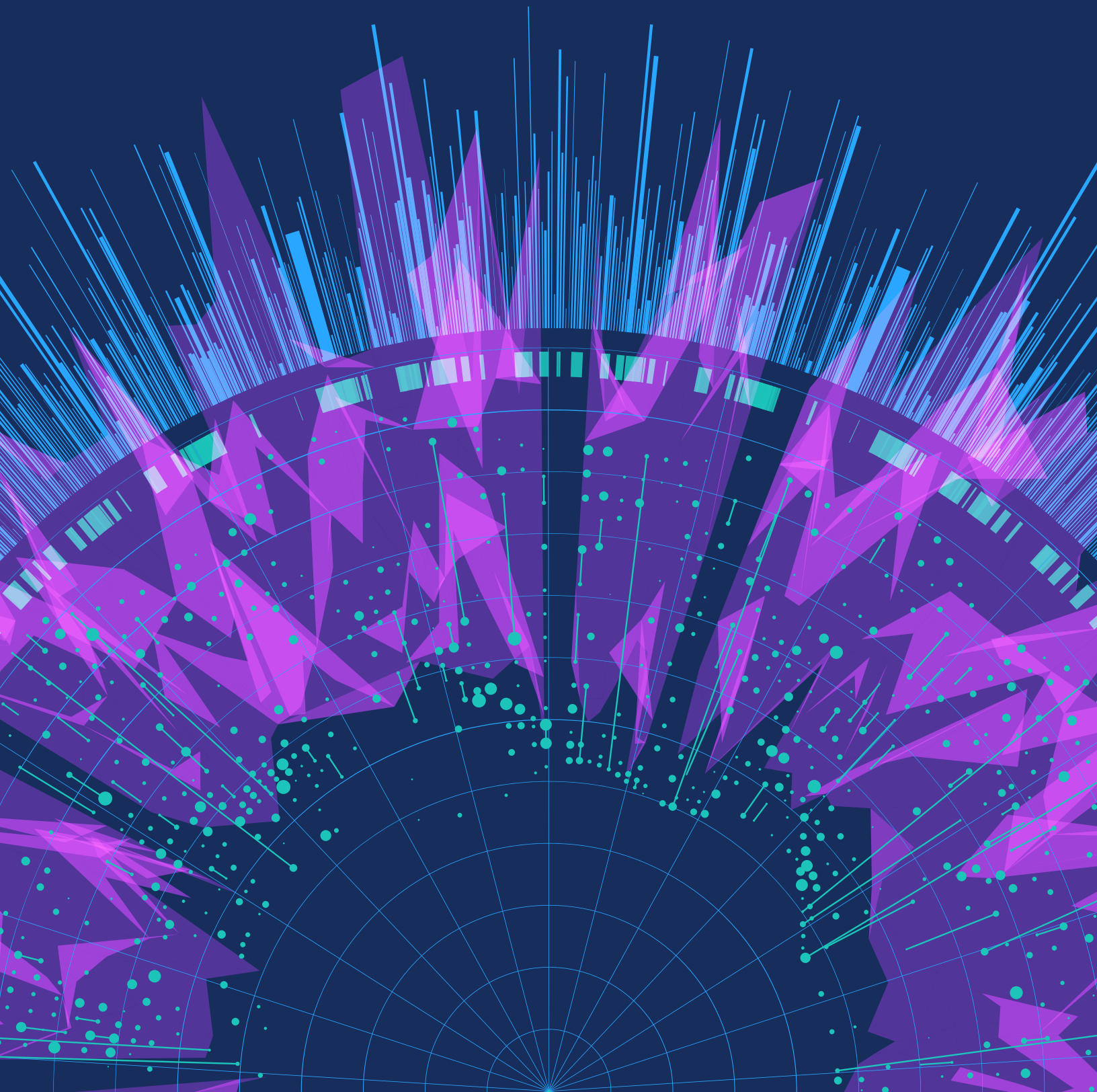
CHAPTER 4:
Economy



Preview

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Overview

The integration of AI into the economy raises many compelling questions. Some predict that AI will drive productivity improvements, but the extent of its impact remains uncertain. A major concern is the potential for massive labor displacement—to what degree will jobs be automated versus augmented by AI? Companies are already utilizing AI in various ways across industries, but some regions of the world are witnessing greater investment inflows into this transformative technology. Moreover, investor interest appears to be gravitating toward specific AI subfields like natural language processing and data management.

