

The TechGPT Compendium

TechGPT series

A comprehensive guidebook for your AI and tech journey

October 2023 | Chief Investment Office GWM | Investment Research



UBS

Contents

- 03 **Foreword**
- 04 **Chapter 1**
At the cusp of AI era
- 17 **Chapter 2**
Tactical drivers in tech
- 23 **Chapter 3**
Taking stock of tech's fundamentals
- 28 **Chapter 4**
Embracing the new frontiers
- 37 **Chapter 5**
Keeping tech in check
- 45 **Chapter 6**
One more thing...

The TechGPT Compendium

A comprehensive guidebook for your AI and tech journey

Editor-in-chief

Sundeep Gantori

Product management

Bennett Chu

Editors

Murugesan Suppayan

Michael Yang

Thompson Wong

Desktop publishing

CIO Content Design

Cover picture

Anita Affentranger (www.unsplash.com)

Contact

ubs.com/cio

Authors



Sundeep Gantori
CFA, CAIA



Delwin Kurnia Limas
CFA



Bennett Chu
CAIA



Kevin Dennean
CFA

Important disclosure

This report has been prepared by UBS AG Singapore Branch and UBS Financial Services Inc. Please see important disclaimers and disclosures at the end of the document.

Foreword



“AI will accelerate (global) tech spend as a percentage of global GDP from 5% to 10%.”

– Satya Nadella, CEO, Microsoft

Dear reader,

In a year redefined by generative AI, globally, tech stocks have rebounded strongly. They have risen 25–30% so far in 2023, recovering most of the losses witnessed in 2022. This is despite muted earnings growth for tech in 1H23 as strong re-rating fuelled by generative AI and restructuring efforts led to significant valuation multiple expansion, with global tech’s forward P/E rebounding from around 20x at the beginning of the year to 24–25x currently.

The strong turnaround in tech’s fortunes has been powered by the rising popularity of generative AI, which has taken the world by storm. Many consumers today can readily approach a chatbot to ask questions on anything that’s on their mind. In the same spirit, to answer the most frequently asked questions from investors on technology and related topics, we introduced our “TechGPT” publication in June 2023.

With strong mid-teen earnings growth expected for tech in 2024, we see no dearth of questions on tech as investors start to position for next year and also review their investments in 2023. Hence, we combine all the questions we have addressed so far into a consolidated “The TechGPT compendium” spread across six chapters focusing on AI, tactical drivers in tech, the latest fundamental outlook, new tech frontiers, regulations, and miscellaneous topics.

We hope you enjoy reading this report. And please send in questions regularly for us to address in our upcoming publications.



Sundeep Gantori
Equity Strategist (Global Tech)
Global Wealth Management

Authors

Sundeep Gantori, CFA, CAIA
Delwin Kurnia Limas, CFA
Bennett Chu, CAIA
Kevin Dennean, CFA

Other contributing authors

Paul Donovan
Lachlan Towart
Allen Pu, CFA



Source: Getty images

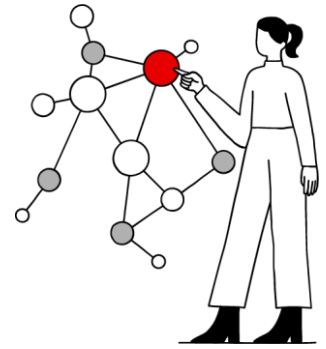
Chapter 1: At the cusp of AI era



“Artificial intelligence is one of the most profound things we're working on as humanity. It is more profound than fire or electricity.”

– Sundar Pichai

All roads are leading to AI in tech as we expect many growth trends to converge and unleash the power of artificial intelligence. In this chapter, we provide a deep dive on how investors should position for the next big thing in tech, i.e. artificial intelligence.



Is AI opportunity comparable with any of the recent tech trends?

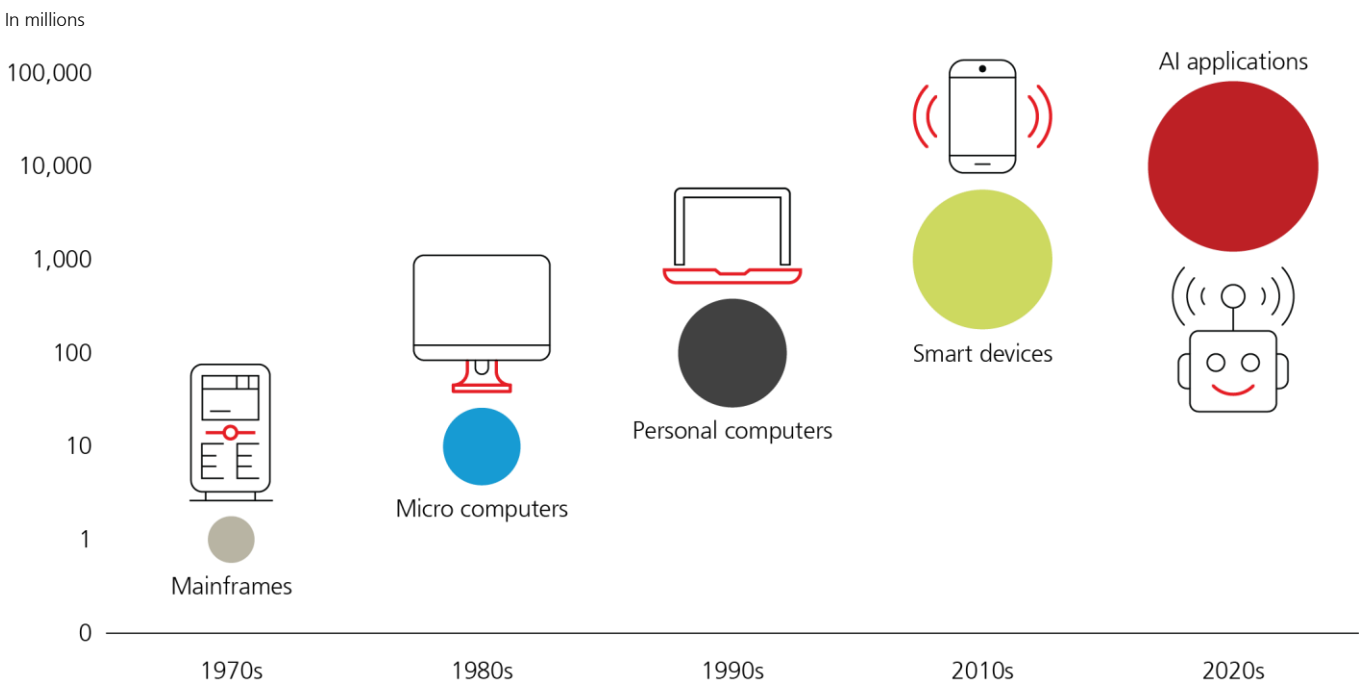
The only constant in technology is change as many new innovations like smart devices, e-commerce, cloud, etc. have redefined the way we use technology although a few innovations like 3D printing or metaverse have so far failed to live up to the hype. Given the AI revolution is in the nascent stages, it is natural to ask whether AI can deliver the promise and whether AI can be compared with other recent technology trends. As highlighted later in this report, we don't think AI is a bubble as we see significant growth opportunities. There are strong comparisons, in our view, with the recent smart device opportunity that can provide investors with a very good blueprint on understanding the investment opportunity. Before we delve into the comparisons, it is imperative to understand the evolution of the computing cycle.

The computing cycle has evolved in such a way that each one lasted for at least 10–15 years with a significant 10x or so expansion in annual shipments. The annual shipments for mainframes was only about 1mn units until the 1980s, when

they expanded to around 10mn when microcomputers became mainstream computing devices. This was then followed by a sharp increase during the PC era, when the annual PC shipments shot up to more than 100mn units, with PC shipments eventually reaching an annual run rate close to 300mn. Smart devices, which include smartphones and tablet PCs, crossed 1bn shipments during the mid-2010s while current annual shipments are close to 1.5bn units. With AI, we expect this 10x growth trend to continue, with potential annual AI chatbots and applications crossing 10bn units very soon.

Consequently, we believe AI has significant potential to exceed the opportunities created by the smart device trend. As a background, while smart devices have now reached the mature stage (growth is only in low single digits), during the early stages from 2009 to 2017 we were very bullish on the trend. We believe AI is set to take off like smart devices did from 2009. Here are four similarities between the two trends:

Evolution of computing devices and size of annual addressable markets



Source: UBS, as of 2023



Innovation triggered by a simple device/application:

While smart devices have existed since 2004, we believe the introduction of the iPhone in 2007 was a game changer thanks to its simple user interface powered by touch screens that attracted millions of users. And with the introduction of App Store in 2008, demand for smart devices exploded, driving many app-based business models like mobile payments or commerce, social networking, ride sharing, etc. Similarly, AI has been in existence for some time but the introduction of ChatGPT in late 2022 provided a similar inflection point. Indeed, we call ChatGPT the “iPhone moment” for AI, which with its simple user interface has helped us reimagine the way we use computing, online search or social interactions in the past few quarters, attracting millions of users to generative AI. The launch of copilots and other enterprise applications with extreme automation and safety is the “App Store” moment as we believe many new business models centered around AI will emerge soon. This gives us confidence that AI is a sustainable trend like smart devices with strong medium to long-term visibility.

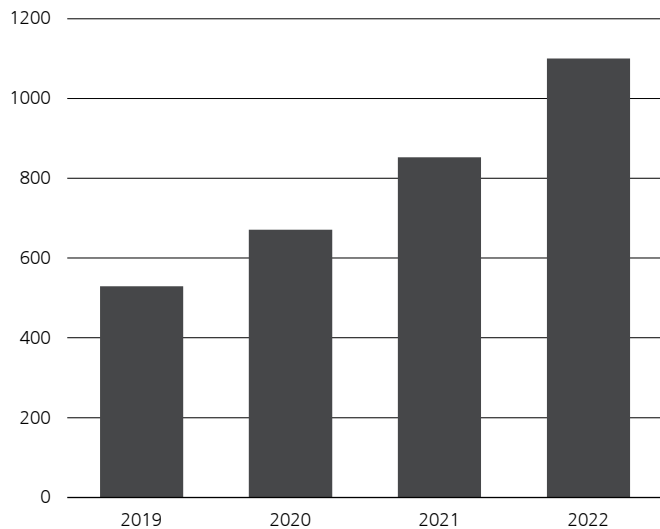


More than 10x jump in revenues in addressable market:

The smart device industry was generating revenues close to USD 50bn in 2009 based on company reports and data from Bloomberg Intelligence and crossed USD 600bn in 2017—that’s almost 12x growth in eight years. The strong growth outlook was one of the major reasons behind our bullish view on the smart device industry during its infancy. While in the past decade many tech trends have emerged, AI is the only one, in our view, which matches the >10x growth potential of smart devices at such a big scale; we expect AI industry revenues to grow from USD 28bn in 2022 to USD 300bn in 2027. Our growth estimates for AI exclude the solid economic value that AI is expected to add across industries. Against this backdrop, despite the ebbs and flows in stocks markets, we see AI as a trend that is going to stay here like smart devices and create strong investor wealth in this decade.

App Store now contributes more than a trillion dollars to developers total billings and sales

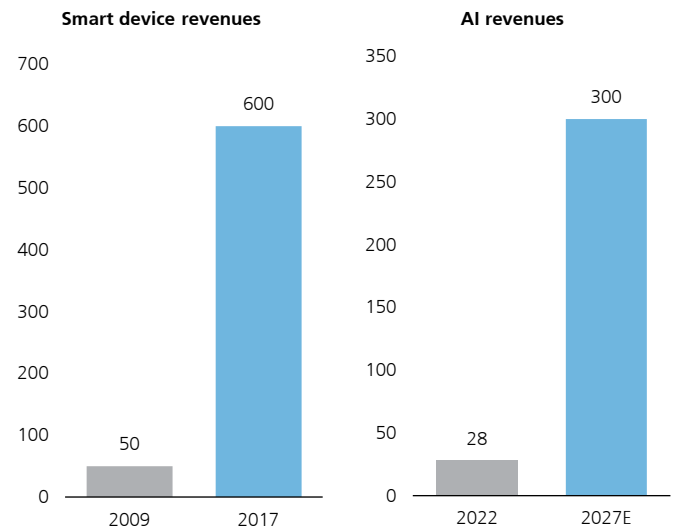
App Store developers billings and sales (USD bn)



Source: Company reports, UBS, as of 2023

More than 10x jump in smart devices and AI revenue addressable market

In USD bn



Source: Company reports, Bloomberg Intelligence, UBS, as of 2023



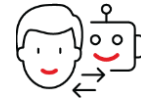
“While in the past decade many tech trends have emerged, AI is the only one, in our view, which matches the >10x growth potential of smart devices at such a big scale”



Major investments from leading companies

creating a solid ecosystem:

While many tech trends have emerged in the past two decades, smart devices and AI are unique as they have attracted very large investments from leading companies from the very early stages. For instance, trends like 3D printing, metaverse, fintech, and healthtech have remained niche areas with select investments, whereas the “mobility” trend powered by smart devices and the “automation” trend powered by AI have become ubiquitous attracting billions of dollars from leading companies, including investments from companies beyond the tech sector. As a result, the strong commitment shown by leading players has created a solid ecosystem, attracting hundreds of thousands of developers to build applications further supporting high recurring revenue models. Hence, we believe if the past decade was defined by the “app economy” having a significant macroeconomic impact on jobs, inflation, and GDP growth, the next decade will be mostly about the “AI economy” creating a bigger impact also on jobs, productivity, inflation, and geopolitics.



“Generative AI is a new form of creativity that will redefine human expression.”

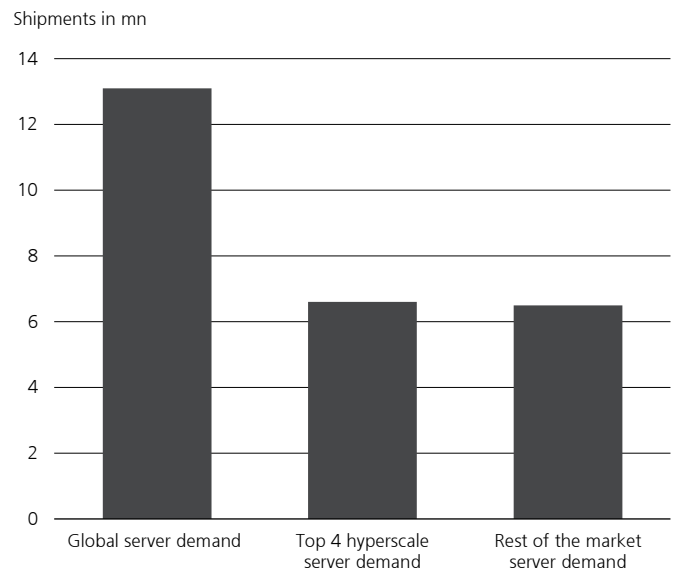
– Sundar Pichai



Further consolidation in tech:

While smart devices have created solid investor wealth over the past decade including in the supply chain, the theme has clearly powered a “winner take it all” trend where industry profitability was dominated by a few companies. As a result, some leading companies disproportionately benefitted from strong profitability which was also reflected in their strong returns. We believe AI will support another consolidation trend in tech where “big will get bigger”. This doesn’t mean only tech benchmark heavyweights will benefit; our view is that AI leaders across industries with strong first mover advantage in AI and deep pockets that can invest in a highly capex intensive industry like AI will benefit. As a result, picking AI industry leaders that can disrupt many traditional business models and also their smaller peers should be the key beneficiaries in the AI era, similar to how smartphone companies benefitted platform companies that managed to amass millions if not billions of users. We expect the top four tech companies to drive more than 50% of global server demand in 2024 based on our estimates, with the rest of the thousand or so companies contributing the rest. As a comparison, these top four companies contributed roughly one third of global server demand before the COVID pandemic. So, we see AI continuing to drive further consolidation in the tech space.

Our 2024 server shipment projections confirm the trend of “big getting bigger” in the AI era



Source: Company report, Bloomberg Intelligence, UBS estimates, as of 2023



“We believe AI will support another consolidation trend in tech where “big will get bigger”.”

Is AI a bubble?

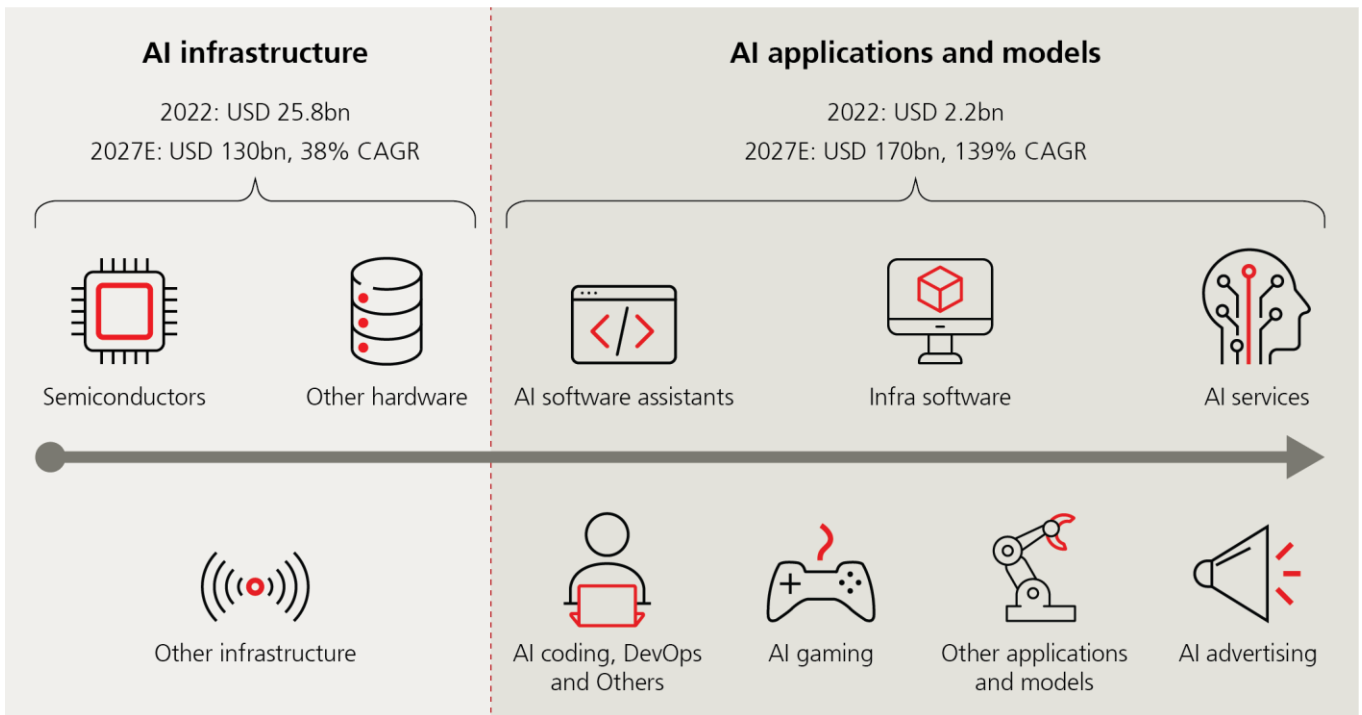
Simply put, no—we don't think the AI trend is a bubble. First, AI, or generative AI, has clear use cases for both consumers and enterprises, distinguishing it from previously-hyped tech trends like 3D printing, which failed to take off in a big way. Popular consumer generative AI tools like ChatGPT and Midjourney have already sparked an enterprise rush to build or incorporate AI tools across a wide range of businesses and services. Crucially, we see artificial intelligence as a “horizontal” technology that will have important use cases across several applications and industries, such as knowledge services (including the technology, media, and telecom sector) and financial services.

Second, the adoption of generative AI has been rapid and consumer-led. ChatGPT built up a million users within a week of its launch in November 2022, and now has more than 200 million users. This is a far faster uptake than most prior technological innovations. Even the smartphone—now ubiquitous in developed nations—took several years to pick up momentum.

In addition, most previous technological innovations, including personal computers and the internet, were used by businesses first, rather than consumers.

Third, AI is fuelling growth for a range of critical industries, including semiconductors and cloud computing. The broad AI market generated nearly USD 28bn in revenues in 2022, according to Bloomberg Intelligence data. We expect the market to grow at a 61% compound annual growth rate (CAGR) to reach USD 300bn by 2027. The strong growth should initially be driven by the AI infrastructure market—which we expect to grow at 38% CAGR—and later driven by AI applications and models, which we expect to grow at 139% CAGR. That said, our estimates may prove to be conservative; the growth opportunity could be even higher if generative AI improvements (e.g., computing power, machine learning, and deep learning capabilities), talent availability, enterprise adoption, government spending, and incentives are stronger than expected.

