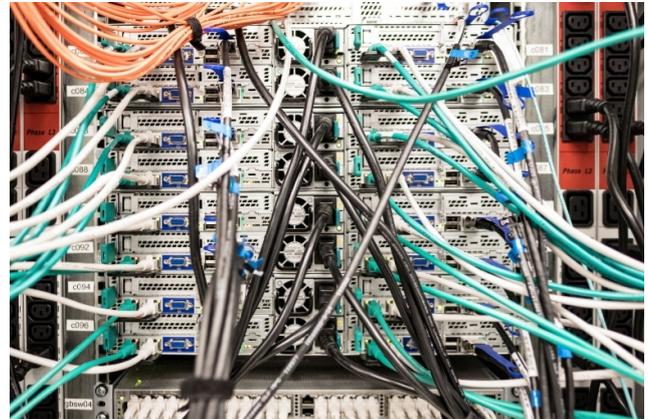


Let's chat about ChatGPT

Information technology

Authors: Kevin Dennean, CFA, CIO Equity Strategist, US Technology & Telecom, UBS Financial Services Inc. (UBS FS); Sundeep Gantori, CFA, CAIA, Equity Strategist, UBS AG Singapore Branch; Delwin Kurnia Limas, CFA, Equity Strategist, UBS AG Singapore Branch; Allen Pu, CFA, Analyst, UBS AG Hong Kong Branch; Reid Gilligan, CIO Equity Strategist, US Media, UBS Financial Services Inc. (UBS FS)

- ChatGPT-3 has captured headlines and generated a mix of excitement and fear among consumers. We view ChatGPT-3 as the current leader in a fast-growing market that will see significant investment and development by leading, large technology companies globally.
- While there are fears of impact on human labor, we think AI tools like ChatGPT will end up as part of the solution in an economy that has more job openings than available workers. Economic history shows that technology ultimately makes productive workers more productive and is net additive to employment and economic growth.
- For more information on investing in AI, please refer to our latest "Investing in the ABCs of tech" update published 6 February 2023. Outside of public equities, investors can also consider opportunities in private equity.



ChatGPT-3 has captured headlines and generated a mix of excitement and fear among consumers. We view ChatGPT-3 as the current leader in a fast growing market that will see significant investment and development by leading, large technology companies globally. Like prior technology developments, we believe artificial intelligence (AI) will ultimately be additive to employment and economic growth. Our "Investing in the ABCs of tech" report focuses on AI, big data, and cybersecurity—three foundational technologies that are at inflection points and should see faster adoption over the next few years as enterprises and governments increase their focus and investments in these areas.

No, this wasn't written by ChatGPT...but it probably could have been

ChatGPT-3 is a chatbot developed by the OpenAI, a US-based artificial intelligence research lab. Many consumers are familiar with chatbots, but less so with the underlying technology. ChatGPT-3 uses a generative pre-trained

transformer (GPT) to generate text that is largely identical to human conversation. GPT is part of the broader family of large language models, which are AI models that understand and can generate text.

Large language models are compelling because of their flexibility. With minimal training, large language models can complete sentences, translate a foreign language, summarize information from multiple sources, and generate content ranging from technical answers to humorous vignettes.

Enormous amounts of data from a range of sources are used in the training process. ChatGPT-3 ingested content from books, academic papers, and the entirety of Wikipedia. According to OpenAI, ChatGPT-3 was trained on over 45 terabytes of data. The system iteratively and without supervision learned to predict the next word in a sequence of text. This unsupervised learning required a network of

distributed computers, which allowed for a faster learning process than could have been accomplished using a single computer. The combination of a vast amount of ingested data and massive computing power resulted in a model with 175 billion parameters, making it one of the largest language models ever created. Parameters in large language models are essentially the values that the model is solving.

Use cases, from the source

Rather than speculate ourselves, we asked ChatGPT for some potential use cases. Here's its response:

"ChatGPT has many potential use cases including chatbots for customer service and mental health support, personal assistants, content creation, language translation, knowledge management, and education/training."

We see ChatGPT as an engine that will eventually power human interactions with computer systems in a familiar, natural, and intuitive way. As ChatGPT stated, large language models can be put to work as a communication engine in a variety of applications across a number of vertical markets.

Glaringly absent in its answer is the use of ChatGPT in search engines. Microsoft, which is an investor in OpenAI, is integrating ChatGPT into its Bing search engine. The use of a large language model enables more complex and more natural searches and extract deeper meaning and better context from source material. This is ultimately expected to deliver more robust and useful results.

Not the only chatbot in town

While ChatGPT has captured press headlines and consumers' enthusiasm, we note that there are a number of other large language models in use at scale today.

- BERT (Bidirectional Encoder Representations from Transformers), developed by Google, is also a transformer-based model that can perform language translation, sentiment analysis, and question-answering.
- T5 (Text-to-Text Transfer Transformer) is another transformer-based language model developed by Google to also provide language translation, summarization, and question-answering.
- XLNet, developed collaboratively by Carnegie Mellon University and Google, is a transformer-based language model that focuses on accurate and coherent responses to text prompts.
- RoBERTa (Robustly Optimized BERT Pre-training Approach), developed by Meta Platforms, is also a transformer-based language model that can provide language translation, question-answering, and text classification.

The latest and the greatest, for now

Is ChatGPT-3 the best large language model (LLM)? It may be so, simply because it is the one of the newest LLMs and therefore benefits from the latest data sources, new AI techniques, and increased computing power at a lower cost. The upshot is that ChatGPT-3 has at least twice as many parameters as its next closest competitors based on publicly available information.