This chapter examines AI-related economic trends using data from Lightcast, LinkedIn, Quid, McKinsey, Stack Overflow, and the International Federation of Robotics (IFR). It begins by analyzing AI-related occupations, covering labor demand, hiring trends, skill penetration, and talent availability. The chapter then explores corporate investment in AI, introducing a new section focused specifically on generative AI. It further examines corporate adoption of AI, assessing current usage and how developers adopt these technologies. Finally, it assesses AI's current and projected economic impact and robot installations across various sectors.

Chapter Highlights

1. Generative AI investment skyrockets. Despite a decline in overall AI private investment last year, funding for generative AI surged, nearly octupling from 2022 to reach $25.2 billion. Major players in the generative AI space, including OpenAI, Anthropic, Hugging Face, and Inflection, reported substantial fundraising rounds.

2. Already a leader, the United States pulls even further ahead in AI private investment. In 2023, the United States saw AI investments reach $67.2 billion, nearly 8.7 times more than China, the next highest investor. While private AI investment in China and the European Union, including the United Kingdom, declined by 44.2% and 14.1%, respectively, since 2022, the United States experienced a notable increase of 22.1% in the same time frame.

3. Fewer AI jobs, in the United States and across the globe. In 2022, AI-related positions made up 2.0% of all job postings in America, a figure that decreased to 1.6% in 2023. This decline in AI job listings is attributed to fewer postings from leading AI firms and a reduced proportion of tech roles within these companies.

4. AI decreases costs and increases revenues. A new McKinsey survey reveals that 42% of surveyed organizations report cost reductions from implementing AI (including generative AI), and 59% report revenue increases. Compared to the previous year, there was a 10 percentage point increase in respondents reporting decreased costs, suggesting AI is driving significant business efficiency gains.

5. Total AI private investment declines again, while the number of newly funded AI companies increases. Global private AI investment has fallen for the second year in a row, though less than the sharp decrease from 2021 to 2022. The count of newly funded AI companies spiked to 1,812, up 40.6% from the previous year.

6. AI organizational adoption ticks up. A 2023 McKinsey report reveals that 55% of organizations now use AI (including generative AI) in at least one business unit or function, up from 50% in 2022 and 20% in 2017.

7. China dominates industrial robotics. Since surpassing Japan in 2013 as the leading installer of industrial robots, China has significantly widened the gap with the nearest competitor nation. In 2013, China's installations accounted for 20.8% of the global total, a share that rose to 52.4% by 2022.

Chapter Highlights (cont'd)

8. Greater diversity in robotic installations. In 2017, collaborative robots represented a mere 2.8% of all new industrial robot installations, a figure that climbed to 9.9% by 2022. Similarly, 2022 saw a rise in service robot installations across all application categories, except for medical robotics. This trend indicates not just an overall increase in robot installations but also a growing emphasis on deploying robots for human-facing roles.

9. The data is in: AI makes workers more productive and leads to higher quality work. In 2023, several studies assessed AI's impact on labor, suggesting that AI enables workers to complete tasks more quickly and to improve the quality of their output. These studies also demonstrated AI's potential to bridge the skill gap between low- and high-skilled workers. Still other studies caution that using AI without proper oversight can lead to diminished performance.

10. Fortune 500 companies start talking a lot about AI, especially generative AI. In 2023, AI was mentioned in 394 earnings calls (nearly 80% of all Fortune 500 companies), a notable increase from 266 mentions in 2022. Since 2018, mentions of AI in Fortune 500 earnings calls have nearly doubled. The most frequently cited theme, appearing in 19.7% of all earnings calls, was generative AI.

The chapter begins with an overview of some of the most significant AI-related economic events in 2023, as selected by the AI Index Steering Committee.

4.1 What's New in 2023: A Timeline

Jan. 10, 2023

InstaDeep acquired by BioNTech

BioNTech, known for developing the first mRNA COVID-19 vaccine in partnership with Pfizer, acquires InstaDeep for $680 million to advance AI-powered drug discovery, design, and development. InstaDeep specializes in creating AI systems for enterprises in biology, logistics, and energy sectors.

Source: Reuters, 2022
Figure 4.1.1

Jan. 23, 2023

Microsoft invests $10 billion in ChatGPT maker OpenAI

With this deal, Microsoft Azure remains the exclusive cloud provider for OpenAI, which relies on Azure to train its models. This follows Microsoft's initial $1 billion investment in 2019 and a subsequent investment in 2021.