The AI monetization stack



Source: UBS, as of 2023

What can bring AI down?

While we don't think AI is a bubble, we agree it's not cheap, overall. There are some segments where valuations are lofty, particularly in unprofitable tech. However, for the more established AI companies, we think valuations look reasonable after the summer reset—at around 30x forward price-to-earnings with an addressable market growth rate of 61% CAGR, based on our estimates.

While we don't expect a meaningful correction for AI stocks after the summer reset, a potential additional reset could come from: a) Expensive valuations as overall AI-related stocks still trade at around 30x forward P/E, well above the broader tech average of 24-25x. While we agree AI-related stocks deserve a premium versus the broader market, we believe unprofitable AI and other sub-scale AI companies have run ahead of fundamentals and could risk a correction if they fail to monetize; b) Increased regulation: Unlike other tech innovations, governments across the world appear keen to regulate AI despite its relatively early stage of adoption, particularly when it comes to security, ethics, and job impact. That said, we don't expect excessive hurdles as governments may seek to avoid stifling AI-related innovation; c) Supply bottlenecks: We believe extended chip shortages (mostly graphics processor units, or GPUs) and talent pose near-term risks to AI adoption, which may weigh on revenues; d) Increased competition: Given the fast pace of innovation, we see more entrants in the AI space (there are already more than 10 generative AI-related unicorns) that could intensify competition and cap margins for key AI players; and e) Broad-based failure in the AI monetization strategy.

Still, we believe a potential meaningful correction after the recent reset for AI-related stocks should provide investors with an opportunity to revisit AI, given the structurally increasing long-term adoption in both consumer and enterprise applications and the solid 61% projected growth rate per year.

How can AI companies monetize?

Before we size up AI's global market, it's critical to understand how AI companies can monetize their value or assets. Generally, there are two broad avenues for AI-related companies to create revenue—the infrastructure layer, and the applications and data model layer.

The infrastructure segment mainly focuses on computing, networking, storage, and other related areas required to run huge datasets and AI-based applications. This segment is dominated by semiconductor and hardware companies, as well as infrastructure-based data center companies. The other way to monetize is through data models and applications. Companies can license their large data sets or run big data analytics in the model layer and AI-specific applications in the

application layer across the spectrum— from enterprise-based applications such as office productivity, customer resource management, front/back office software, all the way to consumer applications like advertising and gaming, among others. Currently, we believe most AI-related spending is concentrated in the infrastructure layer, given the need to build and train huge datasets. But with more signs of broadening demand, we expect the applications and models segment to emerge as the dominant force in the medium to long term.

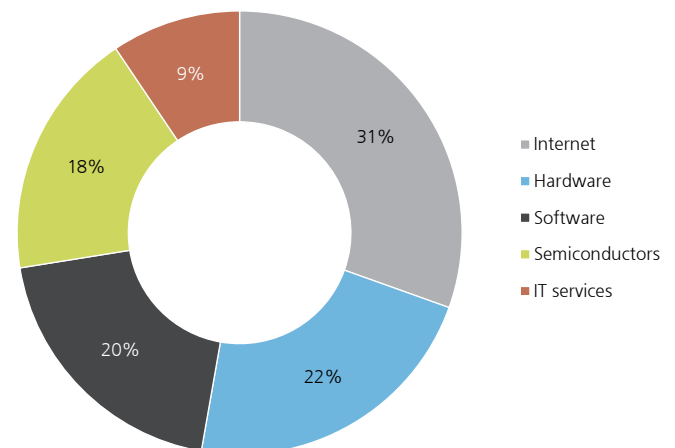
How has AI contributed to the 1H23 tech rally?

Globally, the five industries in tech—semiconductors, hardware (both early cyclicals), software, internet (both mid-cyclicals), and IT services (late cyclicals)—had a combined market cap of around USD 26 trillion in 1H23, accounting for roughly one third of the MSCI AC World Index.

In 1H23, the combined global tech market cap climbed by USD 6 trillion. While rising interest in AI was a key driver, there were other important factors, such as bottoming earnings revisions, market expectations of peaking rates, ongoing tech restructuring efforts, and solid share buybacks. However, based on our bottom-up calculations and the most AI sensitive stocks and industries, we think AI-related stocks contributed roughly USD 2 trillion to the combined market cap, or about one third of the global tech rally in 1H23. While we don't think AI is a bubble given its use cases and solid long-term visibility, we prefer companies with clear monetization trends.

Global tech breakdown by industry as of 1H23

Market cap share (%)



Source: Bloomberg, Factset, UBS, as of 2023

How should investors position in AI?

We believe the strong 1H23 rally in semiconductors and hardware stocks fairly discounted the solid growth prospects in AI infrastructure. Meanwhile, the risk-reward remains more attractive for software and internet stocks, which, in our view, are well-positioned to ride the broadening AI demand trends. We see significant opportunities over the next few quarters, such as in the integration of AI “copilots” in office productivity software, rising demand for AI analytics, and AI integration in image/video and other enterprise applications.

As a result, we believe software companies are well-positioned to not only benefit from a potential expansion of the addressable market as AI-related software spending sharply rises across industries—including healthcare, media, autos, and other traditional industries—but also from repricing tailwinds and other cost efficiencies. A case in point is Microsoft’s 365 Copilot subscription (an AI assistant for designing presentations or writing drafts), priced at USD 30 per user each month—significantly above market expectations of USD 10–15.

With the Microsoft 365 subscriber base at close to 400mn, the table on this page shows a sensitivity analysis on how the Copilot program—with only modest penetration rates—can bring additional AI-related revenues. Meanwhile, UBS expects 15% of new applications globally to be automatically generated by AI without any human involvement by 2027 (from 0% today). This, in our view, represents a large boost to the software industry as innovation and time-to-market are accelerated.

Our positive view on software is consistent with our tech playbook, which calls for a gradual rotation away from early cyclical like semiconductors and hardware into mid-cyclicals. Beyond near-term opportunities in software, we also highlight internet as another medium-term beneficiary as AI is becoming more integrated in consumer applications like gaming, entertainment, and advertising.



“AI is no different from almost all other technological innovation over the centuries. As with previous technological changes, the emphasis should be less about the technology itself and more about how businesses adapt to implement the technology.”

Revenue sensitivity (in USD mn) of Microsoft’s 365 Copilot program (penetration rates vs. number of paid M365 subs.)

Assuming only monthly Copilot subscription fee of USD 30 per user

		% Penetration of Base					
		5%	10%	15%	20%	25%	30%
Number of Paid M365 Subscribers (in mn)	360	6,480	12,960	19,440	25,920	32,400	38,880
	380	6,840	13,680	20,520	27,360	34,200	41,040
	400	7,200	14,400	21,600	28,800	36,000	43,200
	420	7,560	15,120	22,680	30,240	37,800	45,360
	440	7,920	15,840	23,760	31,680	39,600	47,520

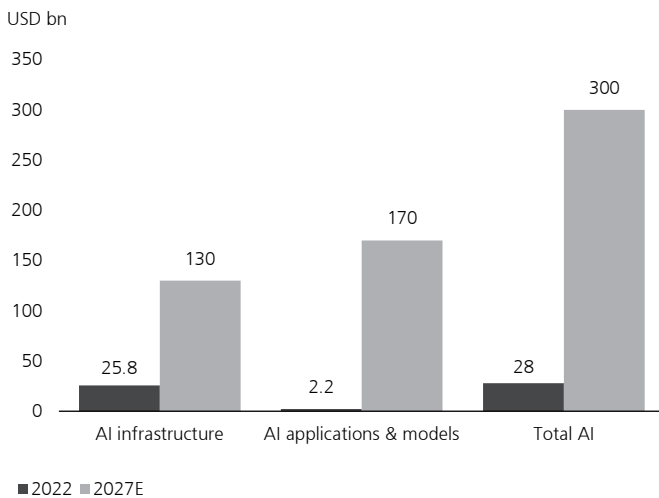
Source: Company report, UBS as of 2023

How large is the global AI addressable market?

In 2022, we forecast that global AI demand would grow from USD 36bn in 2020 to USD 90bn by 2025, or a roughly 20% CAGR, with most of the focus on the infrastructure layer. While AI demand was muted in 2022, the emergence of generative AI at the end of last year and the rapid pace of innovation this year now give us more confidence about end use-cases. As a result, we expect a broadening of the AI market—from the semiconductor and hardware-centric infrastructure layer, to the software and internet-based applications, and the data models layer.

Based on Bloomberg Intelligence data, we now expect global AI demand to grow from USD 28bn in 2022 to USD 300bn in 2027 at a 61% CAGR. In that time, we think the infrastructure segment will grow by a 38% CAGR and the applications and models segment by a 139% CAGR, with both segments sharply outpacing the broader tech market. Key risks to our estimates include tighter regulations, slower-than-expected enterprise adoption, intensive competition, and data privacy issues.

AI's addressable market expected to rise at a 61% CAGR over the next few years



Source: Bloomberg Intelligence, UBS estimates, as of 2023

Why is AI computing so expensive?

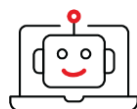
AI-based computing is not cheap. A quick scan across news headlines shows why—some advanced graphics processing units (GPUs) cost USD 20,000 to USD 30,000 for a single chip. Indeed, most generative AI companies today don't actually generate profits, given the heavy investment needed for AI-based computing.

Unlike traditional computing, which is based on serial computing handled by traditional CPU chips, AI-based computing involves parallel processing, which requires investment in training through GPUs. This process, where AI-based neural networks are trained for large language models (LLMs) in generative AI, involves a mathematical approach that differs from classical machine learning and statistics due to the unstructured nature of the datasets it uses. When comparing the cost structure of a traditional server and an AI-based server, it becomes clear that GPUs disproportionately drive the incremental costs. Interestingly, while the relative share of memory is smaller in AI-based servers, we still expect the overall addressable market to expand on an absolute basis, including networking. Beyond the GPU supply chain, which has already rallied significantly this year, we also like leaders in memory and networking segments that have lagged their broader tech peers year-to-date.

Cost structure of traditional servers vs. AI-based servers

	Traditional server		AI-based server	
Costs in USD	9,179	100%	69,590	100%
CPU	1,850	20%	5,200	7%
GPU	0	0%	40,000	57%
Memory and Storage	4,373	48%	9,053	13%
Network	523	6%	8,726	13%
Chassis	316	3%	450	1%
Motherboard	280	3%	700	1%
Cooling	220	2%	370	1%
Power supply	240	3%	960	1%
Assembly and Test	551	6%	1,652	2%
Design	826	9%	2,478	4%

Source: Goldman Sachs, UBS estimates, as of 2023



“AI is in a ‘golden age’ and solving problems that were once in the realm of sci-fi.”

– Jeff Bezos, Amazon CEO

What does AI mean for geopolitics?

AI is likely to be economically disruptive, in our view. Some jobs should become more valued, while others are likely to become obsolete. Such periods of economic upheaval typically create social tensions. Groups that enjoy rising status and income are unlikely to complain, but those who see their income and status decline may want someone to blame (especially if they are on the way down while their neighbor is on the way up).

The causes of this relative social change are complex, but one theory is that people naturally crave simplicity. This creates the risk of scapegoat economics, where a group in society is identified (incorrectly) as being the cause of the loss of social status. This then encourages prejudice politics, where the scapegoat is targeted by policies that seek to undermine them.

This matters geopolitically because throughout history, scapegoat economics has nearly always attacked foreigners at some point. Foreigners tend to always be a convenient target, which, in our view, encourages the specific form of prejudice politics that is represented by economic nationalism.

Meanwhile, in an increasingly bipolar world, we think AI should lead to a further escalation in geopolitical tensions—as evident in recent restrictions and bans introduced by the US and other retaliatory measures by China. Currently, the US and its allies have restricted the sale of advanced chips used in AI to China (like NVIDIA's A100 and H100 chips) and advanced equipment sales related to 14nm and below, while China has retaliated by announcing restrictions on select US companies and the sale of materials and metals used in the manufacturing of chips. With the generative AI industry still in its infancy, we expect a further ratcheting up in geopolitical tensions and advise investors to manage risks accordingly.

Considering all this, we favor stocks that may benefit from a further escalation—largely due to their neutral positioning, their potential benefits from order shifts, and a reduction of concentration risks. Meanwhile, any significant overreaction in stocks exposed to geopolitics should also present opportunities, as witnessed in September/October 2022.

Key risks to our view include weaker-than-expected end-demand, delayed technology migration toward more advanced nodes or architectural designs, geopolitics, and price cuts or discounts from tight competition.

What does AI mean for data privacy?

While the rising trend of generative AI appears irreversible, its success also raises questions around data privacy and cybersecurity. We are entering a new era where a lot of data is likely to be created by AI. This AI-generated content, also known as AGC, evolves first from platform-generated content (PGC), and then user-generated content (UGC). Equally, generative AI can also accelerate innovation around data management and security, in our view.

First, let's address the risks from the growth of generative AI on the security front. Generative AI is exposed to big data risks, in our view, because it trains large-language models (LLMs) which involves huge data sets (many generative AI applications today have almost 200–500 billion parameters, with some exceeding 1 trillion parameters). These risks include a lack of transparency (including irrelevant sources), collection of users' private data, exposure of proprietary data, downsides from the extended storage of data, and other data breaches and leaks. The good news is that major cybersecurity vendors are accelerating innovation and are ready to tackle incremental complexity arising from generative AI.

Meanwhile, generative AI—as an enabling technology—should help the cybersecurity industry drive more innovation, in our view. For example, generative AI can help in synthetic data creation or to synonymize data copies to test the robustness of cybersecurity applications during the development process. Another potential positive is in coding, where generative AI might not just help with code, but also help search existing code for app vulnerabilities and offer contextualized recommendations for remediation. For example, Microsoft leveraged generative AI and introduced Microsoft Security Copilot to optimize incident response management, threat hunting, and security reporting for users, and it integrates insights and information from its other applications to do so.

In summary, while generative AI may pose data risks, we view the technology positively overall, and think it acts as an incremental growth driver, if the risks are addressed properly and if companies are able to leverage this innovation.



“Generative AI—as an enabling technology—should help the cybersecurity industry drive more innovation, in our view”

What does AI mean for productivity and GDP growth?

Introducing AI into the economy should meaningfully improve efficiency—otherwise, why would companies bother to change the way they do things? As more routine tasks are automated, worker productivity should improve. In this, AI is no different from almost all technological innovation over the centuries. As with previous technological changes, the emphasis should be less about the technology itself and more about how businesses adapt to implement the technology. Maximizing productivity may require a rethinking of business models, not just tweaking existing practices to accommodate AI.

The growth implications of AI are less clear. Gross domestic product (GDP), as a measurement of improving living standards, is a rather antiquated concept, in our view. AI may lead to increased production (which is GDP-positive). It might also focus on more efficient production—and while efficiency increases living standards, it does not necessarily increase GDP.

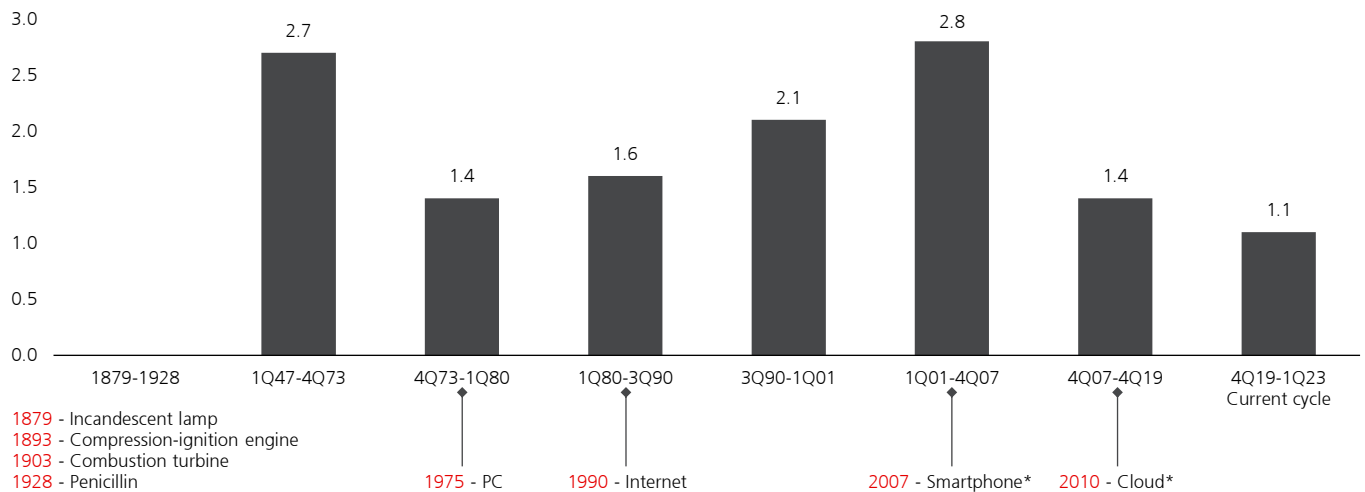
For instance, applying AI appropriately might result in unchanged output but increased leisure time. That is a positive for input economic measures of growth, but not output economic measures of growth like GDP.

Overall, we think it is likely that AI should either generate output that would not otherwise occur, or free up people's time to allow them to pursue new activities to generate different forms of economic output that are not directly related to AI. But the balance between efficiency and output means that the full impact on GDP growth remains uncertain.

While the full impact on GDP growth is not clear, we believe software companies with first-mover advantages in AI that can drive productivity will be clear winners.

AI to increase productivity growth ahead

Productivity change in the US non-farm business sector, average annual percent change (%)



* Inflection points for smartphone and cloud.

Source: US Bureau of Labor Statistics, UBS, as of 2023



“Maximizing productivity may require a rethinking of business models, not just tweaking existing practices to accommodate AI.”

What does AI mean for jobs?

Ever since the First Industrial Revolution, almost every technological change has been seen as reducing employment. Every time the argument has been wrong, in our view. It is certainly true that some jobs will be lost to AI. But it is important to look at the individual tasks one performs in one's job. The simple rule is "if half your job can be automated, change your job. If less than half your job can be automated, your job will change". Clearly, there will be jobs in the first category that technology will render obsolete, as has happened in the past. Few offices today have "typing pools", for example.

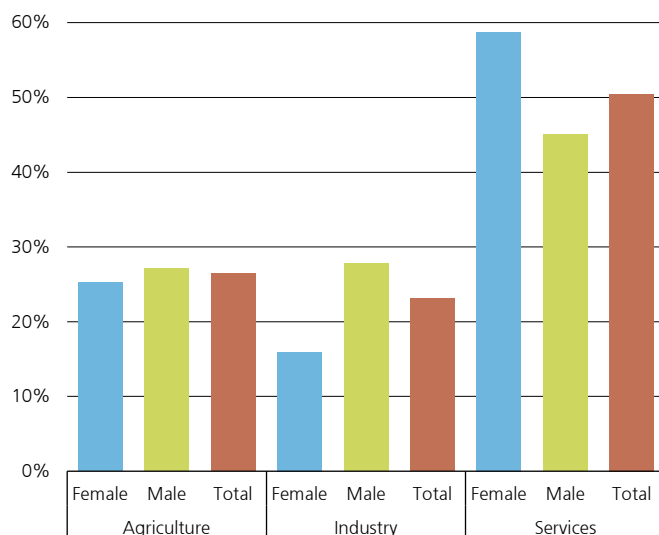
AI is also likely to create new jobs that were not previously thought of. Roughly 10% of the labor roles that existed at the end of any decade did not exist at the start of the next decade. This is either because technology created new opportunities that were not previously possible, or because it lowered barriers to entry in existing professions. A parallel example is the increase in employment in the entertainment industry as social media and streaming collapsed the barriers to entry into music and film.

As with other forms of technology, this means that the flexibility of workers is critical—either in retraining if their jobs are obsolete, or accepting that they need to adapt their working practices to accommodate AI. It will also likely be important to employ the right people, in the right jobs, at the right time. That requires removing barriers to labor mobility—either legal obstacles, or the damaging constraint of social prejudices.

Within technology, we believe industries like IT services which depend the most on human capital (employee costs are >40% sales) are at a risk of disruption from significant automation.

Global share of employment across key sectors

Proportion of total employment (%)



Source: World Bank, UBS, as of 2023

What does AI mean for inflation?

