaming services as well as advertising companies to increase user engagement. And finally, predictive and other analytics can be used by digital media and e-commerce companies to roll out new products and services.

In summary, the integration of generative AI has just begun, and with promising new generative AI applications expected in 1H24, visibility on the internet industry’s ability to monetize should gradually improve. This in turn should also lead to a gradual re-rating of the industry, which has been awaiting a strong catalyst.


Why has the “App Store” moment arrived for AI applications and models?

Many industry pundits claim ChatGPT is the “iPhone moment” for AI, stimulating strong user adoption. However, many bears are still not convinced about AI monetization and are waiting for tangible evidence. We believe the availability of AI products (e.g., copilots, AI vision) in 4Q23 provides more confidence about AI monetization. These developments are akin to the “App Store moment” for the smart device industry, which attracted millions of developers to build apps and, in turn, users to embrace smart devices by replacing traditional PCs or other consumer electronics. Against this backdrop, we see increased AI applications in the next few months, which should drive significant user adoption.


Excluding AI internet, the four segments that address applications and models should grow from USD 2.1bn in 2022 to USD 160bn in 2027, a 138% CAGR. Our positive view is based on:

Multiple AI applications launched so far with strong product pipeline


A few examples of recent AI applications



Copilots
Microsoft 365 Copilot
Google Duet



Cloud
CoreWeave cloud
Lambda cloud



Models
OpenAI API
Amazon SageMaker



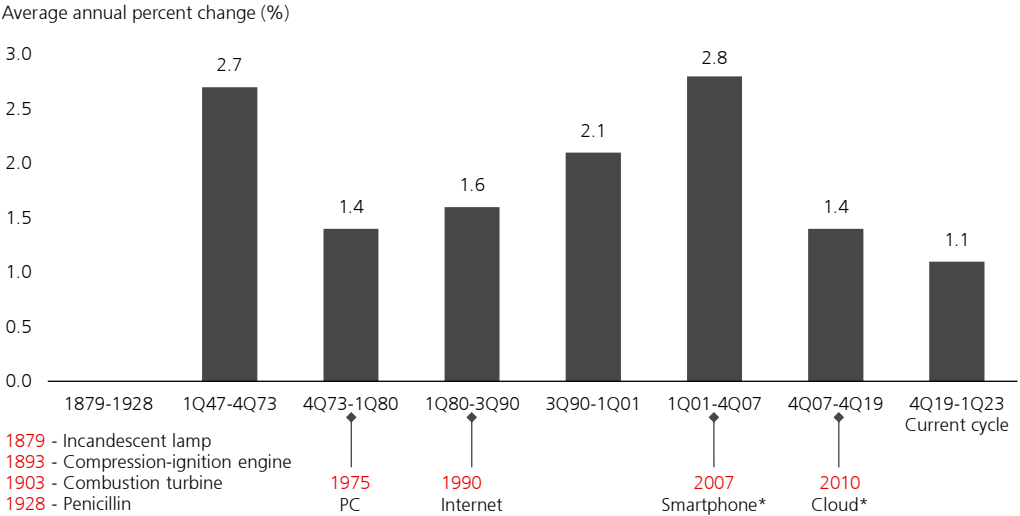
Other software
Adobe Firefly
Servicenow
Vancouver

Source: Company reports, UBS, as of December 2023

- Strong demand for copilots and other software assistants:** Global productivity growth has decelerated over the past few years due to limited innovation and a lack of “killer” apps (see chart below). But AI could reverse that trend and power productivity, with copilots at the center of the revolution due to their ability to boost office productivity. The term “copilots” refers to AI companion tools integrated within office workflow or productivity software. Most leading platforms have launched copilots or similar software assistant products, and while

these are still in their early days, the initial evidence is promising. For example, Microsoft claimed at its recent Ignite conference that with copilots, users could complete specific tasks 29% faster (e.g., searching, writing and summarizing). As a group, we expect copilots and software assistants to reach USD 40bn in revenues in 2027, which at only 4–5% of global software industry revenues, is very conservative, in our view. This is because we believe faster-than-expected productivity gains should drive significant upside.