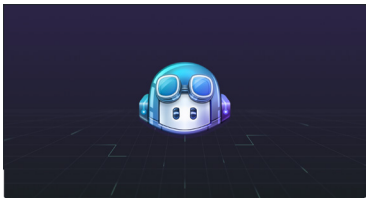
OpenAI | Microsoft

Source: Microsoft, 2023
Figure 4.1.2

Feb. 14, 2023

GitHub Copilot for Business becomes publicly available

Copilot for Business leverages an OpenAI Codex model to enhance code suggestion quality. At launch, GitHub Copilot contributed to an average of 46% of developers' code across various programming languages, with this figure rising to 61% for Java.



Source: GitHub, 2023
Figure 4.1.3

March 7, 2023

Salesforce introduces Einstein GPT

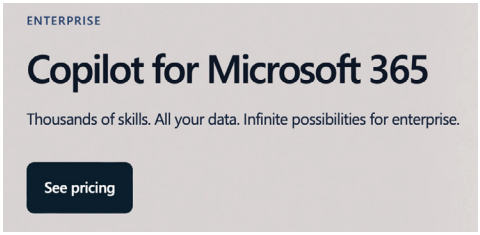
Einstein GPT, the first comprehensive AI for CRM, utilizes OpenAI's models. Einstein GPT aids Salesforce customers in sales, marketing, and customer management.

Source: Salesforce, 2023
Figure 4.1.4

March 16, 2023

Microsoft announces integration of GPT-4 into Office 365

Microsoft rolls out Copilot across Office 365, offering AI assistance in Word, PowerPoint, and Excel.



Source: Microsoft, 2023
Figure 4.1.5

March 30, 2023

Bloomberg announces LLM for finance

Bloomberg's 50-billion parameter LLM is custom-built for analyzing financial data and tailored to finance professionals. This model is capable of performing financial analyses on Bloomberg's extensive datasets.

Source: Bloomberg, 2023
Figure 4.1.6

May 23, 2023

Adobe launches generative AI tools inside Photoshop

Adobe introduces generative AI features in Photoshop via Adobe Firefly, its generative image tool. Users can now add, remove, and edit images within seconds using text prompts.

Source: TechCrunch, 2023
Figure 4.1.7

June 8, 2023

Cohere raises $270 million

Cohere, focused on developing an AI model ecosystem for enterprises, raises $270 million in an oversubscribed Series C round. Inovia Capital led the round, with participation from Nvidia, Oracle, Salesforce Ventures, Schroders Capital, and Index Ventures.

Source: Cohere, 2023
Figure 4.1.8

June 13, 2023

Nvidia reaches $1 trillion valuation

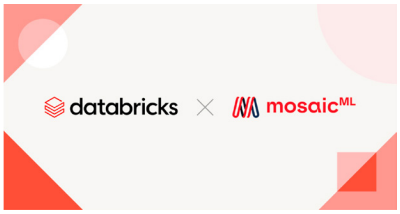
Nvidia's market capitalization consistently exceeds $1 trillion USD, driven by rising demand for its AI-powering chips. Nvidia becomes the fifth company to reach a valuation of $1 trillion, joining the ranks of Apple Inc. (AAPL.O), Alphabet Inc. (GOOGL.O), Microsoft Corp. (MSFT.O), and Amazon.com Inc. (AMZN.O).

Source: The Brand Hopper, 2023
Figure 4.1.9

June 26, 2023

Databricks buys MosaicML for $1.3 billion

Databricks, a leader in data storage and management, announces its acquisition of MosaicML, a generative AI orchestration startup founded in 2021, for $1.3 billion. This move aims to enhance Databricks' generative AI capabilities.



Source: Databricks, 2023
Figure 4.1.10

June 29, 2023

Thomson Reuters acquires Casetext for $650 million

Thomson Reuters finalizes its acquisition of Casetext, a legal startup renowned for its artificial intelligence–powered assistant for law, for a staggering $650 million. At the time of acquisition, Casetext boasted a substantial customer base of over 10,000 law firms and corporate legal departments. Among its flagship offerings is CoCounsel, an AI legal assistant driven by GPT-4, which enables rapid document review, legal research memos, deposition preparation, and contract analysis within minutes.

Source: Legal.io, 2023
Figure 4.1.11

June 30, 2023

Inflection AI raises $1.3 billion from Bill Gates and Nvidia, among others

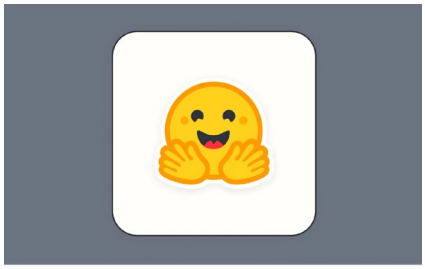
Inflection AI raises $1.3 billion through a combination of cash and cloud credits, bringing the company's valuation to over $4 billion. Founded by Mustafa Suleyman of Google DeepMind and Reid Hoffman of LinkedIn, Inflection AI is developing a "kind and supportive" chatbot named Pi. The funding round attracts investments from Microsoft, Nvidia, Reid Hoffman, Bill Gates, and Eric Schmidt, former CEO of Google.