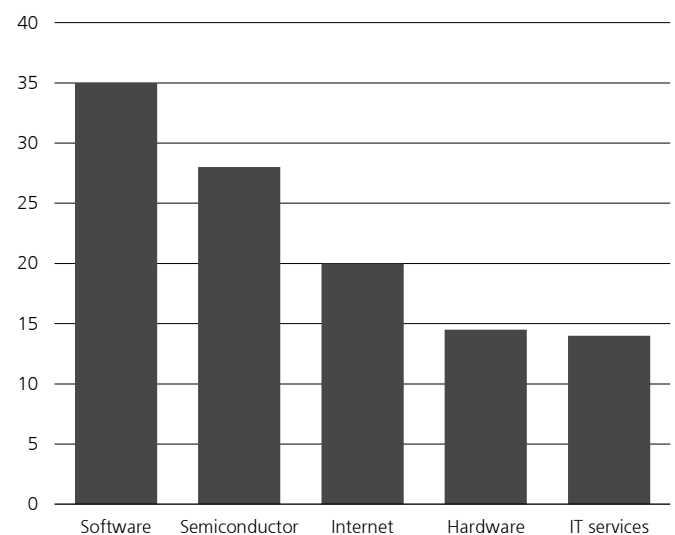
In theory, if AI improves efficiency, there should be a reduction in inflation. Efficiency gains may go into higher profit margins, but over time, economists would expect some of those profits to be competed away—and the competition involved suggests a lower rate of inflation. However, AI should also change relative prices. Thus, the value placed on certain workers or certain commodities may adjust as AI makes some things possible that were previously uneconomical. Within the idea of greater efficiency, there is also the concept of increased volatility for individual prices.

Over time, we think AI may make the concept of economy-wide inflation meaningless. First-degree price discrimination occurs in an economy when each customer is charged a personal price, based on the seller's understanding of the enthusiasm and willingness to pay off that customer. This is an old concept—before the mid-20th century, when retail was a local affair and shopkeepers knew their customers personally, different people would be charged different prices. One application of AI may be to more readily identify an individual's determination to buy a product, which would allow the seller to charge the highest possible price that the buyer will be prepared to pay. Modern calculations of inflation assume a universal price—indeed, they exclude prices generated by schemes that give certain groups a special price discount. AI may make the idea of a universal price an increasingly meaningless concept, in our view.

Within tech, software, internet and semiconductors enjoy better pricing power, whereas hardware and IT services with only low to mid-teen margins are mostly at risk if AI drastically changes the way goods and services are priced.

Operating margins for five tech industries

Operating margin (%)



Source: Factset, UBS estimates, as of 2023

What is the state of healthtech and how can generative AI act as a catalyst?

The past 18 months have challenged healthtech, but we believe the core drivers are still in place. Rising per-capita healthcare spending and constrained government budgets suggest a growing need to find efficiencies in healthcare systems, even before the expected economic slowdown. Digitalization can help to reduce waste and achieve efficiencies without sacrificing outcomes. It also supports another key trend: the consumerization of healthcare. Data and connectivity remain the key enabling technologies; they are increasingly converging with biology to create new approaches to diagnostics, treatment, and drug discovery. The theme is evolving as new applications of technology in healthcare gain traction. Tech companies remain interested in the space, and we have seen signs of consolidation, a trend we expect to continue.

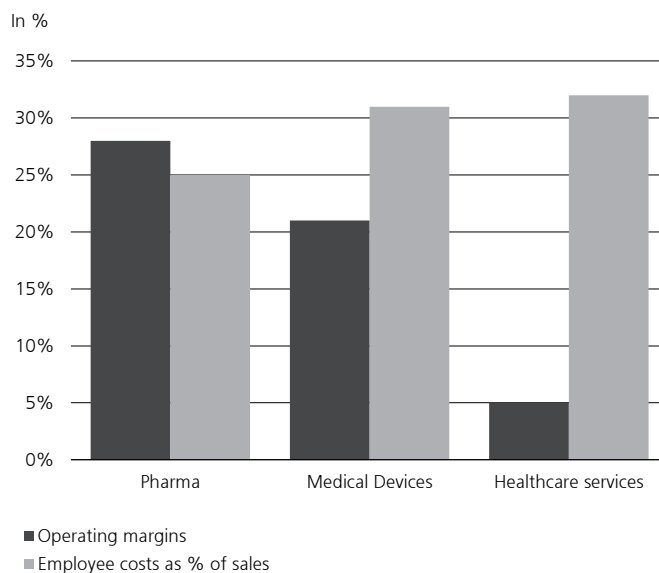
Specific to AI, we see the adoption of digital technology more broadly as one way in which healthcare systems can potentially control costs without sacrificing health outcomes. The industry's exploration of AI and machine learning (ML) approaches should be seen in this context. While there is a need to improve efficiency and reduce costs across the entire healthcare ecosystem, from the investor's point of view, the largest potential area of value creation would be an improvement in biopharma R&D efficiency. Pharma and biotech companies represent around half of the MSCI AC World Healthcare index by capitalization, as well as a substantial part of the universe of private healthcare companies. Pharma and large-cap biotech stocks often trade at a discount to the market, reflecting the perceived decline in the industry's R&D efficiency, and the resulting "patent cliffs" they face. Companies have long been exploring new tools, including AI, in an attempt to improve returns on R&D. This has taken place both internally, within the R&D departments of large-cap pharmas, and at start-up companies sometimes referred to as "tech-enabled drug development".

Two important goals at the early stages of a drug's development are to shorten the drug discovery cycle (from target identification and chemical/biological compound candidate selection through filing and initial investigational new drug (IND) applications with the FDA), and to improve the discovery-through-FDA-approval success rate. Companies that use ML to enhance drug development typically estimate the former can be reduced by around half, from 3–4 years to 18–24 months, with those same companies indicating that the success rate could potentially be increased from 10% to 20–30%. This would have a big impact on the number of drugs in the industry pipeline, and ultimately, approved therapies, if successfully implemented.

However, a number of potential challenges need to be overcome. One key limitation is data—massive amounts of chemical and biological data need to be processed (chemical data 1060, biologic data 1016) and the data is universally available, so there is no proprietary edge in accessing that data. Also, simply bringing more drugs to market may not dramatically change the industry's aggregate growth rate although individual companies could certainly benefit. Drug spending represents around 15–20% of total healthcare costs, and is often targeted for savings; while patients could benefit from more new treatments, the budget impact could lead to more price pressure on the industry as insurers squeeze manufacturers for discounts. Reducing the cost of developing drugs could also lower a competitive moat for the industry, which again could drive price pressure.

More broadly, many healthcare companies are recognizing the benefits of ChatGPT or large language models in streamlining various time-consuming administrative processes. For drug developers, this could include regulatory filings, or potentially procedure coding for healthcare providers. Given the complex and domain-specific procedures involved in many healthcare administrative tasks, companies that specifically offer products and services in these areas have emerged and will likely continue to do so.

AI to drive efficiency gains in healthcare



Source: Factset, UBS, as of 2023

Which healthcare segments are most and least exposed to generative AI?

AI adoption varies across various healthcare verticals. Perhaps the most tangible current applications are linked to reducing administrative costs for providers and insurers, while improving pharma R&D productivity and reducing the total cost of care through more proactive and preventive treatment approaches remain “blue sky” goals. We briefly assess the scope for AI across the major healthcare subsectors; for more details, please refer to our Longer Term Investments—HealthTech series.



Drug development

For biopharma companies, faster drug discovery and development could be an upside when applying AI/ML tools in R&D. However, it is still unclear how much any resulting benefits would ultimately accrue to the drug industry.

Still, the prospect of faster and cheaper drug development has led to the formation of a growing number of companies that either provide AI/ML-driven R&D services to pure-play pharma companies, or apply these techniques to develop their own proprietary drug candidates. As these services gain traction in the industry, they may become attractive targets for life sciences tool companies, such as clinical research organizations (CROs) that provide outsourced R&D services to the pharma industry. While a few tech-enabled drug discovery companies have begun to move their own drug candidates into clinics, this stage of development requires significant know-how and capital, suggesting that the outlicensing of these drugs to pharma partners may ultimately be the chosen strategy.



Diagnostics and treatment

In diagnostics, imaging companies have been successfully implementing AI for several years and software already generally outperforms most human radiologists in reading images. So far, AI has mainly been used to free up radiologists' time for other work, but future use cases could potentially include interrogating larger datasets to identify diseases at an earlier stage than is currently possible. Diagnostic companies that can combine access to proprietary datasets with AI/ML and data-mining may be able to

develop more accurate and timely diagnostic tests. This would improve patient outcomes, while potentially creating a sustainable competitive advantage for the test manufacturer. Earlier treatment usually leads to better outcomes at a lower cost, but there is a risk of over-diagnosis and over-treatment in some cases. The challenge will be getting enough access to quality provider data, as data is siloed and regulated. We do not expect software to reach the point of fully automating medical diagnoses in the foreseeable future.

For healthcare providers, better data analysis, faster/more accurate diagnoses, and optimizing treatment protocols should result in better care, improved outcomes, and lower costs. For at-risk providers (physicians and hospitals that effectively take on the insurance coverage risk), the ability to find savings without compromising the quality of care should boost margins. In the long term, we expect savings to be shared with payers such as employers (in the US) and governments. Healthcare insurers such as managed care have begun to implement AI tools to improve customer service and lower administrative costs—something we think will be increasingly necessary to remain competitive in a world of rising healthcare demand. The holy grail for the industry is more efficient care at lower costs, but this is yet to be proven and challenges remain, regarding access to and control over data, which is rightly regulated for privacy concerns.



Medical devices

Medical device makers are increasingly incorporating data gathering and analysis in their products, which could lead to opportunities to improve quality of care as the ability to interpret data with ML, although the extent to which data can be aggregated and directly monetized is likely limited by privacy considerations. Generative AI could also be used to improve patients' ability to interact with devices, which could be important as patients become more like medical “consumers” and have influence over their choice of device. Greater patient engagement with their health may also improve treatment compliance, leading to better outcomes and fewer wasted resources.

How AI may be implemented in the three segments of healthcare

1

Drug development



Faster drug discovery and development

2

Diagnostics and treatment



More accurate diagnoses and optimization of treatment protocols

3

Medical devices



Higher patients' ability to interact with devices

Source: UBS, as of 2023



Source: Getty images

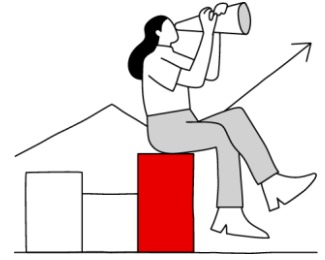
Chapter 2: Tactical drivers in tech



“People who are crazy enough to think they can change the world are the ones who do.”

– Steve Jobs

While long-term investing pays off in tech, still tactical investment opportunities cannot be ignored as we believe growth investors should rebalance their tech portfolios every few months. Hence in this chapter, we provide some of the key tactical drivers in tech.



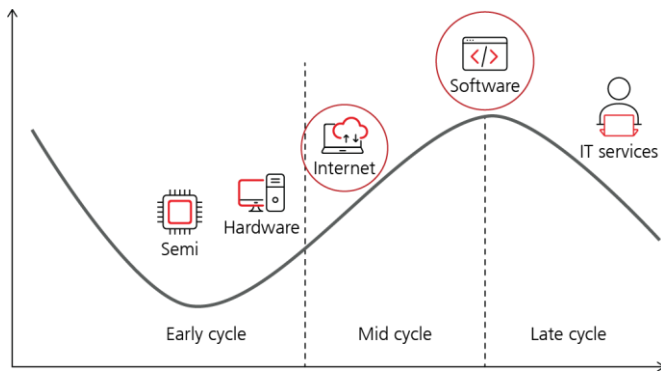
Where are the opportunities according to the CIO tech’s playbook?

CIO’s tech playbook provides investors with a good framework to navigate across the five industries in the tech sector. Simply put, we usually favor semiconductors and hardware in early cycle, software and internet during mid-cycle, and services during late cycle. We believe we are currently in mid-cycle, which means risk-reward is better in software and internet as companies with structural growth outlook and growth at a reasonable premium (GARP) tend to perform better during this stage. With mid-teen earnings growth recovery expected for global tech in 2024, we expect mid-cycle to last for another few quarters, supporting our tactically positive view on software and internet.

Where are the tech laggard opportunities?

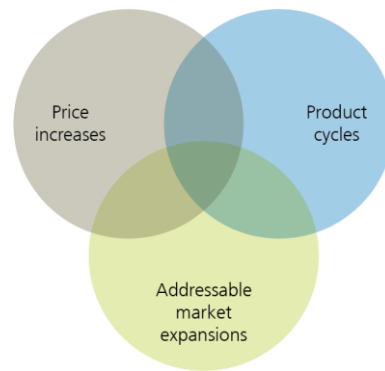
Tech stocks have performed strongly so far in 2023, and investors who haven’t participated are seeking exposure in laggard stocks. However, investing in value tech is not necessarily the right strategy; we believe GARP is better. Investing in laggards without growth visibility may be a risky strategy as they may end up as value traps. Instead, laggards with near-term catalysts should be more rewarding. In particular, we favor laggards exposed to price increases, product cycles, and addressable market expansion.

Our tech playbook to navigate across the cycle



Source: UBS, as of 2023

Laggard opportunities in tech



Source: UBS, as of 2023



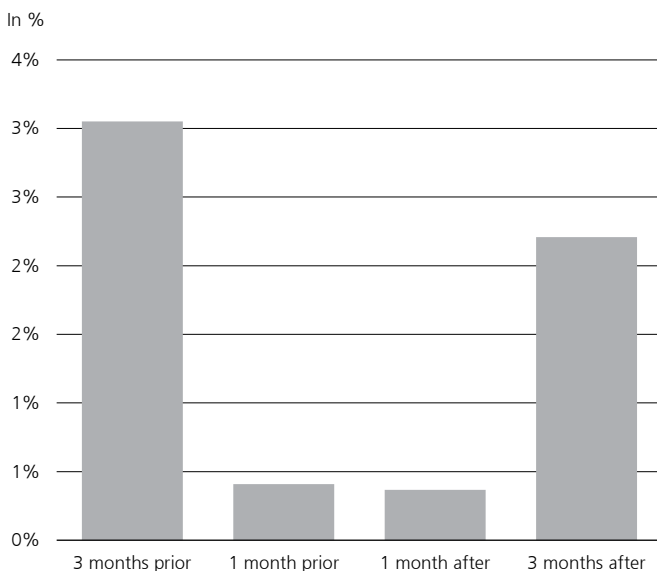
“We believe we are currently in mid-cycle, which means risk-reward is better in software and internet as companies with structural growth outlook and growth at a reasonable premium (GARP) tend to perform better during this stage.”

Do product cycles matter for global tech?

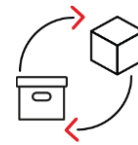
The simple answer is yes as product cycles are how tech companies demonstrate innovation, increase the user base and the addressable market, and also potentially lift pricing. However, in a world increasingly driven by digital subscriptions, gone are the days when the focus was entirely on “blockbuster” products, radically new features, and revolutionary changes in design. Now, the incremental focus is on evolutionary changes around software upgrades and minor product redesigns. Nevertheless, with most consumers willing to splurge their savings during the year-end holiday season and timing purchases when there is a major product upgrade, we still think product cycles are relevant today.

From an equity market point of view, using the iPhone as an example, over the past 15 years, we have noticed product cycles have acted as a tailwind for supply chain companies (using Asia hardware as a proxy). That said, we believe excessive speculation in supply chain companies solely based on product cycles may not compensate for the high risk (volatility) involved. Instead, we prefer supply chain companies that generate sustainable growth throughout the year(s), have strong balance sheets, and superior growth.

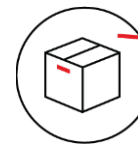
Average historical performance of Asia hardware supply chain stocks before and after iPhone launches



Source: Bloomberg, Factset, UBS, as of 2023



“While product cycles are mostly associated with consumer electronics, enterprise IT product cycles should not be ignored given tailwinds like pent-up demand and repricing driving several quarters of positive earnings upgrades.”



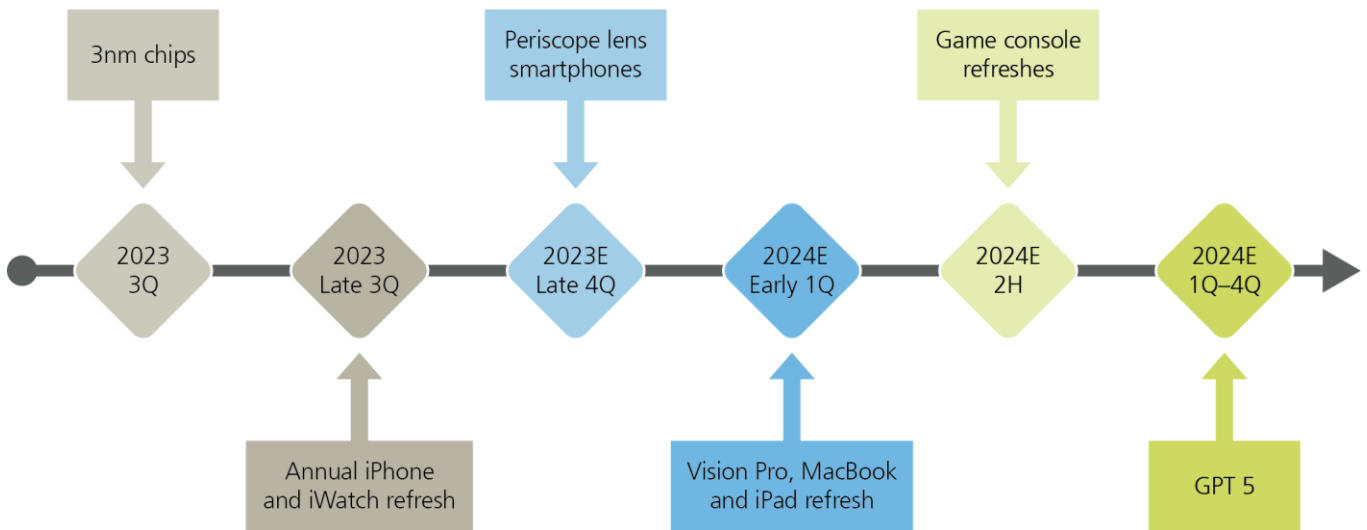
“While technology companies announce their products throughout the year, 4Q is typically associated with major product refreshes thanks to strong year-end holiday demand. 4Q also enjoys good seasonality, contributing almost 30% of full-year revenues for many tech companies.”

What are some of the major tech product cycles?

While technology companies announce their products throughout the year, 4Q is typically associated with major product refreshes thanks to strong year-end holiday demand. 4Q also enjoys good seasonality, contributing almost 30% of full-year revenues for many tech companies. While product cycles are mostly associated with consumer electronics, enterprise IT product cycles should not be ignored given

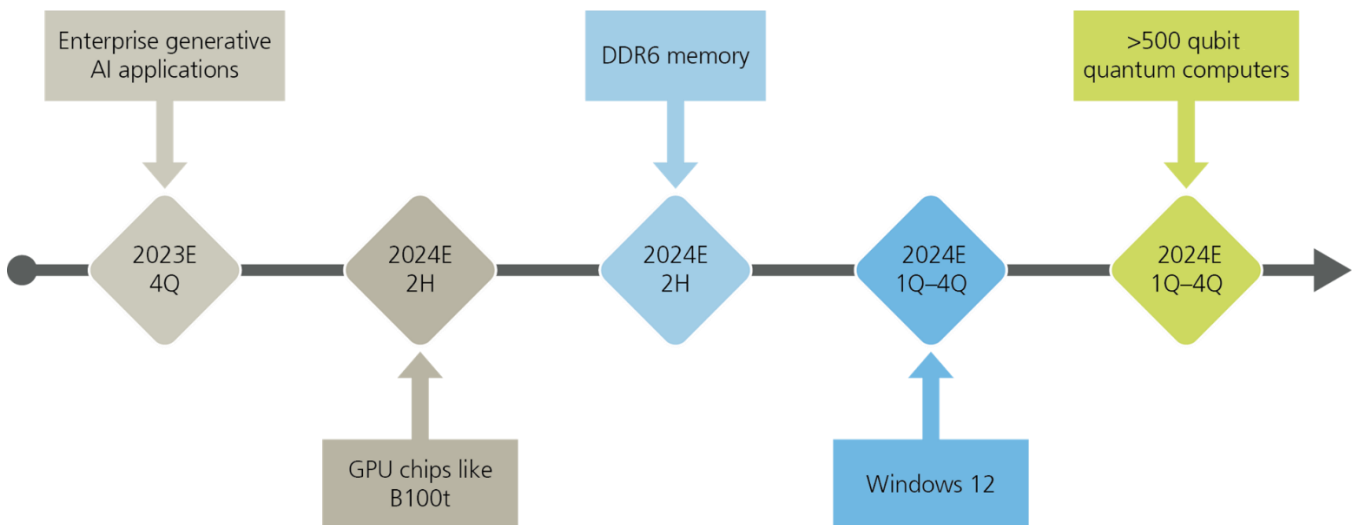
tailwinds like pent-up demand and repricing driving several quarters of positive earnings upgrades. We have summarized key product cycles for both the consumer and enterprise segments, and we highlight iPhone and other smartphone refreshes, the GPT 5 upgrade, and also the GPU refresh cycle as some of the standout upgrades in the near term with disproportionate impact.