Productivity change in the nonfarm business sector, 1947–2023



* Inflection points for cloud and smartphone
 Source: US Bureau of Labour Statistics, UBS, as of December 2023



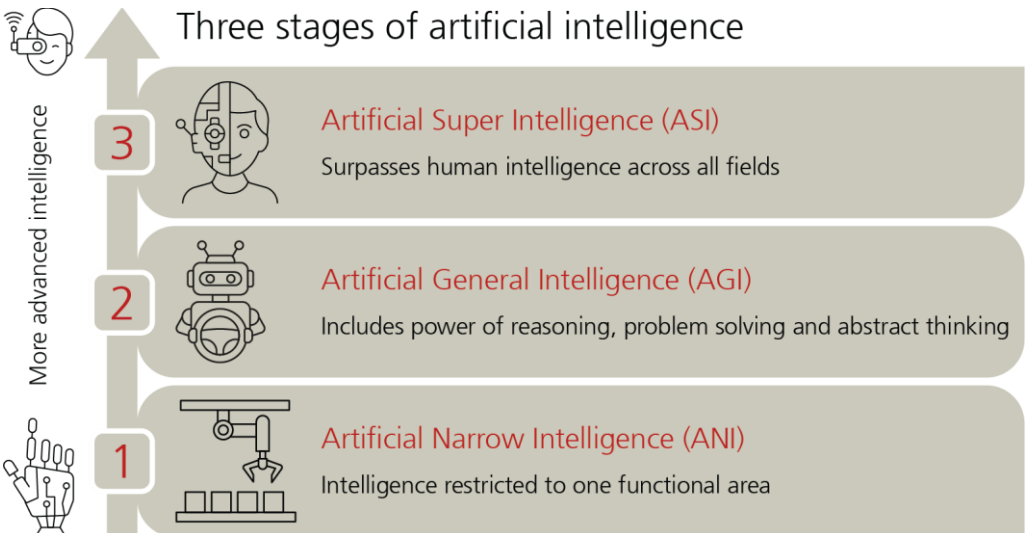
“For leading cloud providers, AI cloud, which includes access to advanced computing infrastructure, LLMs, and the rest of the AI software stack should contribute low- to mid-single digit growth in 2024, based on recent guidance.”

- Steady recurring demand for AI cloud and models:** We see AI—including demand from leading corporates and sovereign cloud (led by major governments)—to drive strong demand for cloud, at potentially about 15–20% of overall cloud demand in the next few years. For leading cloud providers, AI cloud (including access to advanced computing infrastructure), LLMs, and the rest of AI software stack should contribute low- to mid-single growth in 2024, based on recent guidance. In particular, access to LLMs through APIs (application programming interface) should democratize AI innovation. As a group, we expect the segment’s revenues to reach USD 50bn by 2027, which at 2–2.5% of enterprise IT spending is also conservative, in our view.
- Other software and AI revenues:** These include the use of generative AI in creative software (image and video creation), work flow management, gaming, services, and other revenues. We estimate revenues of USD 70bn for the segment by 2027, which represents mid-single-digit addressable market penetration.

How far are we from artificial general intelligence (AGI)?

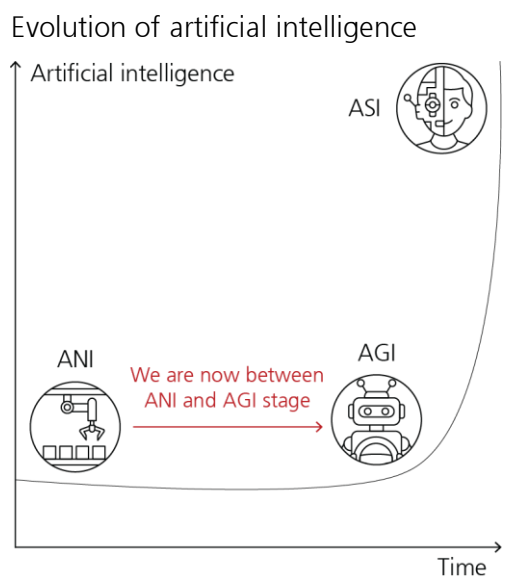
This is challenging to answer and is rooted in philosophical debate, but here’s what we’ve written on the topic in the past. As early as 2017, when we published our primer on artificial intelligence ([How artificial intelligence will transform Asia?](#)), we wrote why artificial general intelligence will become a reality in the next 10 years. But first, let’s understand the basics.

