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Generative AI: enablers and adopters

Frédérique Carrier – London

Emerging technological advancements are driving innovations all around us, transforming how we live, work, and interact with one another, today and in the future. RBC Wealth Management's "Innovations" series examines these agents of change and how they can open up compelling investment opportunities.

The following is an executive summary of the second article in the series, examining generative artificial intelligence (GenAI). We focus on the GenAI ecosystem, both enablers and adopters, zeroing in on those which might be most impacted. We also explore investment strategies we expect to benefit from the GenAI era.

A great leap forward

GenAI is a type of machine learning, whereby users feed data into a computer which can not only solve many problems and learn as it goes along, but also provide output as if it were a human thanks to the use of "large language models."

Due to its broad potential usage, GenAI applications such as ChatGPT, launched in November 2022, have captured the world's imagination.

Among other things, GenAI applications can:

- Generate new content such as writing essays and composing emails;
- Edit and summarize text;
- Quickly classify or digest large amounts of data and draw conclusions from it;
- Answer complex queries; and
- Create digital art.

GenAI has the potential to radically change the way tasks are performed, much like the computer did in the late 1980s.

Impact on productivity and economic growth

Inevitably this transformational technology has sparked a debate on the impact it may have on the economy.

One optimistic estimate from the McKinsey Global Institute (2023) suggests that GenAI stands to add up to $4.4 trillion to the global economy on an annual basis compared to a world GDP of just over $100 trillion in 2023.

However, this extreme optimism is not universally shared. In a May 2024 paper, Daron Acemoglu, institute professor of economics at the Massachusetts Institute of Technology, calculates that productivity would increase by a mere 0.06 percent annually.

In the sections that follow, we review key aspects of GenAI technology.

For perspectives on the week from our regional analysts, please see pages 4–5.

For important disclosures, required non-U.S. analyst disclosures, and authors' contact information, see page 7.

Priced (in USD) as of 8/21/24 market close (unless otherwise stated). Produced: 8/22/24 15:29 ET; Disseminated: 8/22/24 15:40 ET

GenAI ecosystem basics

GenAI enablers

Most operate in the tech industry and include hardware, cloud computing platforms, and model makers. Outside of the tech industry, energy providers and some industrial companies are also key enablers.

Tech enablers

Hardware

High-powered advanced semiconductors facilitate GenAI as the technology needs to be fed huge amounts of data from which to train machine-learning models.

Such workloads require significant amounts of computing power provided mainly by semiconductors called graphic processing units (GPUs), and by custom accelerator chips. Both can handle large amounts of data and perform an enormous number of calculations simultaneously. NVIDIA is the main designer of the advanced chips used to train and run AI models such as OpenAI 's GPT-4, the brain power behind ChatGPT. Design companies outsource to Taiwan Semiconductor Manufacturing Company (TSMC) to produce the chips for them.

NVIDIA's dominance has not gone unnoticed. Established semiconductor firms such as Intel and Advanced Micro Devices are launching rival products and the established cloud companies (including Google's corporate parent Alphabet, Amazon, and Microsoft) are now designing their own chips to reduce reliance on NVIDIA. Many smaller firms, including startups, are also in the race.

Other than AI semiconductor manufacturers, hardware also encompasses semiconductor equipment manufacturers (such as ASML) plus server and networking equipment makers (such as Dell and Amphenol).

Cloud computing platforms

"Cloud computing" is the term coined to refer to the online availability of computer system resources such as data storage and computing capacity. It offers access to these resources without having to manage them directly.

Most businesses find it more cost effective to build, tweak, and run large AI models in the cloud, rather than have this key hardware platform on premises given that infrastructure requirements are expensive.

Model makers

AI models are pretrained to create content and can be adapted to support a wide array of tasks. Microsoft-backed OpenAI had an early lead with its GPT series, but much competition has emerged, such as Alphabet- and Amazon-backed Anthropic, a privately-held U.S.-based rival, or French AI model maker and private company Mistral. Meta, Facebook's parent, also issued its own model, Llama, in 2023.

Non-tech enablers: Data centers, energy providers, industrials

Data centers, already a vital infrastructure required to support mass digitization, are indispensable for AI services. The size of multiple U.S. football fields, data centers host many thousands of servers which process and store online information.