Consumer product cycles



Source: UBS, as of 2023

Enterprise product cycles



Source: UBS, as of 2023

How are hiring trends for global tech?

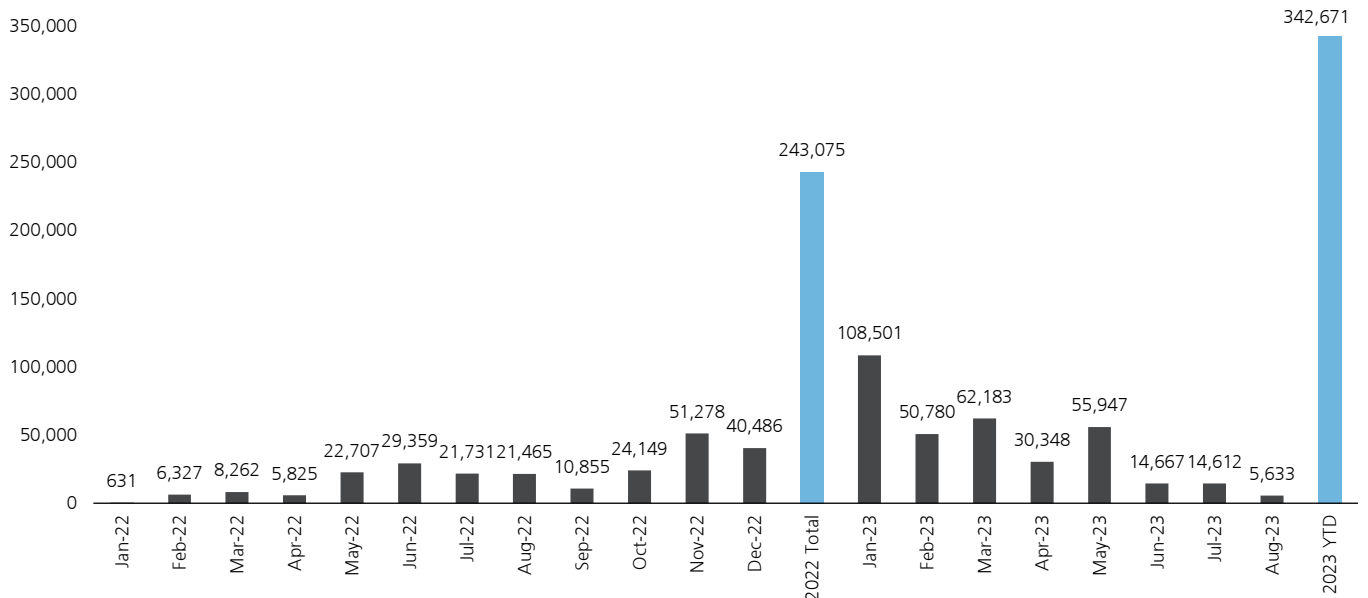
While we see product cycles as a near-term catalyst for many tech companies, we also see another interesting development in tech supporting our argument that growth rates are set to accelerate. Based on our estimates, global tech earnings growth should accelerate from a mid-high single-digit decline in 1H23 to mid-high teen growth in 1H24, or almost 20–25pps of delta. Notably, a sector-wide shift in philosophy over the past 12 months away from growth at any cost to efficiency gains and cash flow generation now appears to have given way to animal spirits, with most of the management comments in the latest quarter returning focus back to growth thanks to the recent AI boom.

As a result, we believe most tech companies will be back on the growth path rehiring, and hence tech layoffs should be largely behind us. Based on the data as of August from Trueup, the trend was already evident in August, and we won't be surprised to see strong hiring trends in the next few months supported by broadening demand trends including AI.

This should also provide comfort to markets that rehiring plans show tech companies' confidence in 2024 and medium-long term growth outlook. This, coupled with product cycles, is an additional near-term catalyst to track.

Tech layoffs in the US are largely behind us

In %



Source: Trueup, UBS, as of mid-August 2023



“A sector-wide shift in philosophy over the past 12 months away from growth at any cost to efficiency gains and cash flow generation now appears to have given way...returning focus back to growth thanks to the recent AI boom.”

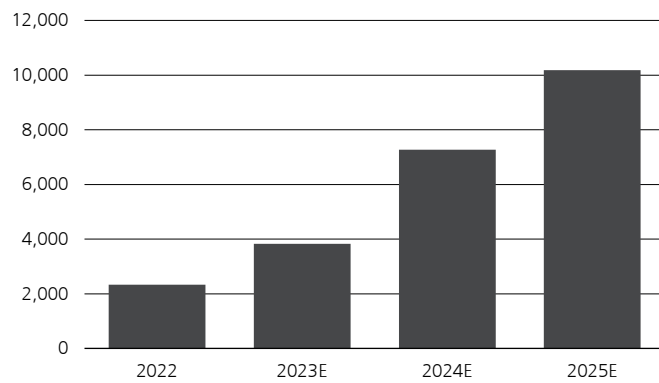
How is memory industry positioned to benefit from AI?

While the GPU and the logic semiconductor supply chains have disproportionately benefited from the strong AI infrastructure spending trends so far, we think laggard semiconductor industries like memory will now also finally participate in the AI boom. First, we believe the memory industry should benefit from strong supply discipline, which, in our view, should eventually trigger DRAM prices to rebound by more than 50% during the next 12 months from the 2Q23 lows. Second, the industry should benefit from increased adoption of high bandwidth memory in generative AI, where we expect industry revenues to grow from USD 2.4bn in 2022 to USD 10.2bn in 2025. High bandwidth memory (HBM) is dedicated DRAM used in high performance

computing applications like AI uses vertically stacked chips. We expect HBM penetration to keep rising in generative AI applications. For instance, Nvidia's popular H100 GPU used in generative AI can support 80 gigabytes (GB) of HBM, whereas AMD's upcoming MI300X can support 192GB of HBM. The rising HBM penetration is positive for the memory industry, considering the significant premium HBM enjoys versus traditional DRAM chips (HBM price is 5–6x standard DDR4 memory pricing). Hence, despite the muted recovery in other tech hardware segments, AI should provide a strong catalyst for the global memory industry, which should benefit from a cyclical recovery due to a favorable demand-supply balance.

High bandwidth memory industry revenues to grow >5x during 2022–25E due to rising generative AI demand

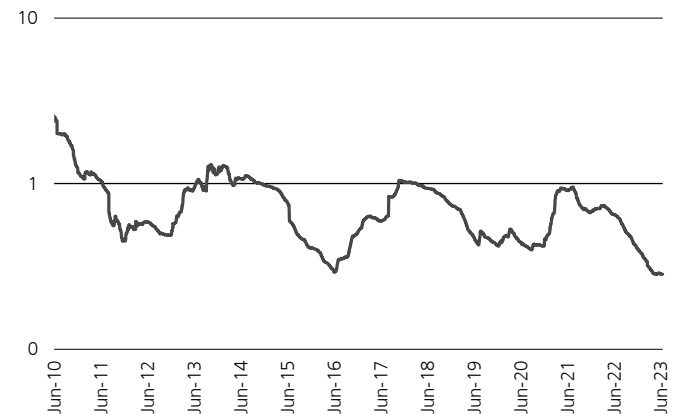
Figures in USD mn



Source: Company reports, UBS estimates as of 2023

Expect gradual recovery for memory prices in coming quarters

Logarithmic DRAM spot prices (USD)



Source: Company data, UBS estimates, as of 2023

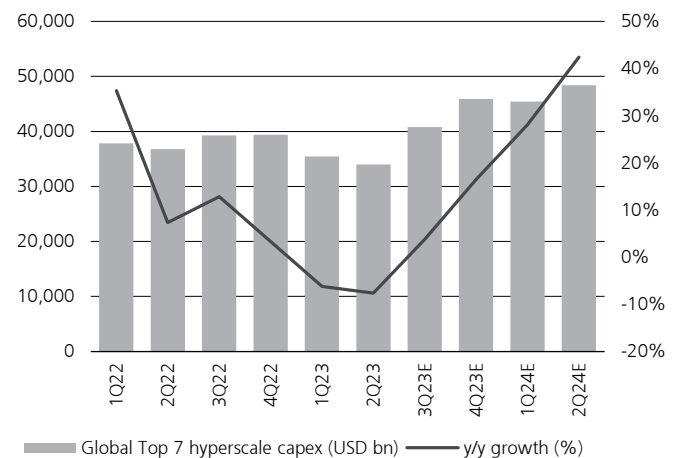
Is tech capex still going down?

In addition to layoffs, during the past 12 months, we have seen a marked slowdown in the capex spending plans of major tech companies. As highlighted in our "Tech self-help" theme published earlier in the year, the market has rewarded tech companies for their restructuring efforts that resulted in lower opex and capex spending. While some market participants have raised concerns about the impact of lower spending on the medium–longer-term growth prospects for tech companies, the good news is we think capex spending bottomed in June and expect a gradual improvement.

However, bears may point to increasing capex as a headwind to tech due to margin impact (from higher depreciation expense). But we believe capex increases based on strong growth and improving demand trends should generally be interpreted positively given the extended medium–long-term growth visibility. In terms of the combined data center capex spending by the top seven hyperscale companies globally, we expect capex growth to accelerate from –8% y/y in June 2023 to +42% y/y in June 2024.

Hyperscale companies' capex growth bottomed in June 2023 and set for strong acceleration

Top 7 hyperscale companies' capex y/y growth, by quarter (%)



Source: UBS estimates, as of 2023



Source: Getty images

Chapter 3: Taking stock of tech's fundamentals



"Good companies do whatever it takes."

– Sundar Pichai

In the past 15 years, two-thirds of tech returns have been driven by fundamentals and one-third by valuation multiple changes. Hence fundamentals matter more in tech and in this chapter, we analyze the latest trends in tech.

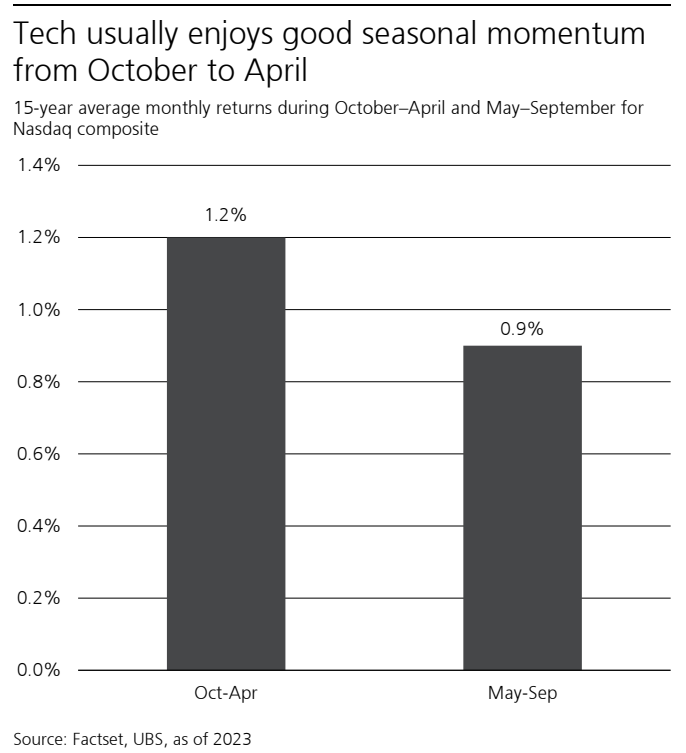
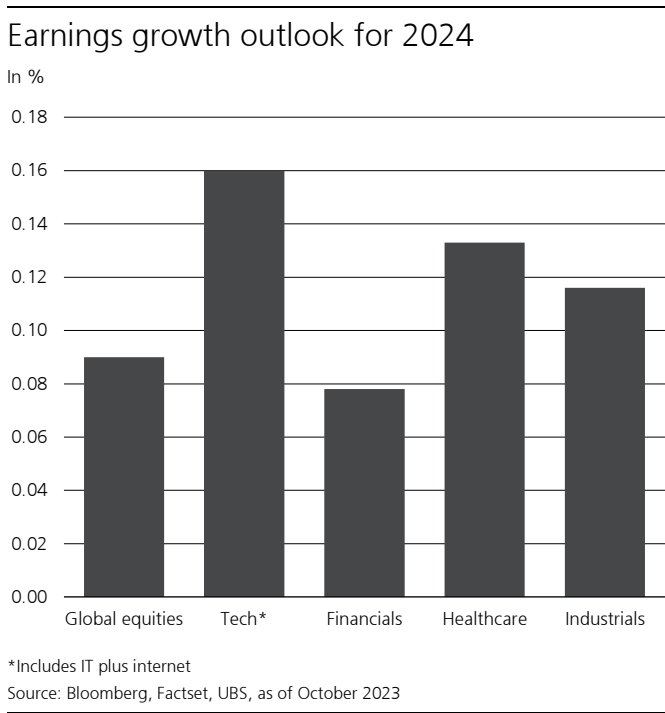


What are the expectations for tech 3Q results?

Globally, tech corporate earnings fell by mid- to high single digits y/y in 1H23 due to a higher base and weak consumer demand. However, with a rising contribution from AI, better base effects, and pricing power, we expect global tech earnings likely turned positive in 3Q23 and to grow by a mid-teen rate for full-year 2024. As a result, the tech sector should emerge as the fastest-growing segment within global equities next year. However, it should be noted that despite the recent correction, global tech's valuation—at 24–25x forward P/E—is not cheap versus global markets and the 20-year average forward P/E of about 20x.

Does seasonality matter in tech?

September is historically the worst month for tech based on the past 15-year average, and this year is no exception. The good news is October to April are historically the best months to invest in tech, again based on the past 15-year average. While it is difficult to attribute tech's better seasonality during this period to fundamental factors, solid product launches, strong consumer electronics demand around Thanksgiving and Chinese New Year holidays, and enterprise budget flushes are some factors that often boost performance. With better days likely ahead, we believe the recent weakness provides a good buying opportunity for AI leaders in our Technology Disruption list, especially as the recent product announcements give additional visibility into how firms are monetizing AI. And with AI demand broadening, we continue to believe mid-cycle segments like software and internet still offer the best risk-reward within global tech. We also see long-term opportunities emerging for select semiconductor leaders following the recent correction.



What is our take on global tech's 2Q results?

We characterize the 2Q reporting season for tech as mixed given the muted share price reaction. Notably, a sector-wide shift in philosophy over the past 12 months away from growth-at-any-cost to efficiency gains and cash flow has given way to animal spirits, with most of the management comments returning focus to growth thanks to the recent AI boom. In fact, it becomes even clearer that AI is at the center of strategy for most tech companies when we

look at the increase in AI-related capex, which is being offset by some weakness elsewhere. During the 2Q reporting season, we also got more visibility on how major tech companies plan to monetize AI across infrastructure (e.g., in more computing choices through cloud) and applications (beyond copilots in areas like advertising, security, etc.), supporting our recent argument that AI demand is broadening. Key highlights from global tech results are summarized below:

Key takeaways from global tech's 2Q results



The good: Modest upward revisions supported by margin expansion.



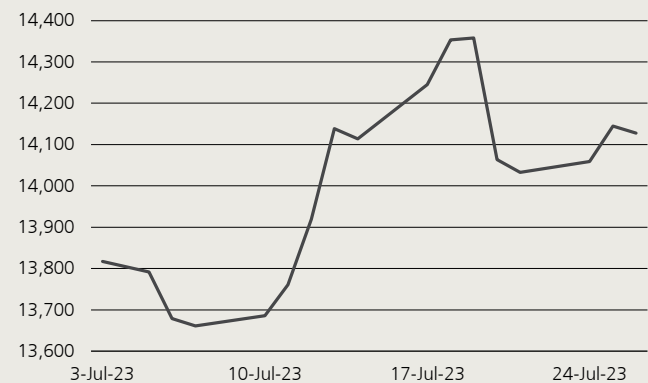
The bad: Pace of share buybacks slowing down and capex intensity rising due to increased AI-related investments.



The ugly: Elevated expectations resulting in muted share price reaction.

Mixed tech performance during 2Q results season

A tale of two halves for NASDAQ in July and August 2023



Source: Bloomberg, Factset, UBS, as of 2023

What are the takeaways from the semiconductor industry's 2Q results?

Semiconductor industry 2Q results were mixed overall, with profit-taking in some industry leaders following the earnings announcements. While AI has been a bright spot, spending trends in other segments have been muted. Inventory levels remain elevated despite ongoing digestion, whereas the recovery in memory pricing is taking time as consumer electronics demand in emerging markets is likely to remain sluggish in the near term. While there have been no major

capex cuts, semiconductor foundry manufacturers have guided for capex intensity to potentially come down from around 40–45% (capex/sales) currently to the mid-30s levels in the medium to long term. The good news, however, is that most semiconductor companies expect revenue growth for the industry to turn positive in 2024 with the potential for a 50%-plus earnings growth rebound for global semis.

Key takeaways from semiconductor industry's 2Q results



The good: Stage set for a strong double-digit revenues growth in 2024.



The bad: Memory pricing recovery still taking time and inventories remain elevated.



The ugly: Geopolitical uncertainty and premium valuations.



“It becomes even clearer that AI is at the center of strategy for most tech companies when we look at the increase in AI-related capex.”

What are the takeaways from the software industry's 2Q results?

The software industry remains a clear bright spot, with double-digit revenue growth in 2Q standing out against the muted growth in other tech industries. Cloud momentum for Azure, the second largest cloud platform globally, remains solid with broadening AI demand clearly acting as a catalyst. The challenges for the space, however, include a slowing margin improvement trend and restructuring efforts. But these trends are understandable, in our view, given a renewed focus on

growth and increased investments to fuel medium- to long-term growth prospects. We think growth-based investors should use the recent weakness in high quality software stocks to accumulate long-term exposure, given our view that the industry is a clear beneficiary of broadening AI demand. In summary, key takeaways from the software industry's 2Q results are shown below:

Key takeaways from software industry's 2Q results



The good: Cloud to continue to drive strong double-digit revenue growth.



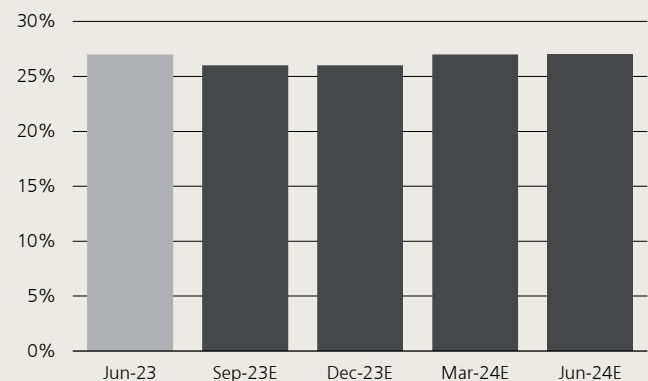
The bad: Pace of margin improvement slowing down due to increased investments related to generative AI and slowing down restructuring efforts but with solid growth, these risks appear manageable.



The ugly: European software companies missed due to weak cloud momentum.

Steady cloud growth trends to continue supporting the software industry

Consensus Azure y/y cloud growth estimates by quarter (%)



Source: Factset, Bloomberg, UBS, company reports, as of 2023

What are the takeaways from the global internet industry's 2Q results?

2Q results from the internet industry segment suggest that the advertising industry fundamentals have bottomed. From here, we expect a gradual recovery. While we believe the overall internet industry may not return to pandemic level growth rates of >20% anytime soon due to a near-term transition period for business models and as companies adapt to emerging threats

from AI, we do see internet as another mid-cyclical beneficiary along with software, based on our tech playbook. Industry valuations are also reasonable as reflected by the discount to its long-term average valuations. Key takeaways from the internet industry's 2Q results are shown below:

Key takeaways from global internet's 2Q results



The good: Accelerating advertising growth and overall reasonable expectations for the industry.