Like all technologies, AI should continue to evolve as progress compounds from one innovation to the next. We believe AI’s evolution fits into three stages: artificial narrow intelligence (ANI), artificial general intelligence (AGI), and artificial super intelligence (ASI). Generally speaking, ANI can be likened to an infant’s intelligence, managing one function at a time. Moving on, AGI is different—it covers more than one field, like the power of reasoning, problem solving, and abstract thinking, and is mostly on par with adults in terms of intelligence levels. ASI is the final stage of the intelligence explosion, in which AI is expected to surpass human intelligence across all fields.



Source: UBS, as of December 2023

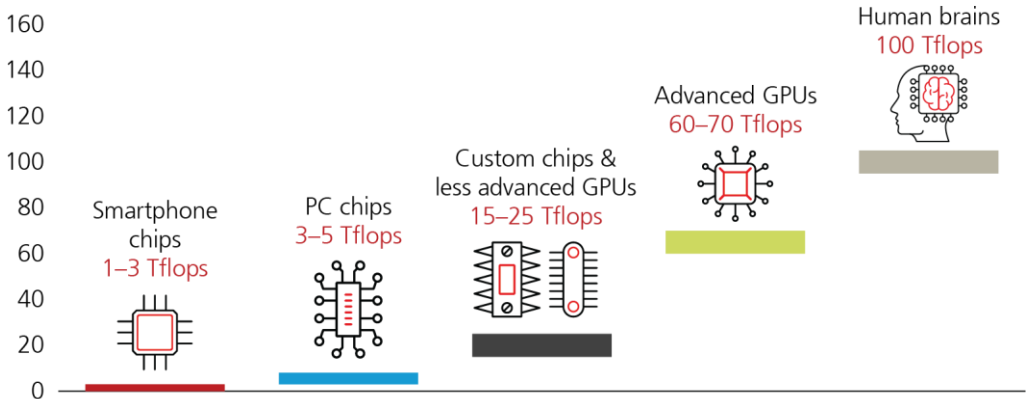
The transition from the first (ANI) to the second (AGI) phase has taken a long time, but when we fast forward six years since our primer, the exponential growth in computing power, the rise of sophisticated algorithms, and the evolution of LLMs and generative AI (coupled with billions of dollars of investments) give us the confidence to say that we are closer to the second AGI stage. While not every aspect of AGI can be deployed across software applications or automated devices overnight—including integrating softer attributes like emotions or empathy—the recent progress of AGI projects at leading firms like OpenAI (Project Q* with reinforcement learning) and other major tech platforms leads us to believe that AGI is coming soon, though predicting an exact timeline is extremely difficult, given the many complexities at hand—e.g., processing power, access to chips, regulations, governance, costs, to name a few.



Source: UBS, as of December 2023

Thanks to advanced GPUs, machine intelligence should soon be on par with human intelligence

Benchmark comparison of key chips based on calculations (TFLOPS FP32)



Source: Company reports, UBS, as of December 2023

That said, with advanced GPUs expected to further narrow the gap with human intelligence, and with a pipeline of strong products in the next few years, we should see an explosion of AI use cases in this decade as AGI eventually becomes a

reality. In this regard, we believe getting exposed to leading AI infrastructure companies and industry leaders with deep pockets and a first-mover advantage (“big will get bigger trend”) is the best way to play the trend, in our view.



Chapter 4:

Risks & opportunities in AI



“Regulations are worth monitoring as a risk, but an excessive correction due to geopolitics or regulations could present a buying opportunity, as underlying demand trends for AI are solid in the foreseeable future.”

Are AI regulations a risk in 2024?

Regulations have always been and will always be a risk for the tech sector—more so for AI today, as we expect regulations to evolve quickly in the years ahead. Moreover, with many general elections scheduled in 2024, we should see further heated debates around AI regulations.

That being said, we welcome regulations at the earlier stages of the industry's evolution, as that should drive more orderly growth. Damage can be done when they are introduced during the later stages of development, which happened in a few industries like education and fintech.

As seen in the figure below, we believe that from a regional perspective, China is currently the most advanced in terms of AI regulations,

followed by the US (mostly guidelines) and Europe. It is likely that Europe will get tough on AI regulations (including privacy) soon as the industry evolves. On the other hand, we expect the US administration to try to strike a balance, since regulation around AI can stifle innovation and erode the US's (and its major tech platforms) significant first-mover advantage.