As GenAI takes off, more and larger data centers will be needed as training GenAI models requires placing thousands of advanced chips into data centers and operating them at full capacity for extended periods.

GenAI enablers

Infrastructure

Hardware:

- Semiconductor equipment (e.g., ASML)
- Semiconductors (e.g., NVIDIA)
- Servers & networking (e.g., Dell, Amphenol)
- Data centers
- Power solutions
- Cooling systems
- Energy providers and utilities

Cloud computing:

- Cloud providers (e.g., Alphabet, Microsoft, Amazon)

Model makers

- OpenAI (GPT series)
- Google (Gemini)
- Meta (Llama series)
- Anthropic (Claude models)
- Mistral

Tech

Non-Tech

GenAI adopters

Applications

- ChatGPT
- Claude
- Mistral

Key areas

- Customer service
- Marketing & sales
- Software engineering

Key sectors

- Software development
- Finance
- Life sciences
- Media & entertainment
- Retail
- Consumer goods

Data centers use vast amounts of energy. Natural gas remains a key source of energy due to current grid constraints, though demand for renewables and nuclear in particular, a more reliable source, should grow over time, as Big Tech has committed to drastically reducing carbon usage over the next decade.

AI data centers also require power management and distribution systems to ensure the efficient use of power and industrial-strength cooling solutions so that the heat from servers remains controlled as they process data.

GenAI adopters

The use of GenAI remains in its infancy. According to a November 2023 U.S. Census Bureau survey, less than four percent of U.S. businesses reported using AI to produce goods and services.

A 2023 McKinsey report suggests three-quarters of the value that GenAI use cases might deliver could fall across four areas: software engineering, marketing and sales, customer operations, and research and development.

Software engineering

Close to 50 percent of new code is now generated by AI. The technology helps developers code more than 50 percent faster.

Software engineering is embedded in many corporate operations, as well as in goods and services.

Customer services

Scores of companies already use AI chatbots for customer support, but GenAI brings it to a new level. For instance, by rapidly processing customer data and browsing histories, GenAI can identify product suggestions tailored to customer preferences.

Marketing and sales

GenAI can significantly improve the efficiency and efficacy of marketing material. It can reduce the time required for content drafting and ensure consistency for a uniform brand voice and writing style.

Research and development (R&D)

In manufacturing, GenAI can optimize designs, reducing costs in logistics as well as production and testing time.

In Biotech and Biopharma, GenAI can shorten trial phases by drafting scenarios and profile testing candidates, expediting drug development for complex disease.

How to invest

The adoption of GenAI is still in its infancy. We think the technology seems very promising, but a full realization of its potential will take time and require intensive management as well as regulation to address the challenges its adoption will present. As has almost always been the case in the past, investors may be overestimating what GenAI can deliver in the short term, but underestimating what it can do in the long term given the technology's great promise.

Enablers selling AI equipment and software have been the clear beneficiaries of the new technology, their valuations having expanded markedly. We think portfolios would likely benefit from exposure to the infrastructure beneficiaries of GenAI, where the eventual spending may take a decade or more to arrive.

As for the GenAI adopters, investors should assess how the new technology is being implemented—to increase sales, reduce costs, or improve productivity—and keep an eye on the competition. If competitors are also using GenAI effectively, any competitive advantage may erode quickly.

For more details about the GenAI ecosystem, see the full report.

In an upcoming Special Report, we will look more closely at the specific impact we believe the technology will have on a wide array of industries and how it will likely create new ones, emphasizing potential opportunities for investors.

UNITED STATES

Alan Robinson – Seattle

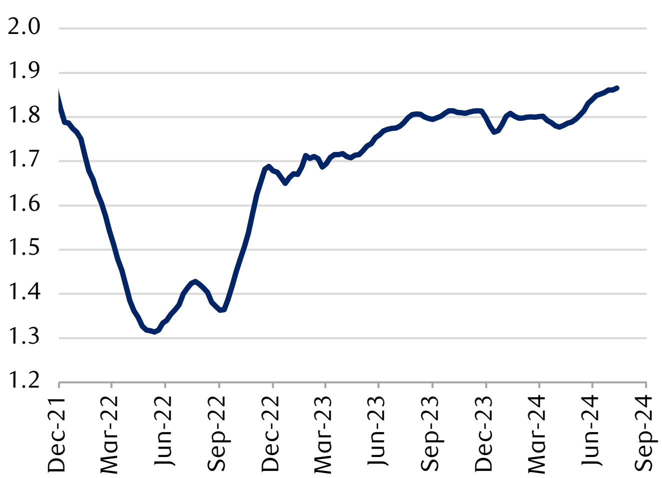
- **U.S. stock indexes continued their nearly three-week-long rally during the week as the sharp declines of the first three days of August faded from view.** The S&P 500 Index moved within 1% of its July 2024 all-time high as the combination of weaker economic data and benign inflation data seen in recent weeks sparked hopes of lower interest rates and a soft landing for the economy.