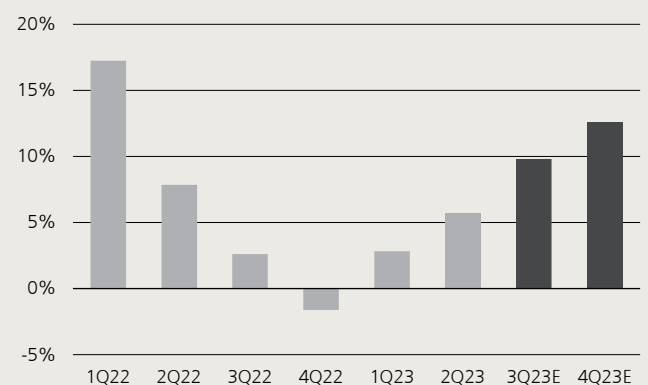
The bad: Business models still in transition mode after the pandemic with rising capex risk.



The ugly: Rising competitive and regulatory risks.

Accelerating advertising growth should support the mid-cyclical internet industry

Combined advertising revenues y/y growth for the top 5 digital (%)



Source: Company reports, Factset, Bloomberg, UBS estimates, as of 2023

What are the takeaways from the hardware and IT services industries' 2Q results?

Overall, the 2Q results from the hardware and services industries were challenging. Wireless equipment companies in Europe disappointed. Unless we see major innovation, overall hardware industry fundamentals will likely stay weak, even in 2024. IT services companies also reported weakness as key verticals like banking and retail

remained under pressure. Beyond the near term, services companies may also face mounting threats from the generative AI industry. In summary, industry fundamentals remain muted, with key takeaways from hardware and services industry's 2Q results shown below:

Key takeaways from hardware and IT services industry's 2Q results



The good: PC shipments were better than expected in 1H but sustainability is key. AI-based servers are another bright spot.



The bad: Smartphone shipments are still down in 2023 and expected to grow by only low-single digits in 2024 unless we see significant innovation.



The ugly: Weak guidance from IT services companies is a concern. With the debate around threats from generative AI to gather further momentum, sentiment should remain weak for services companies.



“Services companies may also face mounting threats from the generative AI industry.”



Source: Getty images

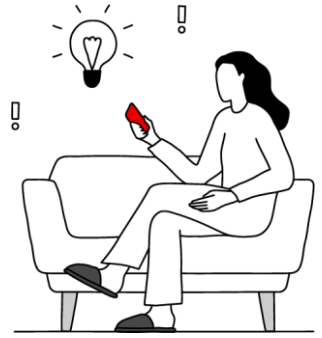
Chapter 4: Embracing the new frontiers



“The biggest risk is not taking any risk.”

– Mark Zuckerberg

As technological revolution continues to accelerate globally, we are presented with an expansive array of investment choices across geographical regions and different frontier technologies. In this chapter, we outline opportunities resulting from longer-term structural changes that are shaping up.



What is the current state of the Middle East's digital economy?

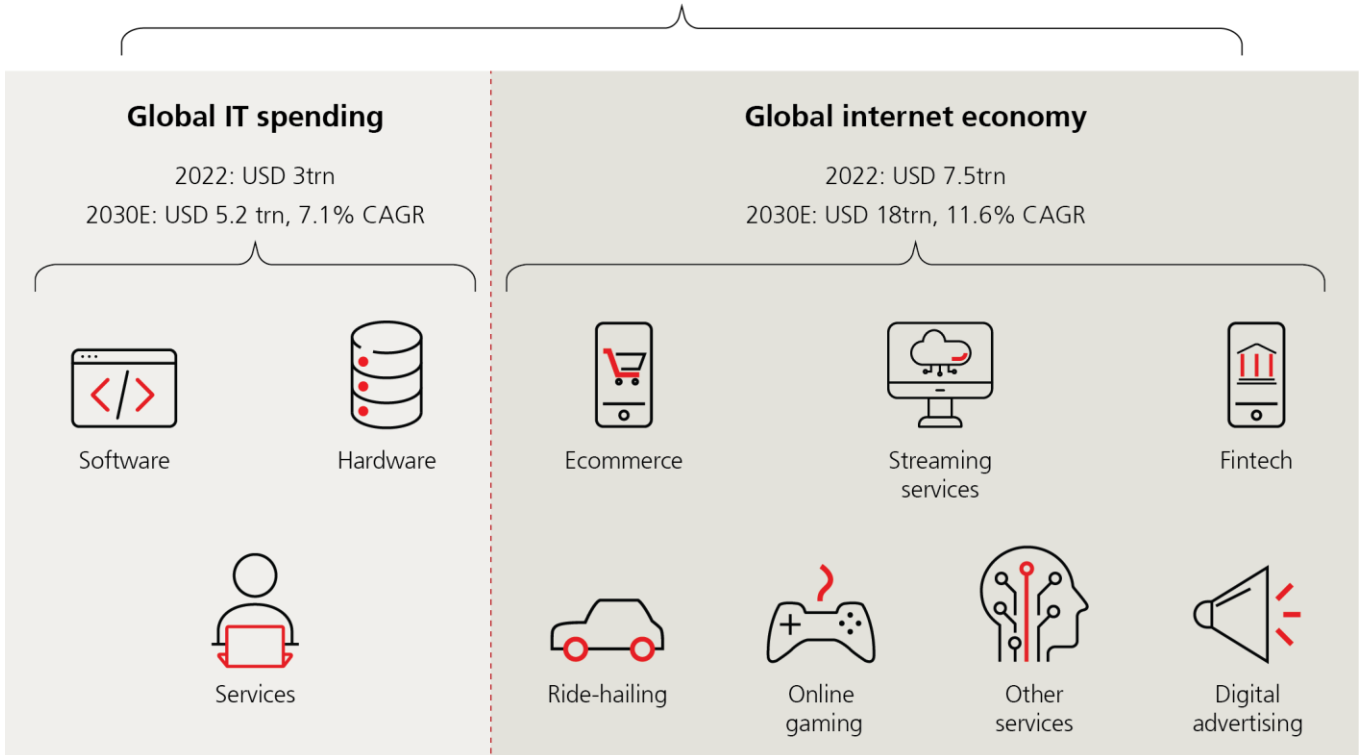
We believe the question is best addressed by appreciating today's technology penetration levels in the Middle East. But before we delve into the details, we need to understand the two key pillars of digital economy: traditional IT spending and internet economy spending. IT spending includes spending by both consumers and enterprises on hardware, software, and services, whereas internet economy spending includes spending on key segments like e-commerce, digital advertising, online gaming, streaming services ride-hailing, fintech, and other services.

Based on data from World Bank, Gartner, Bloomberg Intelligence, and UBS estimates, the global digital economy was close to USD 10.5 trillion in terms of revenue in 2022; that is roughly a 10.5% penetration rate of the global economy. We expect the global digital economy to grow by 10.4% p.a. on average during 2022–2030, reaching USD 23.2tr mainly led by the internet economy.

Global digital economy expected to more than double by 2030

Global digital economy addressable market

2022: USD 10.5trn, 2030E: USD 23.2trn, 10.4% CAGR



Source: World Bank, Gartner, Bloomberg Intelligence, UBS estimates, as of 2023

Meanwhile, based on data from World Bank, Gartner, Bloomberg Intelligence, and UBS estimates, the size of the Middle East's digital economy was close to USD 180bn in 2022, or 4.1% of the region's economy. The Middle East digital economy's penetration rate of only 4.1% versus 10.5% globally or 15% in the US and 7.4% penetration in India (an economy with comparable size) highlights the region's significant medium-long term growth potential.

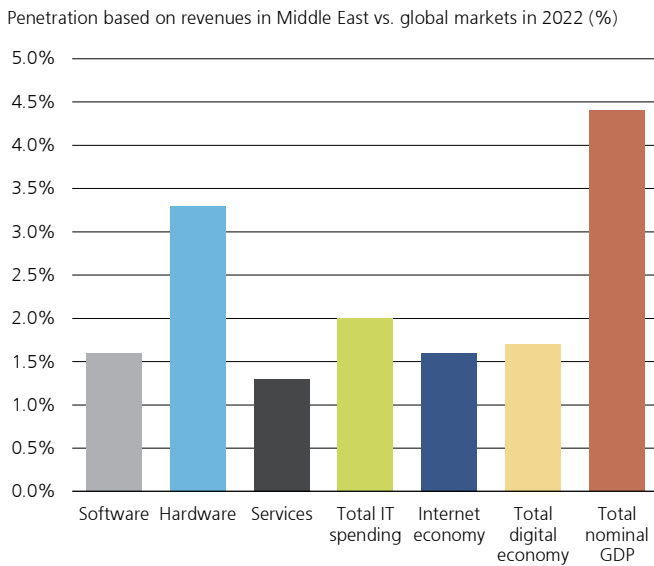
Another way of looking at penetration rates is to compare the current size of the Middle East's technology markets with global levels. Compared to the Middle East digital economy's penetration of 4.1%, its technology penetration across segments is less than 2% except for hardware (3.3%), which is understandable given the mature smartphone and personal computer (PC) spending in the region. However, the overall low penetration rates highlight the strong long-term growth potential of the Middle East's digital economy, including in high margin segments like software, internet, and others in the future which we address in the next few segments.

How big is the opportunity in the Middle East's digital economy?

As highlighted earlier, the Middle East's digital economy was worth some USD 180bn in 2022 thanks to significant new investments during and after the COVID-19 pandemic. We believe we are at a very early stage of the digital ascent in the Middle East (we believe the region is where China was 10–15 years ago and India 5–10 years ago when the digital inflection began), with only 4.1% penetration of the broad economy. Supported by favorable demographics, strong policy support, solid funding, rising innovation, and low penetration rates, we expect the Middle East's digital economy to grow to USD 780bn in 2030 or roughly 20% growth p.a.

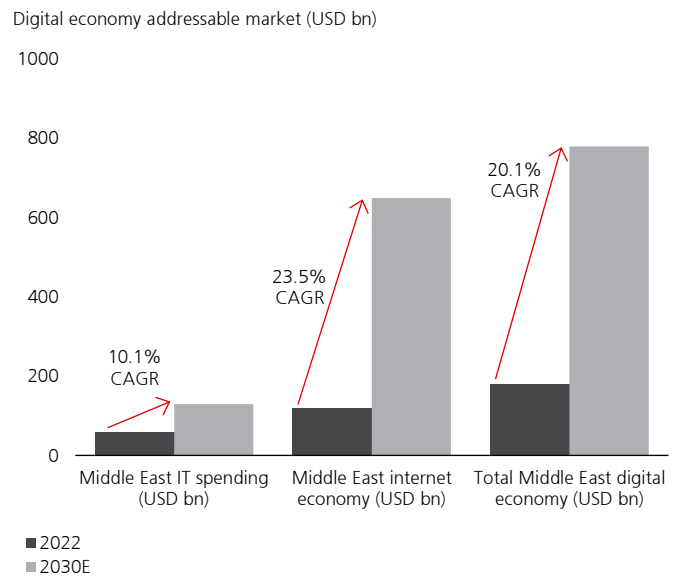
This makes the Middle East one of the fastest growing digital economies globally. To boot, our estimates may prove to be conservative as according to World Bank, Gartner, Bloomberg Intelligence, and UBS estimates, the digital economy's penetration as a percentage of the region's GDP is set to rise from 4.1% in 2022 to 13.4% in 2030, which is still below today's 15% penetration levels in advanced economies like the US.

How the Middle East's key tech segments stack against overall global market



Source: World Bank, Gartner, Bloomberg Intelligence, UBS estimates, as of 2023

The Middle East's digital economy set to grow more than 4x between 2022 and 2030



Source: World Bank, Gartner, Bloomberg Intelligence, UBS estimates, as of 2023



“We are at a very early stage of the digital ascent in the Middle East; we believe the region is where China was 10–15 years ago and India 5–10 years ago.”

What are the technology funding trends in the Middle East?

Funding for startups and unlisted companies in the Middle East hit USD 13.6bn in 2022, according to data from CB Insights. Reflecting the broad weakness last year in the technology landscape amid rising rates, the Middle East's funding was flattish compared to 2021 (down 2.1% y/y to be precise), but we consider that to be impressive considering the 35% decline in global technology funding. While we may need to wait for a few more months to get the full-year data, we believe 2023 will turn out to be a challenging year given the still tough environment for global tech funding, in particular in 1H. But the good news is that green shoots are emerging thanks to the spiking interest around AI and hopes of a revival in key internet segments like e-commerce and digital advertising in the region.

As a result, we believe we are close to a bottom in tech funding in the Middle East as the strong growth outlook for the region's digital economy over the next 10 years should attract solid investor interest including from local technology and telecom players, sovereign wealth funds, and major global venture capital/private equity (VC/PE) funds over the coming quarters. With the Middle East accounting for only 2–3% of global VC/PE tech funding today (based on data from CB Insights), the region's strong 20% p.a. growth outlook should attract more investments going forward, which, in our view, provides good investment alternatives for global growth-based investors beyond major listed tech companies globally.

What is the best way to participate in the Middle East's burgeoning digital economy?

Considering the Middle East's digital economy is set to grow twice as fast as the global digital economy between 2022 and 2030, based on our estimates, we see investor interest rising sharply in the coming years. There are two ways to participate in the Middle East's rapidly growing digital economy—investing in the right industries or in the right companies. For industries, we recommend investors to consider those that can grow faster and also can generate higher margins. Here, three industries stand out—software, internet, and data centers.

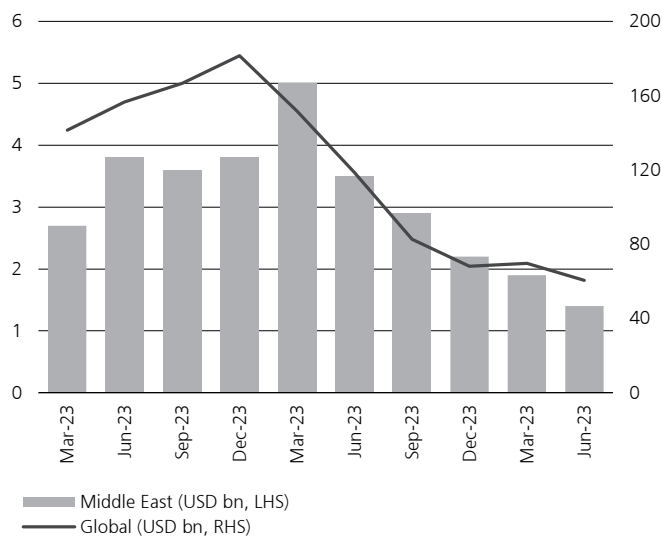
We expect software spending to grow 15% p.a. on average in the Middle East, which, coupled with margin improvement (usually software's operating margins can go as high as 35–40%), should drive strong profitability growth. We believe software is the best way to participate in the region's ongoing digital transformation, where we expect many traditional enterprises to upgrade their IT infrastructure by driving significant investments across software like office productivity and collaboration, cloud including enterprise resource planning and other automation, as well as cybersecurity (see next segment for more details).



“We believe software is the best way to participate in Middle East's ongoing digital transformation.”

Middle Eastern tech funding is set to rebound driven by strong growth outlook

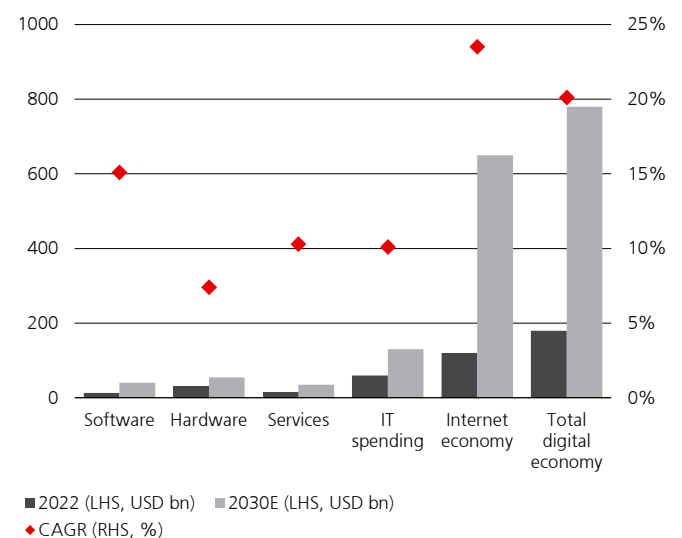
Figures in USD bn



Source: CB Insights, UBS, as of 2023

Growth rates for the Middle East's key tech components

Penetration based on revenues in Middle East vs. global markets in 2022



Source: World Bank, Gartner, Bloomberg Intelligence and UBS estimates as of 2023

Internet is the fastest growing segment in the Middle East at 23.5% CAGR, based on our estimates. Understandably, the industry's profitability is low today due to significant upfront investments; but with rising scale benefits and improving pricing power, we see strong scope for margin expansion in future. As a comparison, global internet profitability in terms of operating margins is close to 20%. Data centers are the third segment, which is hidden under the broader hardware segment. While we believe the traditional hardware segment, including smartphones and PCs, should grow by low-mid single digits, in line with the broader economic growth, data centers are a bright spot within hardware given the sharp uptake of cloud and strong demand for artificial intelligence (AI). We expect strong investments in generative AI in the Middle East in the next few years as we see significant use cases in both consumer and enterprise applications.

From a company point of view, there aren't many pure-play listed companies globally today to participate in the Middle East's booming tech story. However, the limited options available through both local listed tech and telecom companies and through global majors with a decent exposure to the Middle East should provide good options to investors. We see bigger opportunities currently in the unlisted space through VC/PE funding akin to how investors participated in China tech 15 years ago or India tech 5–10 years ago.

What is the best way to play technology in India?

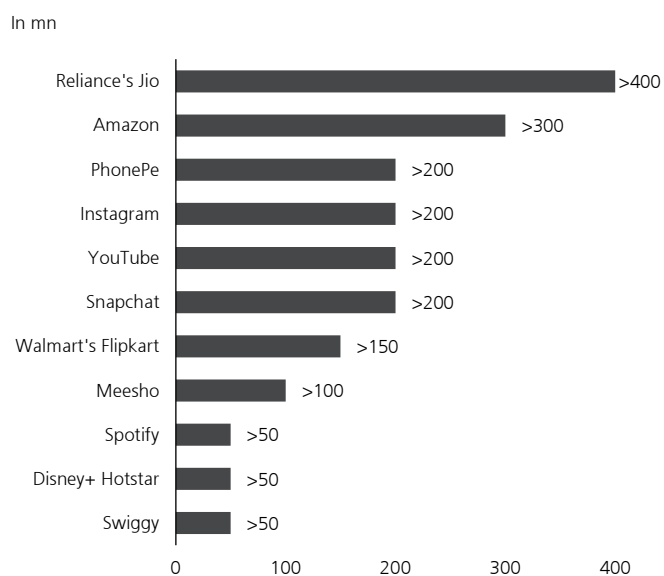
CIO is currently most preferred on India in the regional strategy; and given the ongoing geopolitical tensions between China and the US, one of the questions we get asked frequently is how to play tech in India. With tech stocks exposed to China delivering strong returns in the past decade during its digital ascent, the question now is whether India can replicate that success story as its rising middle class is set to drive a major consumption wave. It is worth highlighting that unlike China, India's open market means key technology end-markets are dominated by global players. Hence, we see three major ways to play technology in India.

The first opportunity is internet, in our view. According to Google, Temasek, Bain, and Bloomberg Intelligence, the size of India's internet economy was about USD 155–175bn in 2022 and is expected to reach USD 1 trillion by 2030, or 12–13% of GDP from mid-single digit penetration levels today. This would make India's internet economy one of the fastest growing industries within global tech in the next few years. India's leading digital platforms are owned by local players like Reliance Industries, but major global internet players such as Alphabet, Meta, and Amazon dominate key internet end-markets like social networking, e-commerce, and video streaming. In the past three years in particular, the choice for at least domestic investors in the public market has grown as a number of private equity holders started to monetize holdings in areas ranging from food delivery and e-commerce to logistics and fintech, for example. That said, the pool available to foreign investors via listings abroad remains somewhat smaller, and hence, we think this space is best reflected via mutual funds that include some of these firms.