Source: TechCrunch, 2023
Figure 4.1.12

Aug. 24, 2023

Hugging Face raises $235 million from investors

Hugging Face, a platform and community dedicated to machine learning and data science, secures an impressive $235 million funding round, pushing its valuation to $4.5 billion. The platform serves as a one-stop destination for building, deploying, and training machine learning models. Offering a GitHub-like hub for AI code repositories, models, and datasets, Hugging Face has attracted significant attention from industry giants.



Source: TechCrunch, 2023
Figure 4.1.13

Sep. 26, 2023

SAP introduces new generative AI assistant Joule

Joule is a ChatGPT-style digital assistant integrated across SAP's diverse product range. Joule will seamlessly integrate into SAP applications spanning HR, finance, supply chain, procurement, and customer experience. Additionally, it will be incorporated into the SAP Business Technology Platform, extending its utility across SAP's extensive user base of nearly 300 million.

Source: SAP, 2023
Figure 4.1.14

Oct. 27, 2023

Amazon and Google make multibillion-dollar investments in Anthropic

Amazon announces its intent to invest up to $4 billion in Anthropic, a rival of OpenAI. This significant investment follows Google's agreement to invest up to $2 billion in Anthropic. The deal comprises an initial $500 million upfront, with an additional $1.5 billion to be invested over time.

Source: TechCrunch, 2023
Figure 4.1.15

Nov. 5, 2023

Kai-Fu Lee launches OpenSource LLM

Kai-Fu Lee's LLM startup publicly unveils an open-source model and secures funding at a $1 billion valuation, with Alibaba leading the investment. Lee, known for his leadership roles at Google in China and for establishing Microsoft Research China, one of Microsoft's key international research hubs, spearheads this initiative.

Source: TechCrunch, 2023
Figure 4.1.16

Nov. 17, 2023

Sam Altman, OpenAI CEO, fired and then rehired

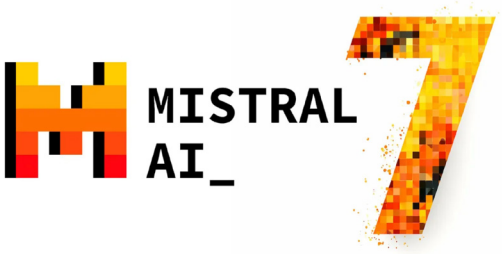
OpenAI's board claims Altman was "not consistently candid in his communications." Chaos ensues at OpenAI. Many employees resign in response to the news, and 745 sign a letter threatening resignation if the current board members do not resign. A few days later, Altman is reinstated.

Source: CoinGape, 2024
Figure 4.1.17

Dec. 11, 2023

Mistral AI closes $415 million funding round

Less than six months after raising a $112 million seed round, Europe-based Mistral AI secures an additional $415 million. The startup, cofounded by alumni from Google's DeepMind and Meta, focuses on developing foundation models with an open-source technology approach, aiming to compete with OpenAI. Leading the round is Andreessen Horowitz, with participation from Lightspeed Venture Partners, Salesforce, BNP Paribas, General Catalyst, and Elad Gil.



Source: TechCrunch, 2023
Figure 4.1.18

4.2 Jobs

AI Labor Demand

This section analyzes the demand for AI-related skills in labor markets, drawing on data from Lightcast. Lightcast has analyzed hundreds of millions of job postings from over 51,000 websites since 2010, identifying those that require AI skills.

Global AI Labor Demand

Figure 4.2.1 shows the percentage of job postings demanding AI skills. In 2023, the United States (1.6%), Spain (1.4%), and Sweden (1.3%) led in this metric. In 2022, AI-related jobs accounted for 2.0% of all American job postings. In 2023, that number dropped to 1.6%. Although most countries saw a decrease from 2022 to 2023 in the share of job postings requiring AI skills, in many, the number of AI-related job postings over the past five years has increased.[1]

Lightcast speculates that the 2023 decrease in AI job postings is driven by many top AI employers (such as Amazon, Deloitte, Capital One, Randstad, and Elevance Health) scaling back their overall posting counts. Additionally, many companies shifted the occupational mix of their postings. For example, Amazon, in 2023, posted a higher share of operational roles like sales delivery driver, packager, and postal service/mail room worker than in 2022. At the same time, there was a lower share of demand for tech roles like software developers and data scientists.