- **While it was a light week for economic data, most releases continued to indicate a slowing economy.** July's leading economic indicators declined for the 29th successive month, and the manufacturing Purchasing Managers Index fell from 49.6 in July to 48.0 in August (a reading below 50 indicates contractionary conditions). Employment data was back in focus as the Bureau of Labor Statistics' annual data revision showed 816,000 fewer jobs were created in the year ending March 2024 than previously estimated. This dramatic revision underlines that individual monthly data points may be less important than trends. However, we also note that the trend in continuing unemployment claims is markedly higher (see chart), which provides more support for potential interest rate cuts.

- This theme was clear in the minutes from July's Federal Open Market Committee (FOMC) meeting that were released during the week. According to the minutes, the "vast majority" of officials expect a September rate cut and note that employment risks have increased. We may gain more insights on this from the 2024 Jackson Hole Economic Policy Symposium, taking place from Thursday, Aug. 22 to Saturday, Aug. 24. This event has a reputation for revealing information about central bankers' thinking and eliciting some major financial market moves.

U.S. unemployment in the current quarter is breaking out of its narrow multi-quarter range

Continuing unemployment claims (millions)



Source - U.S. Department of Labor, RBC Wealth Management; 4-week moving average of weekly unemployment claims as of 8/17/24

- **The recent increase in merger and acquisition (M&A) activity caught market participants' attention as earnings season faded in the rear-view mirror.** The proposal by Canada's Alimentation Couche-Tard to buy the Japanese parent of the 7-Eleven convenience store chain, currently valued at $36 billion, was the week's most notable. Still, several other smaller deals were closed across diverse industries. M&A deals tend to pick up when business conditions slow, as companies look to "buy" elusive growth, and this recent rash of deals plays to the "soft landing" narrative rather than a recession, in our view.

CANADA

Matt Altro, CFA & Zachariah Muhn – Toronto

- As the Sept. 4 Bank of Canada (BoC) monetary policy meeting approaches, markets have priced in another 25 basis point reduction in the benchmark rate. **This would be the third consecutive rate cut as inflation continues to cool, with July headline inflation coming in at 2.5% y/y, the lowest reading since March 2021, and down from 3.4% at the end of 2023.** Mortgage interest costs are a persistent concern, with a large number of mortgages set to renew at potentially much higher rates in 2025 and 2026. That said, falling rates should help ease the payment shock for borrowers. As most of the companies in the consumer sectors in Canada have reported Q2 earnings, management teams across the group continue to caution on the prospect of slower consumer spending amid a softening labour market and elevated financial pressures. These firms have also highlighted the mortgage resets as a key headwind. Looking ahead, Canadian businesses have adopted a cautious outlook for the rest of 2024 and into 2025. Given the uncertain economic environment, we believe it is prudent for investors to maintain a good balance between growth and defence in portfolio positioning.

- **Activity in the Canadian housing market returned to a state of stagnation in July.** Following a 3.5% monthly increase in home resales in June, buyers reduced their purchases of existing homes by 0.7% in July, returning to the trend of small month-to-month fluctuations around the level recorded in March. Meanwhile, housing supply continued to improve; new listings increased for the fourth straight month, rising by 0.9% m/m and marking a 10-month high. In addition to more homeowners listing their properties in anticipation of renewed demand driven by interest rate cuts, a consistent flow of new supply from completed residential construction has also contributed to the rise in inventories. RBC Economics notes a potential uptick in activity in the coming months, but cautions that the recovery will likely be slow. Significant rate reductions will be necessary to alleviate high ownership costs and stimulate demand.