“The strong double-digit growth outlook for India's internet economy makes it one of the fastest growing industries within global tech in the next few years”

User base for key digital platforms in India



Source: Company reports, UBS, as of 2023

The second opportunity to play tech in India is via the consumer electronics market, in our view. Driven by urbanization, favorable demographics, changing digital lifestyles, and rising per capita GDP, India's consumer electronics market is at an inflection point, and we expect mid-high digit growth annually till the end of this decade, which is well above the global average. While India accounts for more than one sixth of the world's population, its share of global consumer electronics is very low at only 6–8%, highlighting the strong long-term potential given changing demographics and premiumization. At its recent earnings conference, Apple's CEO Tim Cook made the following comment:

"Looking at the business in India, we did set a quarterly record and grew very strong double-digits year-over-year. So, it was quite a good quarter for us. Taking a step back, India is an incredibly exciting market. It's a major focus for us. I was just there, and the dynamism in the market, the vibrancy is unbelievable... Overall, I couldn't be more delighted and excited by the enthusiasm I'm seeing for the brand there. There are a lot of people coming into the middle-class, and I really feel that India is at a tipping point, and it's great to be there."

India's strong growth opportunity resembles the extraordinary growth witnessed by China's consumer electronics market during 2005–2015 when penetration rates shot up across key end-markets like smartphones, PCs, and other devices. Similar to the internet landscape, India's consumer electronics segment is also dominated by key global brands. Interestingly, India, a vast and growing end-market, has also begun its PLI (production-linked incentive) scheme to incentivize global companies to use the country as a manufacturing hub for consumer and enterprise electronics and technology products.

Apple reportedly plans to manufacture up to 18% of all its phones produced globally in India, showing that global brands can benefit from the country being both an end-market and a production hub.

The final opportunity we see is in the IT services segment. Thanks to its large talent pool, India has emerged as the global IT services hub, matching China's prowess in manufacturing.

According to NASSCOM, India's main tech sector trade body, the total number of IT employees in the country stood at 5.4mn in March 2023, with the annual turnover of the industry reaching USD 245bn in FY2023 and exports accounting for USD 194bn.

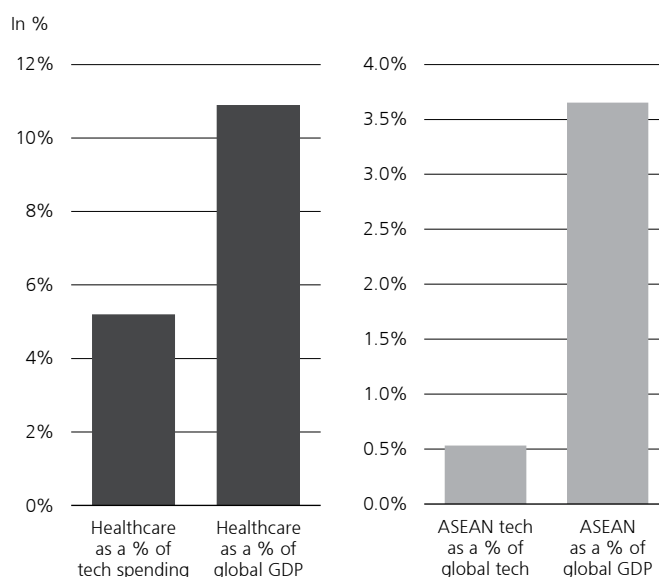
While the rise of generative AI could prove to be a long-term threat for the IT services industry, in the near term, companies with the right digital strategy should benefit from increased integration and application development services.

Beyond AI, where are some other underpenetrated opportunities in tech?

Recently, we raised our long-term growth estimates for AI given broadening demand trends and increased adoption across industries. While there are many such underpenetrated markets in tech like EVs and fintech, in this report, we highlight two such opportunities that are compelling in the long term—healthtech and ASEAN's new economy.

Healthcare spending as a percentage of global GDP is close to 11%, according to World Bank, but as a percentage of technology spending, healthcare represents only 5%, highlighting historical underspending. While the recent growth in healthtech is encouraging, we see solid catch-up potential with other industries like financials or media, and we believe recent progress in generative AI is clearly an additional catalyst. Meanwhile, with the recent mixed performance of Chinese internet companies and the India tech story well underway, investors are looking for other technology frontiers, where we believe the Association of Southeast Asian nations' (ASEAN) new economy provides a compelling opportunity for growth-based investors. ASEAN as a region contributes 3.7% to the global GDP but from a market cap point of view, ASEAN tech companies represent only 0.5% of the global tech market cap, highlighting another catch-up potential.

Healthtech and ASEAN's new economy are two underpenetrated segments of tech



Source: Company reports, UBS, as of 2023

Aside from China and India, what other key growth segments can investors consider in Asia?

ASEAN is one such segment, and it is fast emerging as a major economic powerhouse in Asia. Home to more than 670 million people, if it were a single country it would be the world's third most populous. And with youthful demographics, the region's new economy is quickly gaining strength. Geopolitics is one recent factor that adds to the region's appeal. With US-China tensions ongoing, ASEAN continues to be a key beneficiary of trade and investment flows, particularly from companies adopting the "China plus one" strategy. The build-up of EV- and renewable energy-related supply chains is already evident in ASEAN, along with the ongoing ramp-up in the region's smartphone, consumer electronics, and textile supply chains.

Another driver is medium term in nature, and it includes rising technology adoption. The significant investment in telecommunication infrastructure in the rural parts of ASEAN over the past decade has connected millions of individuals to the internet for the first time in their lives.

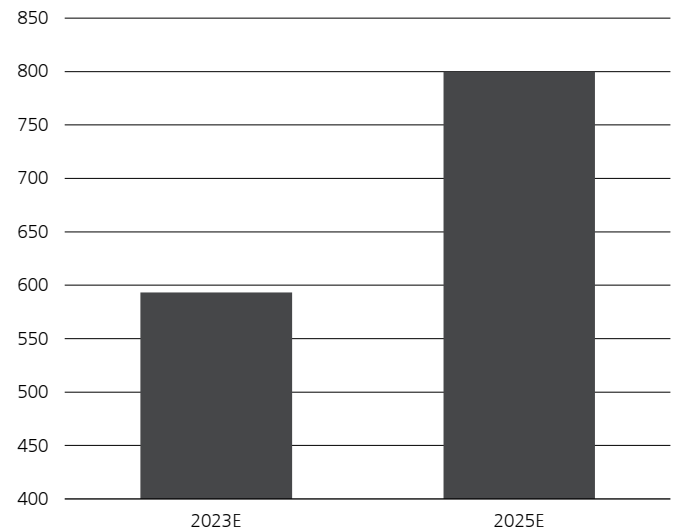
Over the next ten years, we expect more than 200 million new internet users in the region. The proliferation of affordable smartphones produced by Chinese manufacturers in the past decade has also boosted their adoption in the region, making ASEAN a mobile-first economy. Combined with cheaper and faster connections, the rise in penetration will likely pave the ground for technology to disrupt the ways in which millions of people in the region consume, produce, and distribute goods and services.

At the same time, the largest middle-class boom in ASEAN's history is currently underway. On average, one person in the region is entering the middle-class income bucket every two seconds, according to the World Bank. As consumers enter this sweet-spot consumption segment, we expect higher discretionary spending which will disproportionately benefit new economy segments like e-commerce, ride-hailing, and fintech / buy-now-pay-later. Overall, we believe the region is at a tipping point as

rising technology adoption should accelerate the region's shift from old to new economy. The ASEAN new economy's addressable market is set to rise to USD 800bn in 2025 (based on Bloomberg, Factset, and UBS estimates), translating to an annual growth rate of mid-teens, well above many technology industries exposed to mature markets. Investors should therefore pay more attention to ASEAN's new economy growth prospects.

ASEAN's new economy addressable market to reach USD 800bn by 2025

Addressable market (USD bn)



Source: Bloomberg, Factset, UBS, as of 2023



“With one of the largest underbanked populations in the world, ASEAN offers a vast opportunity for financial services. For instance, three out of four people in ASEAN lack access to basic financial services.”

How should investors be positioned in ASEAN's new economy?

We see a few key opportunities in ASEAN:



Ride-hailing industry

The ride-hailing/food delivery names have lagged their global internet peers in the past one year due to their negative margin profile and growth deceleration following the COVID-19-period boom. We expect these two drivers to change over the next six to 12 months. First, the industry is likely to reach an EBITDA-breakeven status over the coming quarters. A gradual improvement in commission rates and subsidy rationalization have been underway for the past one year, and they are starting to bear fruit, with a sequential improvement in their EBITDA profile. Furthermore, key leading players have also undergone rounds of headquarter cost cuts, which will likely improve their free cash flow prints in 2H. Second, the worst in growth deceleration in food delivery business is likely behind us. After a surge in demand during the pandemic era, the sequential growth rate for the segment has seen a deceleration in the past few quarters and caused a valuation multiple derating for the leading names. That said, we believe the headwind is diminishing, with a potential reacceleration in 2H23. In addition, the ride-hailing segment will likely see further growth supported by tourism recovery in the region.



E-commerce

Similar to the ride-hailing industry, e-commerce companies in the region have lagged their global e-commerce peers due to a confluence of factors such as lagging profitability and growth deceleration after a breakneck pace since the pandemic started. In addition, rising competition is a key risk to watch in this segment amid ambitious targets set by large unlisted unicorns that have entered the markets in the past few years. With ample cash from their parent/operations in China, risks of renewed pressure on take rates and profitability must be watched. That said, we continue to see strong growth potential in the region in the medium term.

The industry's GMV (gross merchandising value) amounted to USD 130bn in 2022, according to Google, Temasek and Bain's "e-Economy SEA 2022" report, and is set to rise at mid-to-high teen CAGR till 2025, providing ample growth opportunities for industry leaders. In particular, we see value in select tier-2 internet companies which hold a strong position in Indonesia's smaller-tier cities with beaten-down valuations.



Fintech

With one of the largest underbanked populations in the world, ASEAN offers a vast opportunity for financial services. For instance, three out of four people in ASEAN lack access to basic financial services like credit, investment and insurance, according to a focused research project led by Bain & Company in collaboration with Google and Temasek.

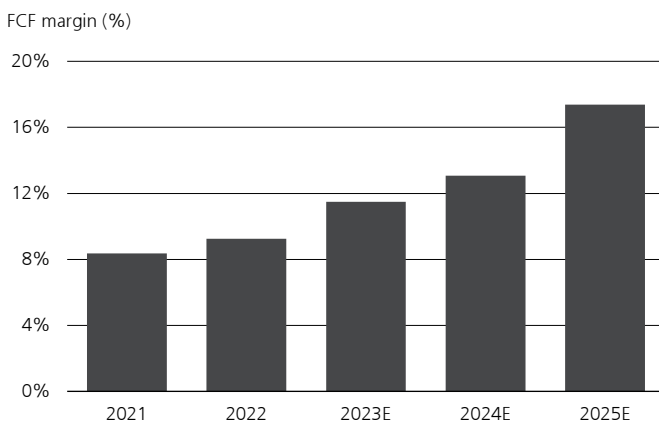
But unlike other new-economy segments, fintech is highly fragmented, with key players ranging from specialized e-payment services, unicorns from other verticals, and global tech giants, to traditional banks and telco operators. While regional tech giants often steal the media spotlight for their innovative fintech use cases, we believe select regional banks are fully embracing the irreversible trend and hold a fighting chance in this land-grab market. In particular, we like incumbent digital banks with strong progress in digitalizing their platforms.



Key risks

The key risks to the ASEAN new economy stocks mentioned above include weaker-than-expected macroeconomic growth, tighter competition due to the entrance of new players (including tech giants from the US and China), and currency volatility.

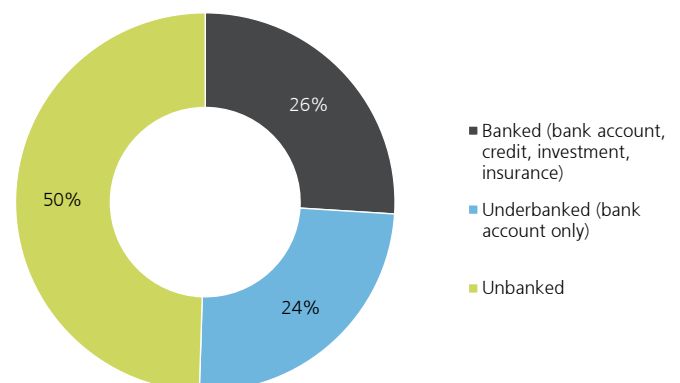
ASEAN new economy names to see further FCF margin expansion ahead



Source: Bloomberg, Factset, UBS, as of 2023

Three out of four people in ASEAN lack access to basic financial services

Financial services penetration in ASEAN



Source: Bain & Company, Google and Temasek, UBS, as of 2023

Can quantum computing change the dynamics of the AI market?

Before addressing this question, it is imperative to understand the difference between traditional computing and quantum computing. Unlike traditional computing, which is developed around the laws of mathematics, quantum computing is built on physics. With traditional computing, information is stored in bits with two states: 0 or 1. With quantum computing, information is stored in qubits (or quantum bits) that can be in any state between 0 and 1. In other words, rather than just being either 0 or 1, qubits can be in what's called a "superposition", when they're both 0 and 1 at the same time, or somewhere on a spectrum between the two.

Here's an easy way to think about it: When you flip a coin, it will either land heads or tails. But if you spin it, the coin can be both heads and tails while it's moving. Binary computing is the flipping of a coin, and superposition the spinning coin; the latter is particularly useful for simulations. While current quantum systems with only a few hundreds of qubits lack the power to perform complex tasks compared to an ideal requirement of a few thousand qubits, recent progress suggests we may reach that stage in a few years. Hence, we believe quantum computing is one of the key technology moonshots in the coming decade; and given that the industry is in its nascent

stages, participation through both public-listed and unlisted companies should provide diversified exposure to the fast-growing market.

However, the question is whether quantum computing can fully replace GPU-based computing used for generative AI.

Admittedly, while generative AI is not cheap, with a few GPUs from NVIDIA costing as high as USD 20,000–30,000 to train the latest AI-based data models, we doubt quantum computing can replace them in the foreseeable future. Instead, we believe quantum computing can be highly complementary to GPU-based computing as we expect it to perform specialized tasks—i.e., tasks that require heavy computing on smaller datasets and where latency is not an issue in industries like drug discovery, material sciences, weather forecasting, and supply chain management.

As a result, in the near term, we expect GPUs—together with other accelerators including CPUs and application specific integrated circuits (ASICs)—to remain the dominant form of computing for AI-based tasks, with quantum computing acting as a nice complement. We will continue to monitor the industry's progress and update our views.

Traditional computing vs. quantum computing

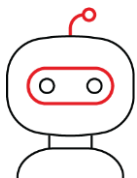
Traditional computing	Quantum computing
Use electric circuits which are in a single state at any given point in time: on or off	Uses quantum circuits that can be in more than one state at any given point of time
Runs at normal temperatures	Runs at extremely low temperatures
Information storage is based on voltage	Information storage is based on direction of electron spin
Processing of information is carried out by logic gates in a sequential basis	Processing of information is carried out by quantum logic gates in a parallel basis
Conventional bits store limited amount of information and consume more energy	Quantum bits can storage an enormous amount of information and use less energy
Circuits interface condition is stable	Circuits are incredibly sensitive to interface
Results are specifically defined, limited by algorithm design	Due to superposition and entanglement, answers are probabilistic in nature
No restriction on copying or measuring signals	Encryption has high degree of restrictions on copying and measuring signals

Source: UBS, as of 2023



Source: Getty images

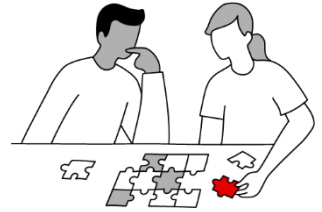
Chapter 5: Keeping tech in check



“Be stubborn on vision, but flexible on details.”

– Jeff Bezos

In recent years, countless policymakers imposed new rules, regulations, and governance on the technology sector, particularly on frontier developments such as AI and distributed ledger technology. Are these critical headwinds that investors should be worried about? In this chapter, we attempt to navigate the regulatory and geopolitical landscape within the rapidly-evolving technological space while identifying pockets of opportunities.



Will regulations derail the tech rally?

The first half of 2023 will be remembered for the strong AI-powered tech rally. But under the surface, the regulatory landscape is also heating up, which could prove to be a moderate risk for tech companies. Broadly speaking, we see rising regulatory risks in four major areas.

First, anti-trust. Rising anti-trust regulations could lead to derating risks for big tech companies. Two recent developments on this front are worth monitoring: The US Federal Trade Commission's (FTC) legal suit against Amazon for allegedly enrolling customers in its Prime program without their consent and potential hurdles for Microsoft's acquisition of leading game software company Activision.

Second, advertising and data privacy. While the advent of generative AI platforms like ChatGPT has already started to disrupt the traditional search advertising business, leading digital media companies like Alphabet are also being hit with fresh regulatory setbacks. Both the US Department of Justice and the European Commission are pushing for structural changes to Google's ad tech business (around 5% of net revenue). Meanwhile, Meta has been slapped with a USD 1.3bn fine from the EU for breaching the recently introduced General Data Protection Regulations and has been ordered to cease processing personal data of EU users in the US within six months.

Third, the gig economy: In June, California's Supreme Court granted a review of the Prop 22 case, a ballot measure passed by voters in 2020 that classifies gig workers for companies like Uber and DoorDash as independent contractors and not employees. This measure had exempted the companies from state labor laws.

Finally, geopolitics. Geopolitical tensions around tech escalated further in 1H23 with the tightening of AI chip sales to China from US companies, China's retaliatory restrictions on the sale of US-based Micron's chips to sensitive domestic industries, and the Netherlands further tightening curbs on the sale of advanced immersion lithography in addition to the previous restrictions on extreme ultraviolet tools. Recent chatter about additional restrictions on the usage of foreign brands like Apple's iPhone in government offices and SOEs in China is another potential sign of escalation.

We view all these developments as incrementally negative for the tech segments involved. However, at this stage, the risks appear somewhat manageable to us. Unless additional restrictions emerge, we believe near-term investor focus will shift to earnings results and the pace of the fundamental recovery in 2H23 and 2024. That said, we recommend investors to avoid concentration risks in companies exposed to regulatory risks.

Rising regulatory risks for tech companies across four major areas



Source: UBS, as of 2023

Will geopolitics hinder the growth of quantum computing?

While the application of quantum computing may remain a niche in the near term, the latest developments suggest it could be the next geopolitical battleground in tech after the power contest we've seen in advanced chips over the past year or so. In fact, several media reports suggest China's presence in quantum computing is rising, pointing to the potential for future trade restrictions. It is therefore important to understand the supply chains and key players in the quantum computing space. There are three different types of qubits on which quantum computers are built.

First, there are superconducting qubits, which are mainly used by leading companies like Google and IBM. A superconductor is a material that changes from a normal state to a superconducting state when cooled, leading to essentially no resistance to the flow of direct electrical current. The advantages of superconducting qubits are faster computation and better integration potential with current circuit processes, while disadvantages include quick decoherence and the need for a very cold environment for them to work. The key components of the superconducting qubit supply chain include Helium-3 gas (mostly from North America and Russia), dielectric resonators (mostly from Germany and Japan), and dilution refrigerators (mostly from Finland, the Netherlands, and the United Kingdom).

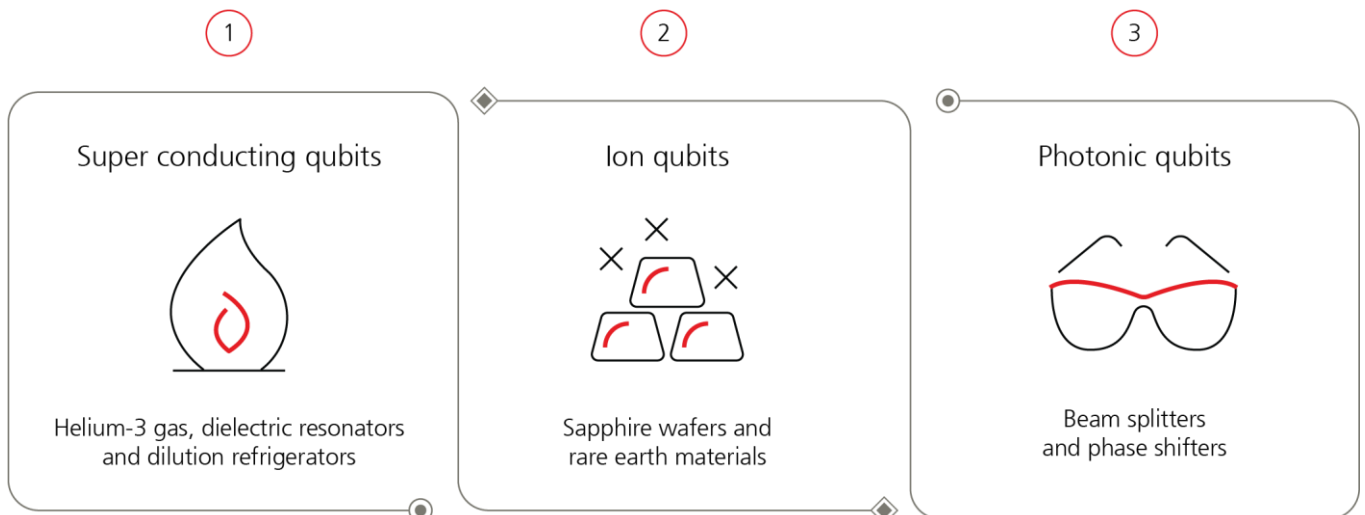
The second type is trapped ion qubits, which are mainly used by companies like Ion Q, Alpine Quantum Technologies, and reportedly, Foxconn, the leading electronics assembly company in the world. This technology traps ions using magnetic fields, with the key advantages being stability and the ability to operate at room temperature. The major disadvantage is that trapped ion qubits are considerably slower compared to superconducting qubits. The key components of the trapped ions qubit supply chain include sapphire wafers (mostly from Japan and Russia) and rare earth materials (mostly from China and byproducts from nuclear reactors).