AI job postings (% of all job postings) by geographic area, 2014–23
Source: Lightcast, 2023 | Chart: 2024 AI Index report

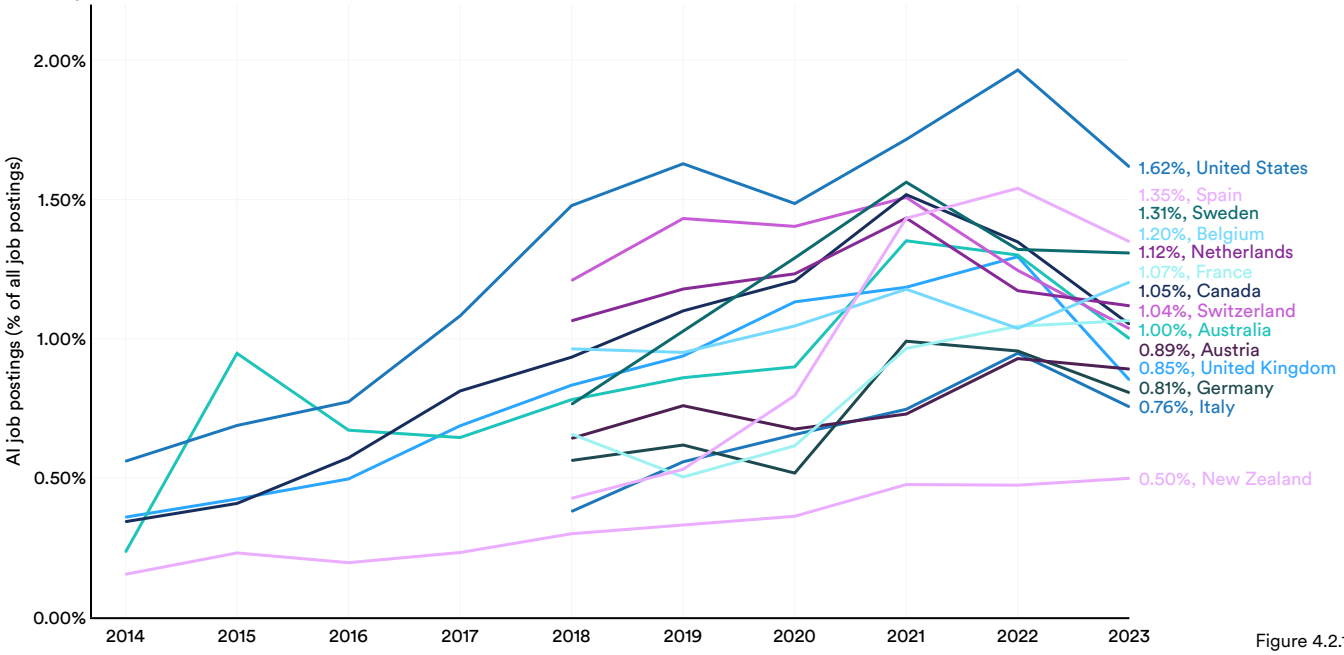


Figure 4.2.1

1 In 2023, Lightcast slightly changed its methodology for determining AI-related job postings from what was used in previous versions of the AI Index report. Lightcast also updated its taxonomy of AI-related skills. As such, some of the numbers in this chart do not completely align with those featured in last year's report.

U.S. AI Labor Demand by Skill Cluster and Specialized Skill

Figure 4.2.2 highlights the most sought-after AI skills in the U.S. labor market since 2010. Leading the demand was machine learning at 0.7%, with artificial intelligence at 0.5%, and natural language processing at 0.2%. Despite a recent dip, machine learning continues to be the most in-demand skill. Since last year, every AI-related skill cluster tracked by Lightcast had a decrease in market share, with the exception of generative AI, which grew by more than a factor of 10.