EUROPE

Frédérique Carrier – London

- **The euro strengthened against the U.S. dollar,** reaching a 12-month high of €1.11 on Aug. 20, as market expectations grew for a less aggressive interest rate cutting cycle by the European Central Bank (ECB) compared to the Fed.
- Wage data in Europe remains firm, with negotiated pay rising 3.6% y/y in Q2, suggesting the ECB may have to exercise caution while cutting interest rates. Markets are factoring in six cuts of 25 basis points (bps) to mid-2025. By contrast, with strong evidence that U.S. labour markets are cooling and progress having been made on inflation, markets now factor in a total of nine 25 bps cuts in the same period for the Fed.
- The UK economy defied the most pessimistic expectations and grew at a healthy pace for the first half of the year. **GDP grew by 0.6% q/q in Q2, following a 0.7% q/q increase in Q1.** Such growth points to a healthy recovery from last year's mild recession. This could be attributable to real wage growth as core inflation decreased over the period.
- However, we think this healthy growth is unlikely to be sustained in the second half of the year. **Consumers may become more cautious ahead of the new Labour government's October budget, which is widely expected to include tax increases.**
- Still, the UK may be in a sweet spot. The economy has enough momentum to continue expanding, yet growth is subdued enough to allow the Bank of England to maintain its interest rate reduction strategy.
- **Though we would hold a modest Underweight position in UK equities, we favour high-quality dividend-paying shares in defensive industries.**

ASIA PACIFIC

Jasmine Duan – Hong Kong

- **Japan's total exports in July were up 10.3% y/y vs. the 11.5% Bloomberg median estimate.** Total imports increased 16.6%, stronger than the consensus forecast and the fourth consecutive month of growth, resulting in a trade deficit of JPY621.8 billion (US$4.28 billion).
- **Semiconductors and automobiles were key drivers of export growth.** Electronic components, including semiconductors, saw a 25.2% increase. Automobile exports rose 6.2% as the industry recovers from an export decline following a testing scandal.
- **The strong monthly export number is likely largely due to yen weakness,** as the total export volume was down by 5.2% y/y. We think the Bank of Japan will closely monitor economic data as it considers its next monetary policy move.
- **Shares of JD.com (9618 HK/JD US) dropped 8.7% on Wednesday in Hong Kong trading.** Walmart (WMT US), which had been JD's second-largest shareholder with a 9% stake, unexpectedly sold its entire holdings at US$24.95 per share, raising about US$3.6 billion. The stock decline followed the release of a regulatory filing that disclosed the news.
- **JD's profitability improved in the past quarter,** with adjusted net profit margin rising two percentage points to 5%, exceeding the 3.3% consensus forecast. Its adjusted net profit increased 69% y/y to RMB14.5 billion.