Finally, the third type is photonic qubits, which are mainly used by companies like Xanadu. This technology uses particles of light to carry and process information and manipulate photons with mirrors, beam splitters, and phase shifters. The key advantages include the ability to operate at room temperature, whereas the main disadvantages include problems with scalability. The key components of the supply chain include beam splitters and phase shifters (mostly from the US).



Investment implications: Geopolitics present a key risk to monitor for quantum computing, but we see potential investment opportunities in both publicly listed and private companies given the dynamic nature of the technology.

Three segments of quantum computing



Source: UBS, as of 2023

What are the risks involved when investing in the Middle East's digital economy?

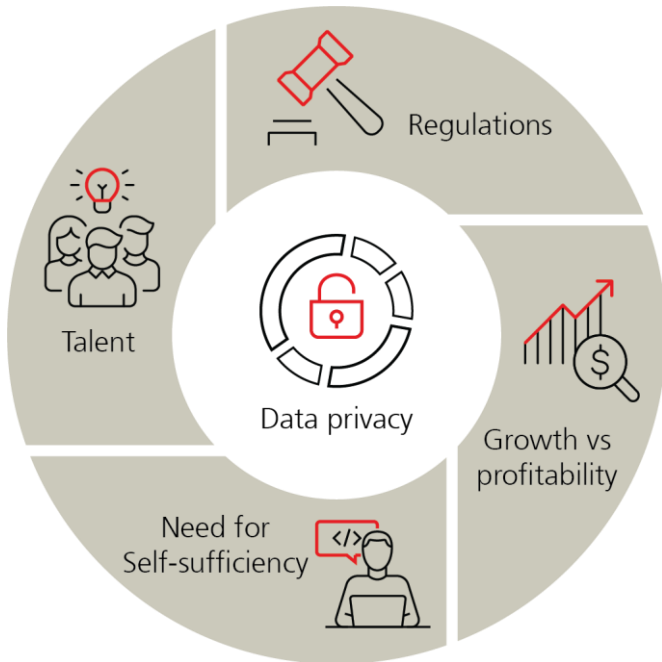
We believe the Middle East is not immune to the risks that many global tech companies and investors face today. While regulations are a global issue, they are even more relevant in the Middle East where the region's early stages of development present risks around managing antitrust, competition, labor, and pricing-related regulations. Talent is another issue as the region needs to build a robust homegrown talent base including a solid developer ecosystem that matches other global talent pools in Silicon Valley, China, and India. The path to profitability is another risk for investors considering investments in unprofitable startups in the Middle East, given an ongoing tug of war between growth and profitability—one where we see many trade-offs. This too is not a risk specific to the Middle East, but with smaller startups set to deliver significant growth in the next few years, investors should actively manage these issues.

Additionally, geopolitical tensions between the US and China highlight the need for the Middle East to be self-sufficient. The region currently relies on the West for critical technologies like semiconductors and software, so we see both challenges and opportunities as the region strives to be self-sufficient. Among the risks, data privacy is particularly pressing given the region's high vulnerability to cybersecurity breaches. According to data from the IBM Security and Ponemon Institute, the cost of a data breach in the Middle East has climbed to USD 8.07mn in 2023, up 8.2% y/y from USD 7.46mn in 2022.

This is alarming given the cost in 2023 is not only well above the global average of USD 4.45mn, but the increase of 8.2% is also sharp compared to the global average of 2.3%. The good news is that Middle Eastern tech companies have realized the importance of cybersecurity and are starting to step up investments, which also provides interesting investment opportunities. For more details, please refer to our "Security and safety" longer-term investment theme.

In summary, we believe the significant investment opportunities the Middle East over the next decade outweigh the risks at this stage. With the region's digital economy growing twice as fast as the global digital economy, we highlight software, internet, and data centers as standouts, alongside diversified venture capital and private equity opportunities to capture early stage growth and cybersecurity to manage data privacy risks.

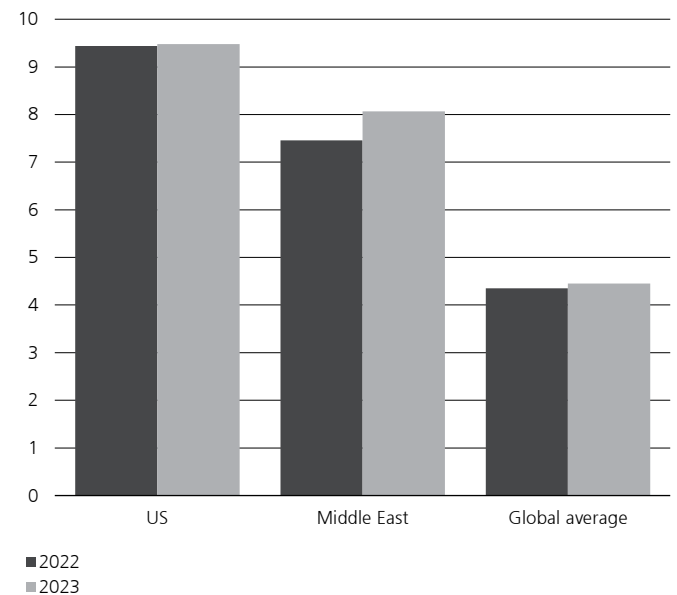
Key risks of investing in the Middle East's digital economy



Source: UBS, as of 2023

The Middle East ranks second in terms of data breach costs globally

Figures in USD mn



Source: IBM Security, Ponemon Institute, Cost of a Data Breach Report 2023, UBS, as of 2023

What are the key drivers behind resilient cybersecurity spending?

Global internet users have grown by an average of 10% over the past few years, driven by rapid digital transformation after the pandemic. This, coupled with the ongoing development in AI—particularly generative AI—should continue to drive strong growth for digital data, which in turn should also expose organizations to more cybersecurity attacks. In addition, with the proliferation of connected devices such as PCs, smartphones, and wearable devices, this increased data complexity exposes users to security risks. At the highest level, companies should invest in cybersecurity to protect themselves from these increasingly existential threats. In a world where data is quickly becoming the most valuable corporate asset, companies face an increasing threat landscape. Two decades ago, “script kiddies” broke into secure systems for fun or to impress their peers. However, over the years, hacking has evolved into a much more complex and dangerous activity. Threats now include state-sponsored hackers, political “hacktivists”, and corporate cyber-spies.

Furthermore, the past few years have seen a rise in cybercriminal organizations operating in the dark web, a part of the internet that is often home to illegal activity and requires special software and knowledge to access. These “hackers for hire” provide services ranging from an à la carte piece of malware to an end-to-end cyberattack campaign. With access to the dark web, anyone from motivated individuals to rogue governments can have a turnkey hacking solution to be instantly weaponized.

At the same time, the attack surface—the number of connection points into a network—continues to increase at a rapid rate, both in terms of volume and complexity. More workers than ever connect to corporate networks from personal devices. Customers demand more digital interaction and more automation; this increases the interconnectedness and risk of bad actors.

The IT architecture landscape continues to evolve and integrate more cloud functionality. This has several implications. Corporate data is often no longer stored within a company’s own data center, but instead resides in a cloud service provider which is entrusted to safekeep the data. New applications are increasingly distributed; rather than being part of a monolithic stack, cloud-based applications can be thought of as a program that runs on multiple interconnected servers. This decreases visibility and increases the risk of newly-developed attack technologies.

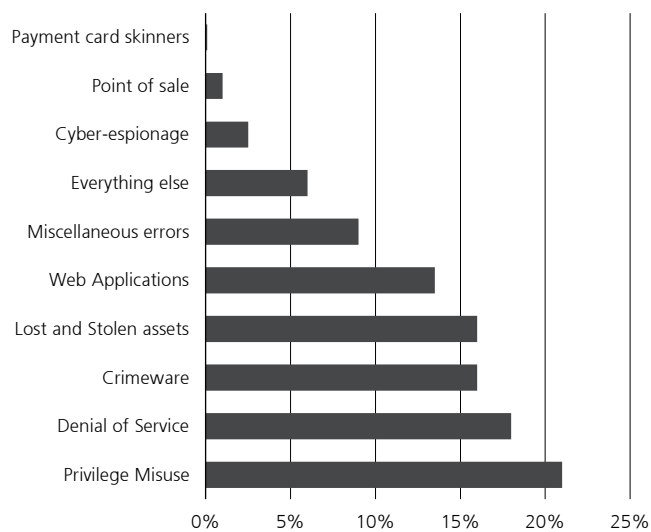
Lastly, cybersecurity attacks have become more sophisticated. Most successful hacks are a result of employee errors (i.e., opening an unknown attachment, downloading unapproved software) or a process failure (i.e., not staying current with software updates).

In a world that is more digitally focused with every passing year, a company’s IT infrastructure is increasingly core to the operations of a business, as well as customers’ perception of that business. The result is that cybersecurity is now often viewed as a board-level topic—cybersecurity breaches have dire consequences that range from reputational damage, regulatory penalties and sanctions, disruption of operations, and in the most extreme cases, corporate failure. According to IBM Security and Ponemon Institute’s “Cost of a Data Breach Report 2023”, the cost of a data breach continues to rise with the latest average cost at USD 4.45mn.

In our view, these factors provide a solid underpinning for durable cybersecurity spending growth in excess of overall IT spending.

Increasing breadth of security attack vectors

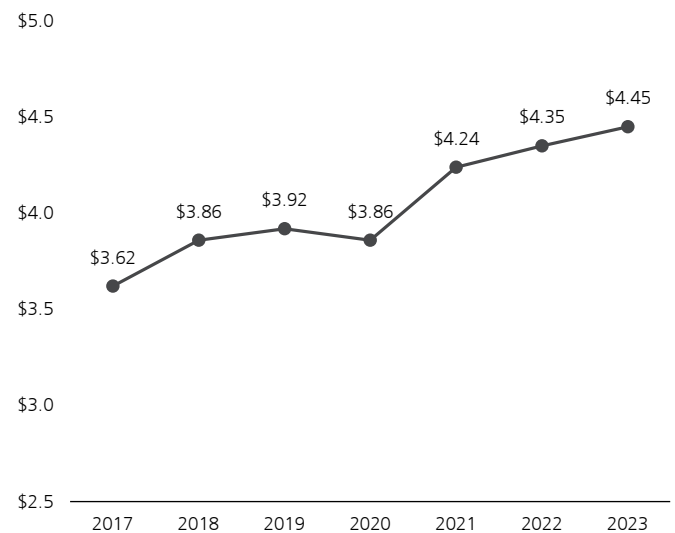
Likelihood of breaches %



Source: IDC, Bloomberg Intelligence, UBS, as of 2023

Global average cost of a data breach

In USD mn



Source: IBM Security, Ponemon Institute, Cost of a Data Breach Report 2023, UBS, as of 2023

How big is the cybersecurity market?

The size of the global market was close to USD 145bn in 2020. We expect the industry to grow at an average annual clip of 10% from 2020 to 2024 thanks to steadily-higher enterprise IT spending and stronger adoption of cloud security. This should take the addressable market to USD 220bn by 2024. Cybersecurity is also one of the most defensive segments within IT; due to its importance, spending on it has continued to grow at a high-single-digit rate in recent years at a time when broader enterprise IT spending has limped along at low-single-digit rates. This has limited the downside in the segment, as seen in 2020.

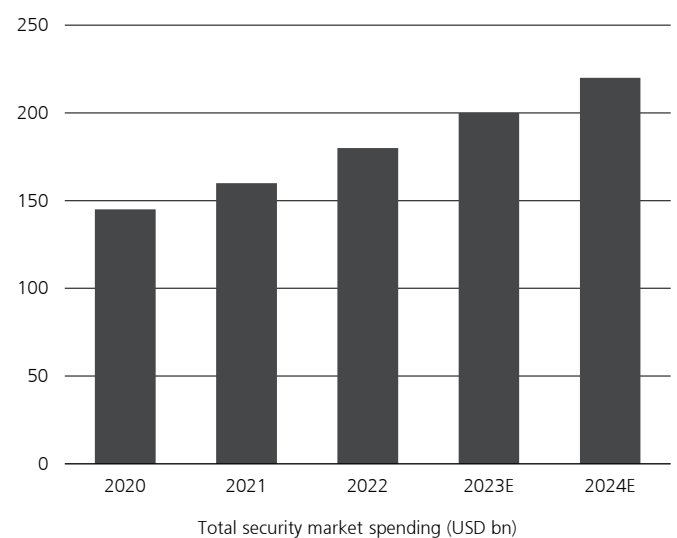
While this is a large market, it is highly fragmented, with ten separate market segments. We further note that unlike much of enterprise technology, each market segment is further fragmented, with no single dominant vendor. The cybersecurity market is also being upended by innovation. New business models are required to defend against ever-growing cyber complexity, resulting in the creation of new solutions. COVID-19, for instance, accelerated many digital trends like cloud, thanks to emerging trends such as work-from-home. As a result, we expect cloud security to be the fastest-growing crowd segment, given that the penetration rate across key large segments, such as firewalls, remains relatively low. With an average enterprise deploying more than 50 security tools, we see larger opportunities for comprehensive and cross-functional products that should eventually drive consolidation among both vendors and existing security tools. Likewise, we see potential for frontier technology to be embedded within cybersecurity to drive the development of these offerings.

Security services is the largest segment of the overall security market and includes consulting, hardware support, and other services. As cloud adoption by companies of all sizes grows, cloud security has had the fastest growth rate.

As noted earlier, we remain constructive on the prospects for security spending growth to outpace the broader IT market. Even at current levels, security spending is less than 5% of overall technology spending (excluding smartphones), based on data from Gartner. Furthermore, in the US, corporations on average spend roughly 5% of revenue on information technology. In our view, security should continue to gain a bigger share of the IT spending wallet, given the multitude of challenges faced by chief information security officers (CISOs).

Security spending to outpace broader IT spending

Figures in USD bn



Source: IDC, Bloomberg Intelligence, UBS, as of 2023



“Compared to other technology sectors in hardware and semiconductors, cybersecurity providers could also be more resilient amid heightened geopolitical tensions due to their high domestic sales contribution.”

What are the opportunities in China's emerging cybersecurity market?

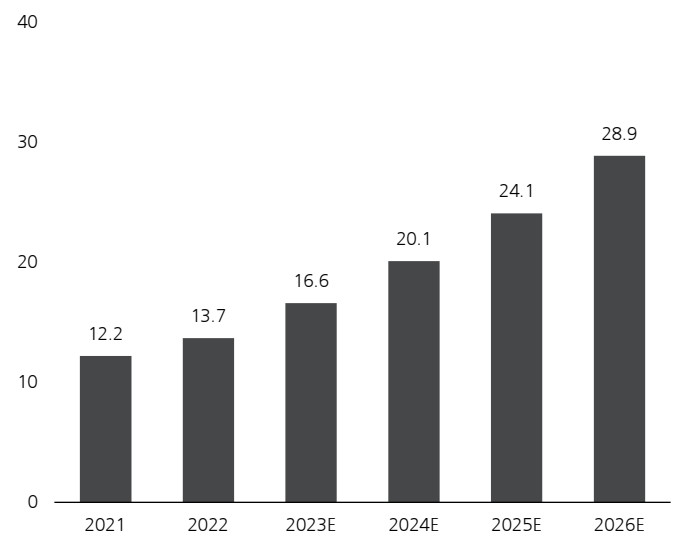
We see upside potential in China's cybersecurity industry due to the government's consistent support of digitalization since 2012. In February 2023, Beijing announced its "Digital China" plan to guide the layout and development of the digital economy. According to the plan, China wants to enhance the connectivity of digital infrastructure and improve the scale and quality of data resources by 2025. Improving data security is among the top priorities in order to reach the target. In fact, China's State Council has even set up a new National Data Bureau to coordinate and integrate digital data resource sharing and transfer. Because of the increasing connectivity and rising data transfer volume afterwards, the demand for cybersecurity, especially in software, is expected to surge.

Due to the high-level guidance from the central government, China's businesses have generally become more conscious of the importance of cybersecurity, especially in cybersecurity software. China's cybersecurity software market were relatively fragmented, depending on client industry. But over the past few years, the technology requirement for cybersecurity has escalated due to the faster adoption of cloud services and the increasing complexity of the upgraded network environment. Growth opportunities have also increased for these cybersecurity service providers in China as traditional industries like manufacturing and healthcare are also starting to adopt cloud technologies. In addition, with the increasing adoption of AI in China by most big cloud service providers, the demand of cybersecurity software service should continue to increase in the coming years. Hence, we see the market getting more and more concentrated, with market leaders gaining market share with stronger R&D and service capability to offer broader product lines for different industries.

In the near to mid-term, we expect cybersecurity companies with a higher revenue exposure to the government or state-owned enterprises (SOEs) to benefit the most as Beijing has already set plans to allocate more resources to investing in that area. The higher sensitivity of government data has also created more opportunities for cybersecurity service providers, especially when transferring data onto the cloud. The leading companies mentioned earlier thus have dominant market share when it comes to the government and industries with more SOEs, such as financials, telecommunication, and energy. Compared to other technology sectors in hardware and semiconductors, cybersecurity providers could also be more resilient amid heightened geopolitical tensions due to their high domestic sales contribution.

Solid cybersecurity spending growth in China

China's cybersecurity spending, USD bn



Source: IDC, Morgan Stanley Research, UBS, as of 2023



"The good news is that major cybersecurity vendors are accelerating innovation and are ready to tackle incremental complexity arising from generative AI."

How to invest in cybersecurity?

We believe there are two overarching trends in the security market.

First, security professionals are generally faced with too many security products, from too many vendors, and not enough experienced staff. In our view, this has and will continue to be a driver towards "platformization", or the consolidation of previously-discrete security functions, and less use of "best-of-breed" solutions. These security platforms may not have individual "best-of-breed" components, but overall security can be improved through tighter integration and greater efficiency. We believe cybersecurity platform leaders are better positioned to ride this trend.

Second, security professionals are increasingly focused on the detection and remediation of breaches rather than pure defense. This has led to increased demand for security systems that can capture and analyze cybersecurity events, with an aim of quickly understanding new attack vectors as well as isolating the damage done by an attack.

Against this backdrop, we prefer companies that are consolidators and also capture significant amounts of data that can be monetized either directly through additional services or through better product functionality. At this stage, we recommend selectivity in cybersecurity where we prefer leading platform companies.



Source: Getty images

Chapter 6: One more thing...



“Innovation distinguishes between a leader and a follower.”

– Steve Jobs

“One more thing” is a famous segment popularized by Steve Jobs, the founder of Apple, during his product launch events where he would typically conclude his presentation by introducing new surprises. Keeping this spirit alive, we use this “One more thing” segment to challenge ourselves and address some of the tough questions regarding the “fallen angels” in tech.