AI job postings (% of all job postings) in the United States by skill cluster, 2010–23
Source: Lightcast, 2023 | Chart: 2024 AI Index report

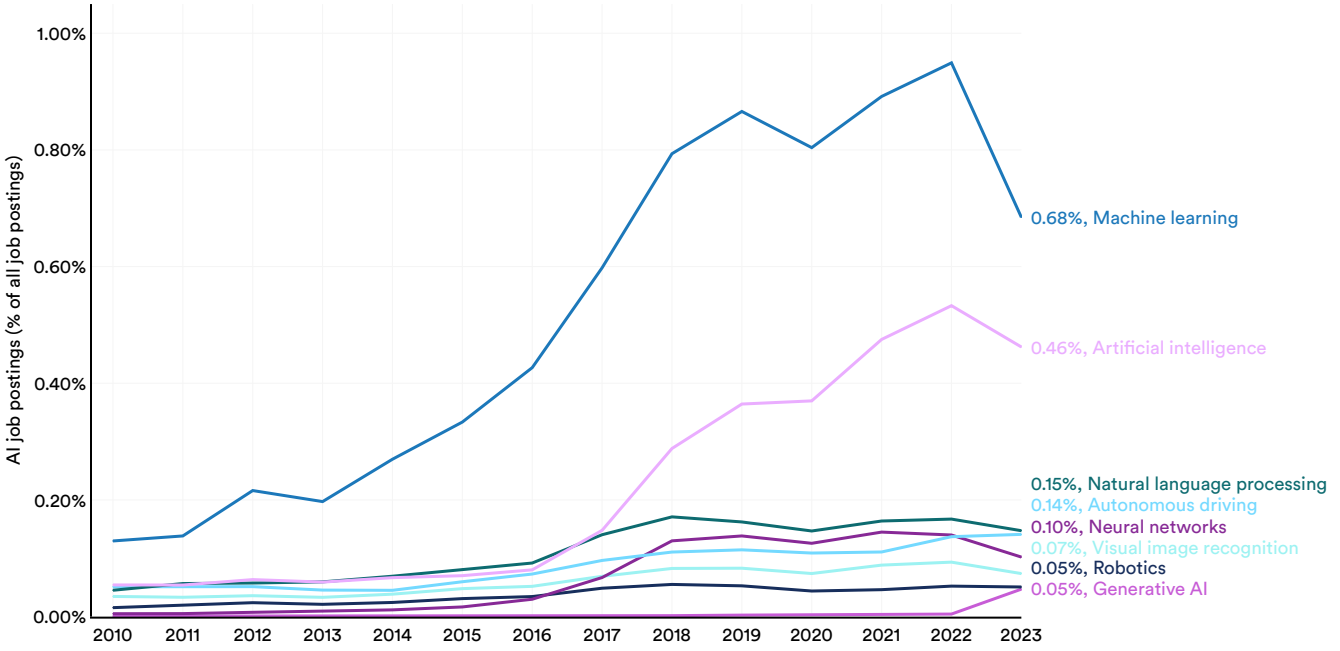


Figure 4.2.2

Figure 4.2.3 compares the top 10 specialized skills sought in AI job postings in 2023 versus those from 2011 to 2013.[2] On an absolute scale, the demand for nearly every specialized skill has increased over the past decade, with Python's notable increase in popularity highlighting its ascendance as a preferred AI programming language.

Top 10 specialized skills in 2023 AI job postings in the United States, 2011–13 vs. 2023
Source: Lightcast, 2023 | Chart: 2024 AI Index report