In summary, regulations are worth monitoring as a risk, including export controls, but as we highlighted recently in our semiconductor thematic note, an excessive correction due to geopolitics or regulations could present a buying opportunity. Underlying demand trends for AI should continue to be solid in the foreseeable future, in our view.

Expect faster-than-expected regulations in AI



Source: UBS, as of December 2023

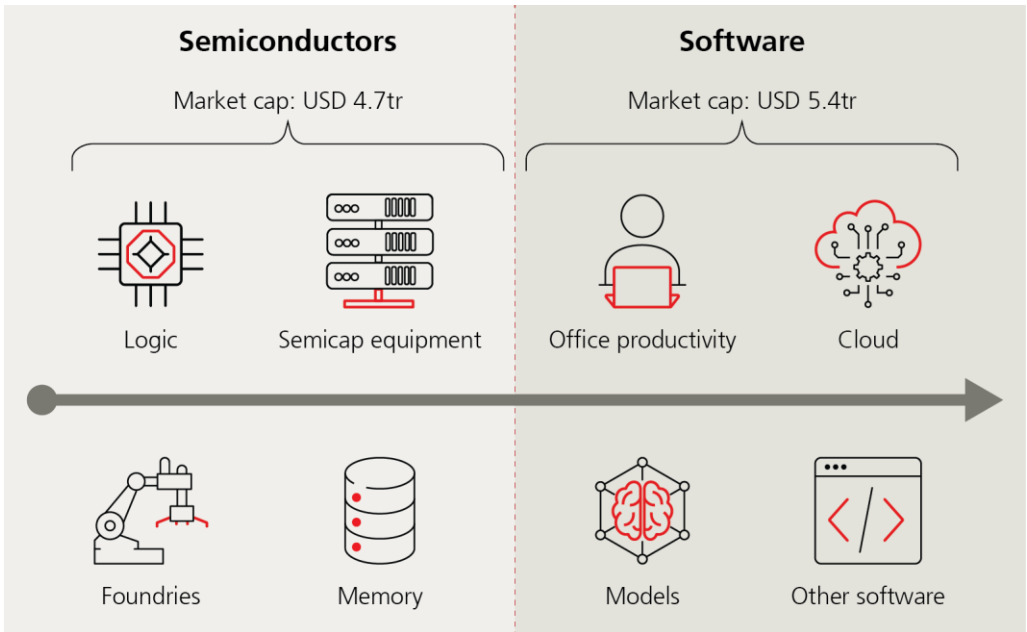
What is the best way to position in AI in 2024?

We believe the semiconductor and software industries (with a combined market cap of more than USD 10tr) are the best ways to play the strong and improving visibility for AI.

Semiconductors, while cyclical, are well-positioned to benefit from solid near-term demand for AI infrastructure. Meanwhile,

software, with broadening AI demand trends from applications and models, is a defensive play, thanks to its strong recurring revenue base. We expect both industries to post strong operating margins—33% for semiconductors and 36% for software—which are significantly above the global IT average of 22% and global average of 16%.

Semiconductors are the best way to ride the strong demand for AI infrastructure and software for AI applications & models in 2024



Source: Factset, UBS, as of 30 November 2023



“Semiconductors should benefit from strong pricing tailwinds in 2024, which we think should translate into 25% revenue growth and more than 50% operating profit growth.”