MARKET Scorecard

Equities (local currency)	Level	MTD	YTD	1 yr	2 yr
S&P 500	5,620.85	1.8%	17.8%	27.8%	32.9%
Dow Industrials (DJIA)	40,890.49	0.1%	8.5%	18.6%	21.3%
Nasdaq	17,918.99	1.8%	19.4%	32.8%	41.0%
Russell 2000	2,170.56	-3.7%	7.1%	16.9%	10.9%
S&P/TSX Comp	23,121.73	0.0%	10.3%	16.9%	15.0%
FTSE All-Share	4,536.49	-1.1%	7.2%	14.7%	9.1%
STOXX Europe 600	513.95	-0.8%	7.3%	14.6%	17.5%
EURO STOXX 50	4,885.28	0.3%	8.0%	15.6%	31.0%
Hang Seng	17,391.01	0.3%	2.0%	-1.3%	-12.0%
Shanghai Comp	2,856.58	-2.8%	-4.0%	-7.6%	-12.3%
Nikkei 225	37,951.80	-2.9%	13.4%	20.2%	31.2%
India Sensex	80,905.30	-1.0%	12.0%	24.1%	35.6%
Singapore Straits Times	3,373.76	-2.4%	4.1%	7.0%	3.9%
Brazil Ibovespa	136,463.65	6.9%	1.7%	19.3%	22.4%
Mexican Bolsa IPC	53,864.73	1.5%	-6.1%	1.4%	11.1%
Gov't bonds (bps change)	**Yield**	**MTD**	**YTD**	**1 yr**	**2 yr**
U.S. 10-Yr Treasury	3.799%	-23.1	-8.0	-53.9	82.7
Canada 10-Yr	3.017%	-14.4	-9.3	-76.0	7.6
UK 10-Yr	3.891%	-7.9	35.4	-83.8	148.0
Germany 10-Yr	2.191%	-11.3	16.7	-51.2	96.1
Fixed income (returns)	**Yield**	**MTD**	**YTD**	**1 yr**	**2 yr**
U.S. Aggregate	4.40%	1.7%	3.4%	9.5%	5.1%
U.S. Investment-Grade Corp	4.92%	1.9%	3.8%	12.0%	9.0%
U.S. High-Yield Corp	7.42%	1.0%	5.6%	13.5%	16.7%
Commodities (USD)	**Price**	**MTD**	**YTD**	**1 yr**	**2 yr**
Gold (spot $/oz)	2,511.22	2.6%	21.7%	32.5%	43.7%
Silver (spot $/oz)	29.58	2.0%	24.3%	26.9%	55.3%
Copper ($/metric ton)	9,085.84	-0.2%	7.3%	10.3%	12.2%
Oil (WTI spot $/bbl)	74.04	-5.0%	3.3%	-8.3%	-18.4%
Oil (Brent spot $/bbl)	76.09	-5.7%	-1.2%	-9.9%	-21.3%
Natural Gas ($/mmBtu)	2.19	7.6%	-12.9%	-16.8%	-76.5%
Currencies	**Rate**	**MTD**	**YTD**	**1 yr**	**2 yr**
U.S. Dollar Index	101.1720	-2.8%	-0.2%	-2.1%	-6.5%
CAD/USD	0.7355	1.6%	-2.6%	-0.4%	-4.4%
USD/CAD	1.3596	-1.5%	2.7%	0.4%	4.6%
EUR/USD	1.1151	3.0%	1.0%	2.3%	11.1%
GBP/USD	1.3090	1.8%	2.8%	2.6%	10.7%
AUD/USD	0.6743	3.1%	-1.0%	5.1%	-1.9%
USD/JPY	145.2500	-3.2%	3.0%	-0.7%	6.0%
EUR/JPY	161.9700	-0.2%	4.0%	1.7%	17.7%
EUR/GBP	0.8519	1.2%	-1.7%	-0.3%	0.4%
EUR/CHF	0.9498	-0.1%	2.3%	-0.8%	-1.4%
USD/SGD	1.3057	-2.3%	-1.1%	-3.8%	-6.2%
USD/CNY	7.1314	-1.3%	0.4%	-2.1%	4.6%
USD/MXN	19.2716	3.5%	13.5%	13.2%	-4.5%
USD/BRL	5.4892	-2.9%	13.0%	10.3%	6.2%

Equity returns do not include dividends, except for the Brazilian Ibovespa. Bond yields in local currencies. Copper Index data and U.S. fixed income returns as of Tuesday's close. Dollar Index measures USD vs. six major currencies. Currency rates reflect market convention (CAD/USD is the exception). Currency returns quoted in terms of the first currency in each pairing.

Examples of how to interpret currency data: CAD/USD 0.73 means 1 Canadian dollar will buy 0.73 U.S. dollar. CAD/USD -2.6% return means the Canadian dollar has fallen 2.6% vs. the U.S. dollar year to date. USD/JPY 145.25 means 1 U.S. dollar will buy 145.25 yen. USD/JPY 3.0% return means the U.S. dollar has risen 3.0% vs. the yen year to date.

Source - Bloomberg; data as of 8/21/24

Authors

Matt Altro, CFA – Toronto, Canada
matt.altro@rbc.com; RBC Dominion Securities Inc.

Frédérique Carrier – London, United Kingdom
frederique.carrier@rbc.com; RBC Europe Limited

Jasmine Duan – Hong Kong, China
jasmine.duan@rbc.com; Royal Bank of Canada, Hong Kong Branch

Zachariah Muhn – Toronto, Canada
zachariah.muhn@rbc.com; RBC Dominion Securities Inc.

Alan Robinson – Seattle, United States
alan.robinson@rbc.com; RBC Capital Markets, LLC

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As of June 30, 2024

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Rating	Count	Percent	Count	Percent
Buy [Outperform]	857	57.44	271	31.62
Hold [Sector Perform]	588	39.41	146	24.83
Sell [Underperform]	47	3.15	5	10.64

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