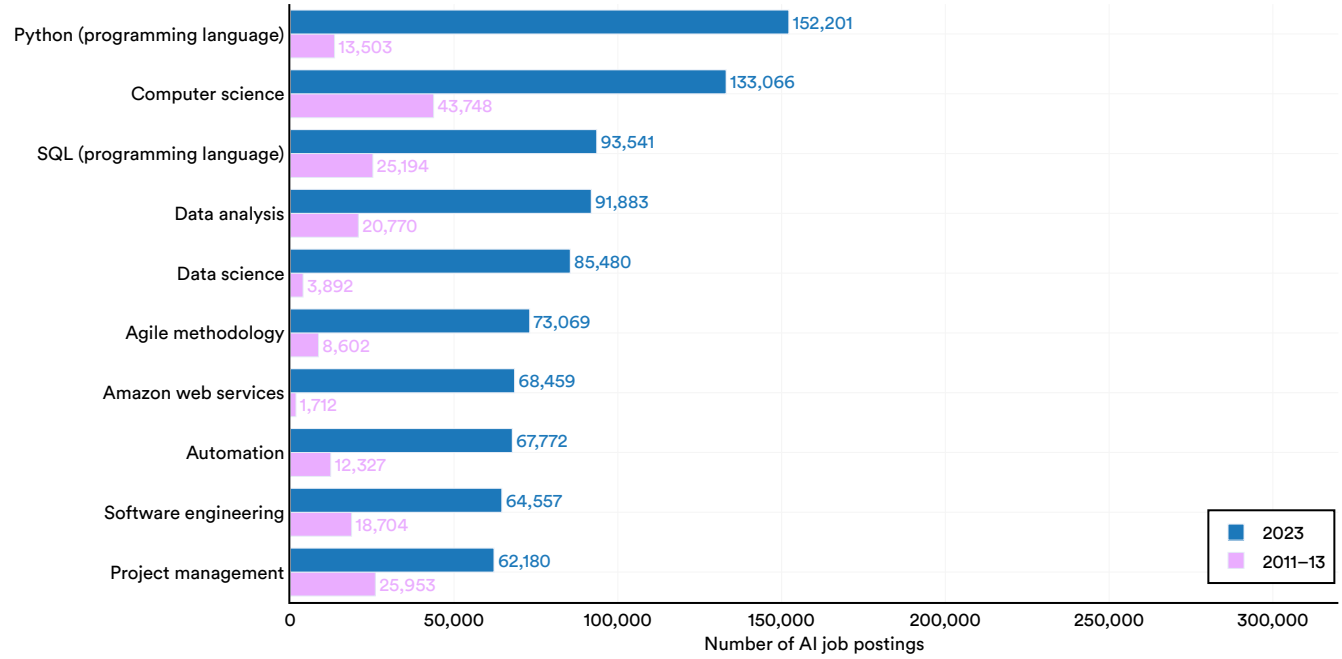


Figure 4.2.3

2 The decision to select 2011–2013 as the point of comparison was because some data at the jobs/skills level from earlier years is quite sparse. Lightcast therefore used 2011–2013 to have a larger sample size for a benchmark from 10 years ago with which to compare. Figure 4.2.3 juxtaposes the total number of job postings requiring certain skills from 2011 to 2013 with the total amount in 2023.

In 2023, Lightcast saw great increases in the number of U.S. job postings citing generative AI skills. That year, 15,410 job postings specifically cited generative AI as a desired skill, large language modeling was mentioned in 4,669 postings, and ChatGPT appeared in 2,841 job listings (Figure 4.2.4).

Generative AI skills in AI job postings in the United States, 2023
Source: Lightcast, 2023 | Chart: 2024 AI Index report