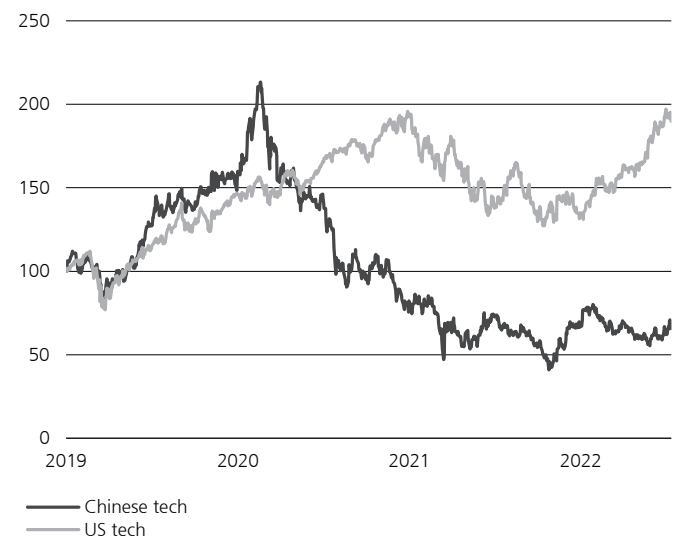
What would revive Chinese tech?

Since peaking in late 2020, Chinese internet companies have significantly underperformed their US peers due to multiple challenges around regulations, geopolitics, and business conditions. However, CIO remains positive on Chinese equities and sees some light at the end of the tunnel for technology companies. A turnaround will depend on: a) A broader recovery in the economy and favorable regulations, including proactive policy support promoting innovation and growth in key industries like artificial intelligence, e-commerce, and gaming; b) the absence of any further sharp acceleration in US restrictions on chip supply access and broad investment restrictions; c) a normalization in the competitive landscape across key segments like e-commerce, food delivery, cloud, and smartphones, supporting margin stabilization; and d) strong cash distribution on par with US tech companies in the form of both share buybacks and rising dividend payouts.

There has been progress in some of these areas, driving brief relief rallies, but we need to see most of the factors working in tandem for a sustained recovery. In short, at this stage, we assign a medium-level probability of a significant turnaround in the Chinese tech sector in the next 6–12 months.

Regulations, geopolitics, and challenging business conditions have hurt the performance of Chinese tech

Performance rebased on 31 December 2019



Source: Bloomberg, Factset, UBS, as of 2023



“Information technology and business are becoming inextricably interwoven. I don’t think anybody can talk meaningfully about one without the talking about the other.”

– Bill Gates

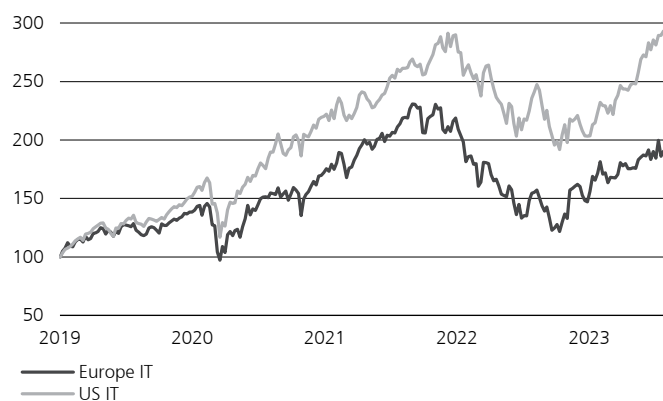
What would revive European tech?

European tech firms have significantly underperformed their US peers over the past few years as the technology gap continues to widen. While there are some global leaders in Europe tech that have performed well, including in the semiconductor equipment and auto chip segments, tech companies in Europe have broadly lagged due to disproportionate exposure to legacy technologies like wireless equipment, on-premise software, and traditional IT services. In a challenging market environment like 2022, which saw a broad-based correction in tech, European tech companies could hold up well versus their US peers due to their relative defensiveness. However, during market rebounds, we generally expect growth-based investors to favor US and emerging market tech companies instead.

While we struggle to see a strong turnaround opportunity for European tech companies beyond the relative valuation argument, there are several potential scenarios that may lead to a revival: a) An accelerated shift to faster-growth areas like cloud, artificial intelligence, big data, etc.; b) a significant margin expansion due to a shift in product mix to higher margin software and high-end semiconductors; c) favorable regulations including financing and other R&D grant support; d) strong M&A, venture capital, and private equity inflows across key technology hubs in the region, driving significant innovation and the emergence of regional champions across tech industries including internet; and e) solid cash distribution to shareholders in the form of both share buybacks and dividends. Some of these actions require time and strong government support, but considering the region's historical track record and solid talent base, a turnaround opportunity cannot be fully ruled out. At this stage, we see a low probability of a significant turnaround in the European tech market in the next 6–12 months.

Europe tech firms have significantly underperformed their US peers in recent years

Performance rebased on 1 January 2019



Source: Bloomberg, Factset, UBS, as of 2023

What would revive global fintech?

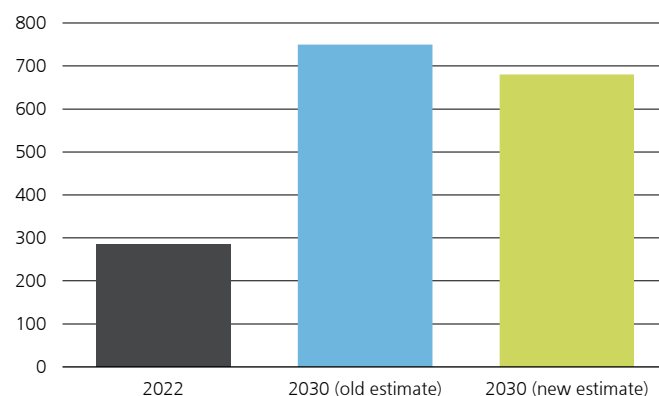
After a strong performance during the early part of the pandemic, the global fintech industry has underperformed broader tech from mid-2021 onwards. The industry remains in a period of transition as tailwinds during the pandemic fade and business models adjust to cope with higher-for-longer interest rates by prioritizing profitability over revenue growth. The slowdown was also reflected in a 46% drop in fintech VC funding in 2022. Therefore, we have lowered our fintech industry revenue growth forecast and now expect revenues to grow from USD 285bn in 2022 to USD 680bn in 2030 (vs. our previous forecast of growth from USD 225bn in 2020 to USD 750bn in 2030).

The good news, however, is that we see these issues as largely temporary. After a near-term adjustment, we expect the fintech industry to resume its above-average growth starting in 2H23. As a result, we still project fintech to report double-digit growth through the end of the decade. Our positive long-term view is based on structural drivers which are still intact—rapid urbanization, the need for financial inclusion, favorable regulations supported by digitalization trends around mobility, cloud, analytics, and social media, plus emerging technologies like distributed ledgers and artificial intelligence.

Tactically, we think some of the following catalysts are needed for the fintech industry to stage a turnaround: a) a margin rebound as we believe fintech is one of the few tech industries where margins did not expand much over the past few quarters due to a lack of significant restructuring or self-help efforts; b) a potential acceleration in e-commerce volumes, which can buoy online payments (one of the largest fintech segments); c) normalizing interest rates coupled with a pickup in fintech funding; d) a meaningful adoption of generative AI in the fintech industry, driving strong cost efficiencies and an expansion of the addressable market; and e) less intense competition and favorable regulations, particularly in emerging markets. For now, we see a medium-level probability of a big turnaround in the global fintech market over the next 6–12 months.

We have cut our 2030 fintech revenue forecast from USD 750bn to USD 680bn

Estimated fintech revenues (USD bn)



Source: UBS, as of 2023

What would revive legacy tech?

Legacy tech includes incumbent technology leaders in mature industries like PCs, storage, networking, and low-end assembly. The group overall has heavily underperformed broader tech benchmarks over the past decade due to major disruptions from emerging leaders in areas like cloud, big data, AI, internet, etc. For instance, the MSCI AC World Electronic Equipment, Instruments & Components Index, which is a representation of legacy electronic manufacturers and electronic manufacturing services companies, has underperformed the MSCI AC World IT index by 280pps over the past 10 years.

With AI in its nascent stages, we see further disruptions as the gap between the haves (innovative companies) and have-nots (legacy companies) widens further. Still, a turnaround may happen depending on: a) transformative acquisitions by legacy companies, in particular acquiring and properly integrating leading cloud and AI platforms; b) a big step-up in R&D investments and management changes driving significant innovation; c) strong backing by governments and private equity firms providing funding and other support; and d) reverse acquisitions of legacy tech by well-established tech platforms due to the niche assets legacy companies own. Currently, we see a very low probability of a large turnaround in legacy tech companies in the next 6–12 months.

What would revive profitless tech?

Investors have historically favored the technology sector for its unique combination of strong revenue growth and high levels of profitability. Furthermore, companies with a high return-on-equity (RoE, a measure of profitability) have historically outperformed their low RoE peers by a wide margin.

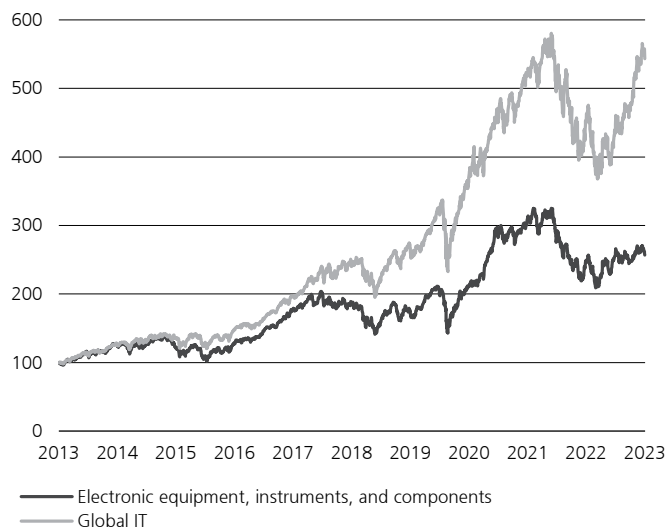
However, unprofitable technology companies materially outpaced the broader group in 2020 and 2021 during the global pandemic. We believe this outperformance was driven by negative real interest rates (i.e., the 10-year US Treasury nominal interest rate was less than the 10-year breakeven inflation rate), which increased investors' risk appetite and drove them to "growth at any price."



“The question now is whether unprofitable tech stocks will rally from here.”

Legacy tech performance relative to global IT sector

Performance rebased on 2 August 2013



Source: Bloomberg, Factset, UBS, as of 2023

Unprofitable tech stocks have declined significantly amid rise in rates

10Y real rates (RHS), stocks performance (LHS)



Source: Bloomberg, Factset, UBS, as of 2023

Our unprofitable technology basket of 50 stocks reversed course in late 2021 as real rates turned higher thanks to the Federal Reserve’s policy tightening.

The question now is whether unprofitable tech stocks will rally from here. We think it will take a more benign interest rate environment, along with continued solid fundamentals at the company level, for this to happen. Looking at fundamentals, we note that revenue growth estimates have been declining, with the average growth rate for the basket now at 18% versus 25–35% during 2020–21.

Looking ahead, we continue to prefer growth-at-a-reasonable price technology stocks, which we believe are in many cases better positioned to capitalize on secular IT trends as well as manage a still-difficult IT spending environment. Unprofitable technology companies may have some upside, but we think there will be continued challenges to fundamentals as well as the risk of a further derating and slower economic growth. For now, we see a low probability of a significant turnaround in the unprofitable tech market in the next 6–12 months.

In sum, we don’t think these fallen angels will scale their previous highs. But on a relative basis, as a turnaround opportunity over the next 6–12 months, we assign a medium probability for global fintech, a low probability for European tech and profitless tech, and a very low probability for legacy tech. Instead, we see better risk-reward for well-established tech companies in mid-cyclical industries like software and internet.

Decelerating growth for unprofitable tech stocks

Average estimated forward revenue growth rate



Source: Bloomberg, Factset, UBS, as of 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.

Interests in alternative investment funds are not deposits or obligations of, or guaranteed or endorsed by, any bank or other insured depository institution, and are not federally insured by the Federal Deposit Insurance Corporation, the Federal Reserve Board, or any other governmental agency. Prospective investors should understand these risks and have the financial ability and willingness to accept them for an extended period of time before making an investment in an alternative investment fund and should consider an alternative investment fund as a supplement to an overall investment program.

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.
- **Foreign Exchange/Currency Risk:** Investors in securities of issuers located outside of the United States should be aware that even for securities denominated in U.S. dollars, changes in the exchange rate between the U.S. dollar and the issuer's "home" currency can have unexpected effects on the market value and liquidity of those securities. Those securities may also be affected by other risks (such as political, economic or regulatory changes) that may not be readily known to a U.S. investor.

UBS Chief Investment Office's ("CIO") investment views are prepared and published by the Global Wealth Management business of UBS Switzerland AG (regulated by FINMA in Switzerland) or its affiliates ("UBS"), part of UBS Group AG ("UBS Group"). UBS Group includes Credit Suisse AG, its subsidiaries, branches and affiliates. Additional disclaimer relevant to Credit Suisse Wealth Management follows at the end of this section.

The investment views have been prepared in accordance with legal requirements designed to promote the **independence of investment research**.

Generic investment research – Risk information:

This publication is **for your information only** and is not intended as an offer, or a solicitation of an offer, to buy or sell any investment or other specific product. The analysis contained herein does not constitute a personal recommendation or take into account the particular investment objectives, investment strategies, financial situation and needs of any specific recipient. It is based on numerous assumptions. Different assumptions could result in materially different results. Certain services and products are subject to legal restrictions and cannot be offered worldwide on an unrestricted basis and/or may not be eligible for sale to all investors. All information and opinions expressed in this document were obtained from sources believed to be reliable and in good faith, but no representation or warranty, express or implied, is made as to its accuracy or completeness (other than disclosures relating to UBS). All information and opinions as well as any forecasts, estimates and market prices indicated are current as of the date of this report, and are subject to change without notice. Opinions expressed herein may differ or be contrary to those expressed by other business areas or divisions of UBS as a result of using different assumptions and/or criteria.

In no circumstances may this document or any of the information (including any forecast, value, index or other calculated amount ("Values")) be used for any of the following purposes (i) valuation or accounting purposes; (ii) to determine the amounts due or payable, the price or the value of any financial instrument or financial contract; or (iii) to measure the performance of any financial instrument including, without limitation, for the purpose of tracking the return or performance of any Value or of defining the asset allocation of portfolio or of computing performance fees. By receiving this document and the information you will be deemed to represent and warrant to UBS that you will not use this document or otherwise rely on any of the information for any of the above purposes. UBS and any of its directors or employees may be entitled at any time to hold long or short positions in investment instruments referred to herein, carry out transactions involving relevant investment instruments in the capacity of principal or agent, or provide any other services or have officers, who serve as directors, either to/for the issuer, the investment instrument itself or to/for any company commercially or financially affiliated to such issuers. At any time, investment decisions (including whether to buy, sell or hold securities) made by UBS and its employees may differ from or be contrary to the opinions expressed in UBS research publications. Some investments may not be readily realizable since the market in the securities is illiquid and therefore valuing the investment and identifying the risk to which you are exposed may be difficult to quantify. UBS relies on information barriers to control the flow of information contained in one or more areas within UBS, into other areas, units, divisions or affiliates of UBS. Futures and options trading is not suitable for every investor as there is a substantial risk of loss, and losses in excess of an initial investment may occur. Past performance of an investment is no guarantee for its future performance. Additional information will be made available upon request. Some investments may be subject to sudden and large falls in value and on realization you may receive back less than you invested or may be required to pay more. Changes in foreign exchange rates may have an adverse effect on the price, value or income of an investment. The analyst(s) responsible for the preparation of this report may interact with trading desk personnel, sales personnel and other constituencies for the purpose of gathering, synthesizing and interpreting market information.

Different areas, groups, and personnel within UBS Group may produce and distribute separate research products **independently of each other**. For example, research publications from **CIO** are produced by UBS Global Wealth Management. **UBS Global Research** is produced by UBS Investment Bank. **Credit Suisse Global CIO Office Research** is produced by Credit Suisse Wealth Management. **Credit Suisse Securities Research** is produced by Credit Suisse operating under its Securities Research function within the Investment Banking Division. **Research methodologies and rating systems of each separate research organization may differ**, for example, in terms of investment recommendations, investment horizon, model assumptions, and valuation methods. As a consequence, except for certain economic forecasts (for which UBS CIO and UBS Global Research may collaborate), investment recommendations, ratings, price targets, and valuations provided by each of the separate research organizations may be different, or inconsistent. You should refer to each relevant research product for the details as to their methodologies and rating system. Not all clients may have access to all products from every organization. Each research product is subject to the policies and procedures of the organization that produces it.

The compensation of the analyst(s) who prepared this report is determined exclusively by research management and senior management (not including investment banking). Analyst compensation is not based on investment banking, sales and trading or principal trading revenues, however, compensation may relate to the revenues of UBS Group as a whole, of which investment banking, sales and trading and principal trading are a part.

Tax treatment depends on the individual circumstances and may be subject to change in the future. UBS does not provide legal or tax advice and makes no representations as to the tax treatment of assets or the investment returns thereon both in general or with reference to specific client's circumstances and needs. We are of necessity unable to take into account the particular investment objectives, financial situation and needs of our individual clients and we would recommend that you take financial and/or tax advice as to the implications (including tax) of investing in any of the products mentioned herein.

This material may not be reproduced or copies circulated without prior authority of UBS. Unless otherwise agreed in writing UBS expressly prohibits the distribution and transfer of this material to third parties for any reason. UBS accepts no liability whatsoever for any claims or lawsuits from any third parties arising from the use or distribution of this material. This report is for distribution only under such circumstances as may be permitted by applicable law. For information on the ways in which CIO manages conflicts and maintains independence of its investment views and publication offering, and research and rating methodologies, please visit www.ubs.com/research-methodology. Additional information on the relevant authors of this publication and other CIO publication(s) referenced in this report; and copies of any past reports on this topic; are available upon request from your client advisor.

Important Information About Sustainable Investing Strategies: Sustainable investing strategies aim to consider and incorporate environmental, social and governance (ESG) factors into investment process and portfolio construction. Strategies across geographies approach ESG analysis and incorporate the findings in a variety of ways. Incorporating ESG factors or Sustainable Investing considerations may inhibit UBS's ability to participate in or to advise on certain investment opportunities that otherwise would be consistent with the Client's investment objectives. The returns on a portfolio incorporating ESG factors or Sustainable Investing considerations may be lower or higher than portfolios where ESG factors, exclusions, or other sustainability issues are not considered by UBS, and the investment opportunities available to such portfolios may differ.

External Asset Managers / External Financial Consultants: In case this research or publication is provided to an External Asset Manager or an External Financial Consultant, UBS expressly prohibits that it is redistributed by the External Asset Manager or the External Financial Consultant and is made available to their clients and/or third parties.

USA: Distributed to US persons only by UBS Financial Services Inc. or UBS Securities LLC, subsidiaries of UBS AG. UBS Switzerland AG, UBS Europe SE, UBS Bank, S.A., UBS Brasil Administradora de Valores Mobiliarios Ltda, UBS Asesores Mexico, S.A. de C.V., UBS SuMi TRUST Wealth Management Co., Ltd., UBS Wealth Management Israel Ltd and UBS Menkul Degerler AS are affiliates of UBS AG. **UBS Financial Services Inc. accepts responsibility for the content of a report prepared by a non-US affiliate when it distributes reports to US persons. All transactions by a US person in the securities mentioned in this report should be effected through a US-registered broker dealer affiliated with UBS, and not through a non-US affiliate. The contents of this report have not been and will not be approved by any securities or investment authority in the United States or elsewhere. UBS Financial Services Inc. is not acting as a municipal advisor to any municipal entity or obligated person within the meaning of Section 15B of the Securities Exchange Act (the "Municipal Advisor Rule") and the opinions or views contained herein are not intended to be, and do not constitute, advice within the meaning of the Municipal Advisor Rule**

For country information, please visit ubs.com/cio-country-disclaimer-gr or ask your client advisor for the full disclaimer.

Additional Disclaimer relevant to Credit Suisse Wealth Management

You receive this document in your capacity as a client of Credit Suisse Wealth Management. Your personal data will be processed in accordance with the Credit Suisse privacy statement accessible at your domicile through the official Credit Suisse website <https://www.credit-suisse.com>. In order to provide you with marketing materials concerning our products and services, UBS Group AG and its subsidiaries may process your basic personal data (i.e. contact details such as name, e-mail address) until you notify us that you no longer wish to receive them. You can optout from receiving these materials at any time by informing your Relationship Manager.

Except as otherwise specified herein and/or depending on the local Credit Suisse entity from which you are receiving this report, this report is distributed by Credit Suisse AG, authorised and regulated by the Swiss Financial Market Supervisory Authority (FINMA). Credit Suisse AG is a UBS Group company.

Version C/2023. CIO82652744

© UBS 2023. The key symbol and UBS are among the registered and unregistered trademarks of UBS. All rights reserved.