Beyond its powerful capability, we believe one obvious, but underappreciated, reason for the excitement around ChatGPT-3 is simply that it is the first and only LLM that is easily accessible to consumers. The other LLMs noted above are used by consumers and businesses every day, but in less obvious ways as they are integrated into other applications and therefore largely transparent to users.

While ChatGPT-3 seems to be the leading solution today, we believe this is a fast-moving market that will see significant investment and development by all the leading large technology companies globally. We also note that large cloud service providers may have some inherent advantages in that they can offer an integrated solution. Lastly, we think the use of LLMs will only grow from here, broadening their use cases and deepening their integration into a number of applications.

Is AI coming for your job?

Every wave of new and disruptive technology has incited fears of mass job losses due to automation, and we are already seeing those fears expressed relative to AI generally and ChatGPT specifically. The year 1896, when Henry Ford rolled out his first automobile, was probably not a good year for buggy whip makers. When IBM introduced its first mainframe, the System/360, in 1964, office workers feared replacement by mechanical brains that never made mistakes, never called in sick, and never took vacations.

There are certainly historical cases of job displacement due to new technology adoption, and ChatGPT may unseat some office workers or customer service reps. However, we think AI tools broadly will end up as part of the solution in an economy that has more job openings than available workers.

However, economic history shows that technology of any sort (i.e., manufacturing technology, communications technology, information technology) ultimately makes productive workers more productive and is net additive to employment and economic growth.

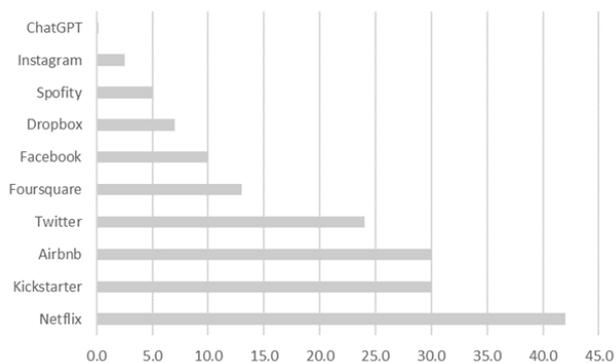
How big is the opportunity?

The broad AI hardware and services market was nearly USD 36bn in 2020, based on IDC and Bloomberg Intelligence data. We expect the market to grow by 20% CAGR to reach USD 90bn by 2025. Given the relatively early monetization

stage of conversational AI, we estimate that the segment accounted for 10% of the broader AI’s addressable market in 2020, predominantly from enterprise and consumer subscriptions. That said, user adoption is rapidly rising. ChatGPT reached its first 1 million user milestone in a week, surpassing Instagram to become the quickest application to do so. Similarly, we see strong interest from enterprises to integrate conversational AI into their existing ecosystem. As a result, we believe conversational AI’s share in the broader AI’s addressable market can climb to 20% by 2025 (USD 18–20bn). Our estimate may prove to be conservative; they could be even higher if conversational AI improvements (in terms of computing power, machine learning, and deep learning capabilities), availability of talent, enterprise adoption, spending from governments, and incentives are stronger than expected.

In addition to higher subscription revenues, we believe advertising potential on AI-generated content (AGC) will become more prevalent. Content generation has seen a remarkably fast-paced transition over the past decade or so. From platform-generated content (in-house content that is often well-executed by content professionals) in the first half of the 2010s to the user-generated content (UGC) era where consumers hold a pivotal role in producing content, leveraging on the effects of peer-to-peer influence. We believe AGC will usher in a new era, with strong use cases on dialogue-based search and AI-generated articles and videos.

Fig. 1: Fast adoption curve for ChatGPT
Months it took to reach 1 million users for each application



Source: Company data, Morgan Stanley, UBS, as of February 2023

How to invest in AI?

We see artificial intelligence as a horizontal technology that will have important use cases across a number of applications and industries. From a broader perspective, AI, along with big data and cybersecurity, forms what we call the ABCs of technology. We believe these three major foundational technologies are at inflection points and should see faster adoption over the next few years as enterprises and governments increase their focus and investments in these areas.

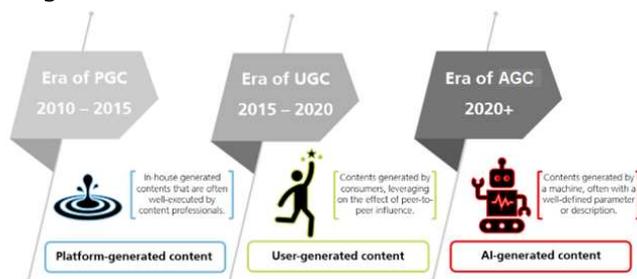
Conversational AI is currently in its early stages of monetization and costs remain high as it is expensive to run. Instead of investing directly in such platforms, interested investors in the short term can consider semiconductor companies, and cloud-service providers that provides the infrastructure needed for generative AI to take off.

In the medium to long term, companies can integrate generative AI to improve margins across industries and sectors, such as within healthcare and traditional manufacturing.

Outside of public equities, investors can also consider opportunities in private equity (PE). We believe the tech sector is currently undergoing a new innovation cycle after 12–18 months of muted activity, which provides interesting and new opportunities that PE can capture through early-stage investments.

For more information on investing in AI, please refer to our latest update “Investing in the ABCs of Tech” published 6 February 2023.

Fig. 2: Decade-long transition toward the era of AI-generated content



Source: UBS, as of February 2023

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