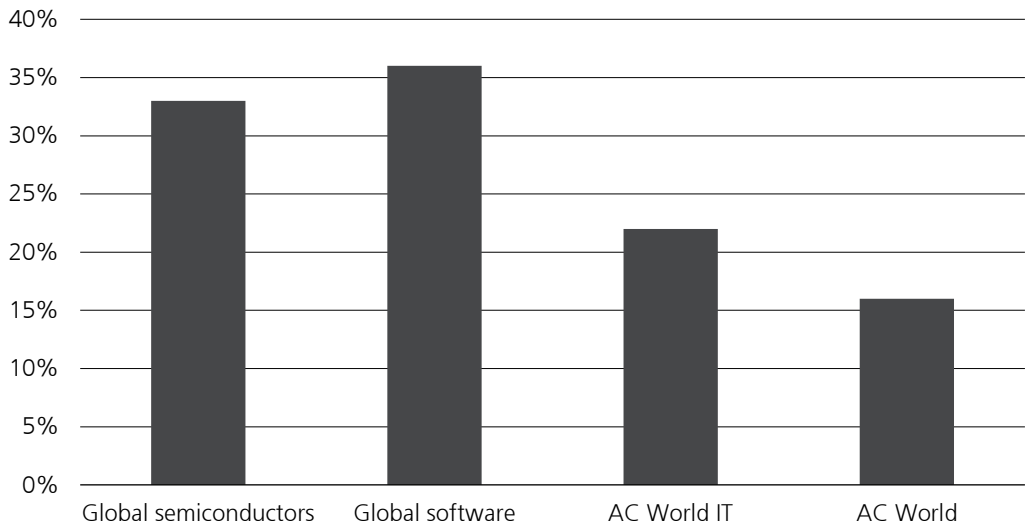
Additionally, semiconductors (as highlighted in our thematic note in 4Q23) should benefit from strong pricing tailwinds in 2024, which we think should translate into 25% revenue growth and more than 50% operating profit growth. Within semiconductors, we believe logic, semiconductor capital equipment, foundries, and memory companies are the four sub-industries that are well-positioned to ride the AI wave. For software, we expect mid- to high-teen percentage revenue growth in 2024, which would be a solid outcome, thanks to strong AI and cloud tailwinds, as well as resilient margins.

Within software, industry leaders exposed to office productivity, cloud, models, and other software segments are relatively better positioned to benefit from rising AI contributions.

Eventually, we also believe the internet industry should benefit from AI as demand broadens, but we believe semiconductors and software offer the most compelling risk-reward in the near term. This is also supported by strong pricing power and margin leadership in 2024. For more details, please follow our regular TechGPT reports.

Semiconductors and software should post one of the best operating margins across global industries in 2024

2024E operating margins



Note: Global semiconductors is measured by the MSCI AC World Semiconductors & Semiconductor equipment Index, and global software is measured by the MSCI AC World Software Index

Source: Factset, Bloomberg, UBS estimates, as of December 2023

Non-Traditional Assets

Non-traditional asset classes are alternative investments that include hedge funds, private equity, real estate, and managed futures (collectively, alternative investments). Interests of alternative investment

funds are sold only to qualified investors, and only by means of offering documents that include information about the risks, performance and expenses of alternative investment funds, and which clients are urged to read carefully before subscribing and retain. An investment in an alternative investment fund is speculative and involves significant risks. Specifically, these investments

1. are not mutual funds and are not subject to the same regulatory requirements as mutual funds;
2. may have performance that is volatile, and investors may lose all or a substantial amount of their investment;
3. may engage in leverage and other speculative investment practices that may increase the risk of investment loss;
4. are long-term, illiquid investments, there is generally no secondary market for the interests of a fund, and none is expected to develop;
5. interests of alternative investment funds typically will be illiquid and subject to restrictions on transfer;
6. may not be required to provide periodic pricing or valuation information to investors;
7. generally involve complex tax strategies and there may be delays in distributing tax information to investors;
8. are subject to high fees, including management fees and other fees and expenses, all of which will reduce profits.

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In addition to the risks that apply to alternative investments generally, the following are additional risks related to an investment in these strategies:

- **Hedge Fund Risk:** There are risks specifically associated with investing in hedge funds, which may include risks associated with investing in short sales, options, small-cap stocks, "junk bonds," derivatives, distressed securities, non-U.S. securities and illiquid investments.
- **Managed Futures:** There are risks specifically associated with investing in managed futures programs. For example, not all managers focus on all strategies at all times, and managed futures strategies may have material directional elements.
- **Real Estate:** There are risks specifically associated with investing in real estate products and real estate investment trusts. They involve risks associated with debt, adverse changes in general economic or local market conditions, changes in governmental, tax, real estate and zoning laws or regulations, risks associated with capital calls and, for some real estate products, the risks associated with the ability to qualify for favorable treatment under the federal tax laws.
- **Private Equity:** There are risks specifically associated with investing in private equity. Capital calls can be made on short no-tice, and the failure to meet capital calls can result in significant adverse consequences including, but not limited to, a total loss of investment.
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