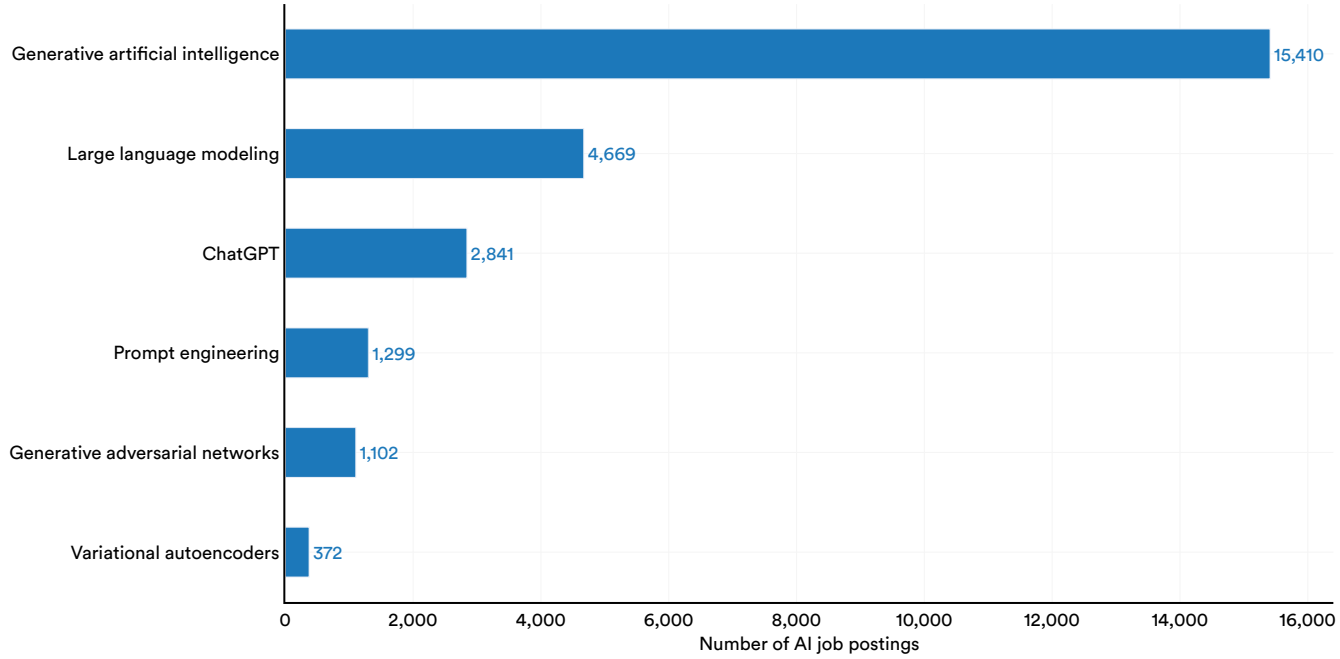


Figure 4.2.4

Figure 4.2.5 illustrates what proportion of all generative AI job postings released in 2023 referenced particular generative AI skills. The most cited skill was generative AI (60.0%), followed by large language modeling (18.2%) and ChatGPT (11.1%).

Share of generative AI skills in AI job postings in the United States, 2023
Source: Lightcast, 2023 | Chart: 2024 AI Index report

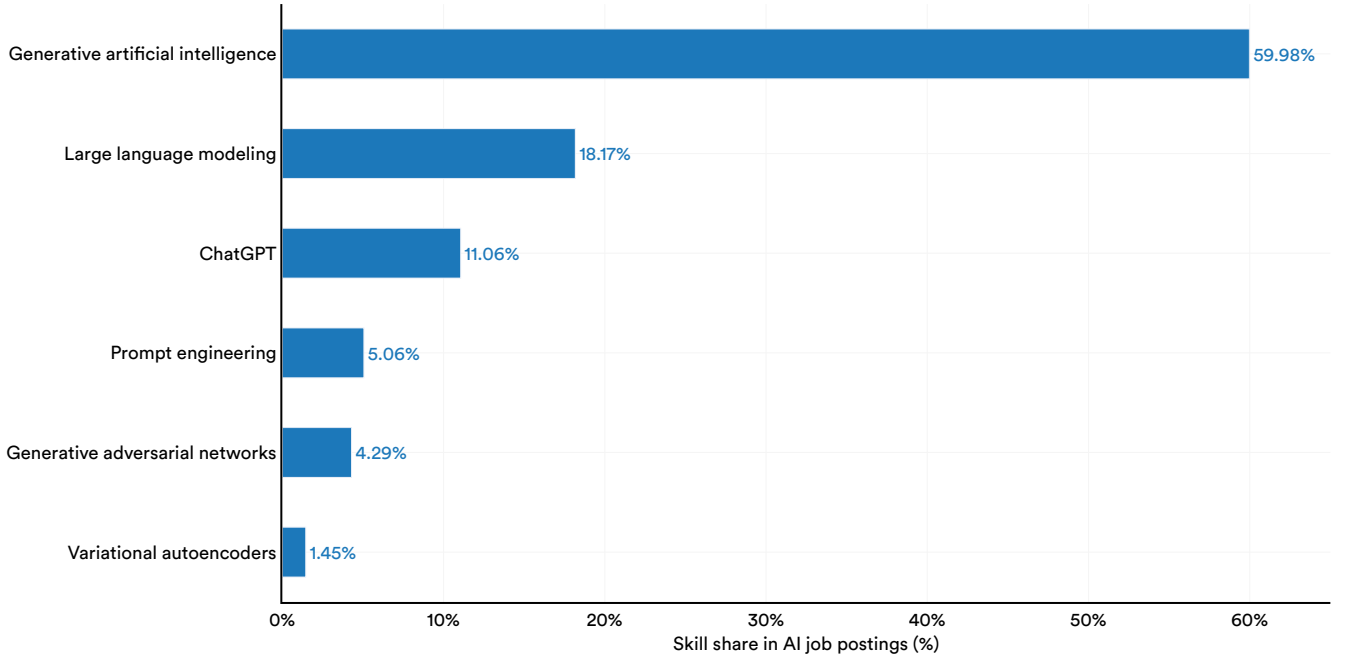


Figure 4.2.5

U.S. AI Labor Demand by Sector

Figure 4.2.6 shows the percentage of U.S. job postings requiring AI skills by industry sector from 2022 to 2023. Nearly every sector experienced a decrease in the proportion of AI job postings in 2023 compared to 2022, except for public administration and educational services. The leading sectors were information (4.6%); professional, scientific, and technical services (3.3%); and finance and insurance (2.9%). As noted earlier, the decrease in AI job postings was related to changes in the hiring patterns of several major U.S. employers.

AI job postings (% of all job postings) in the United States by sector, 2022 vs. 2023
Source: Lightcast, 2023 | Chart: 2024 AI Index report

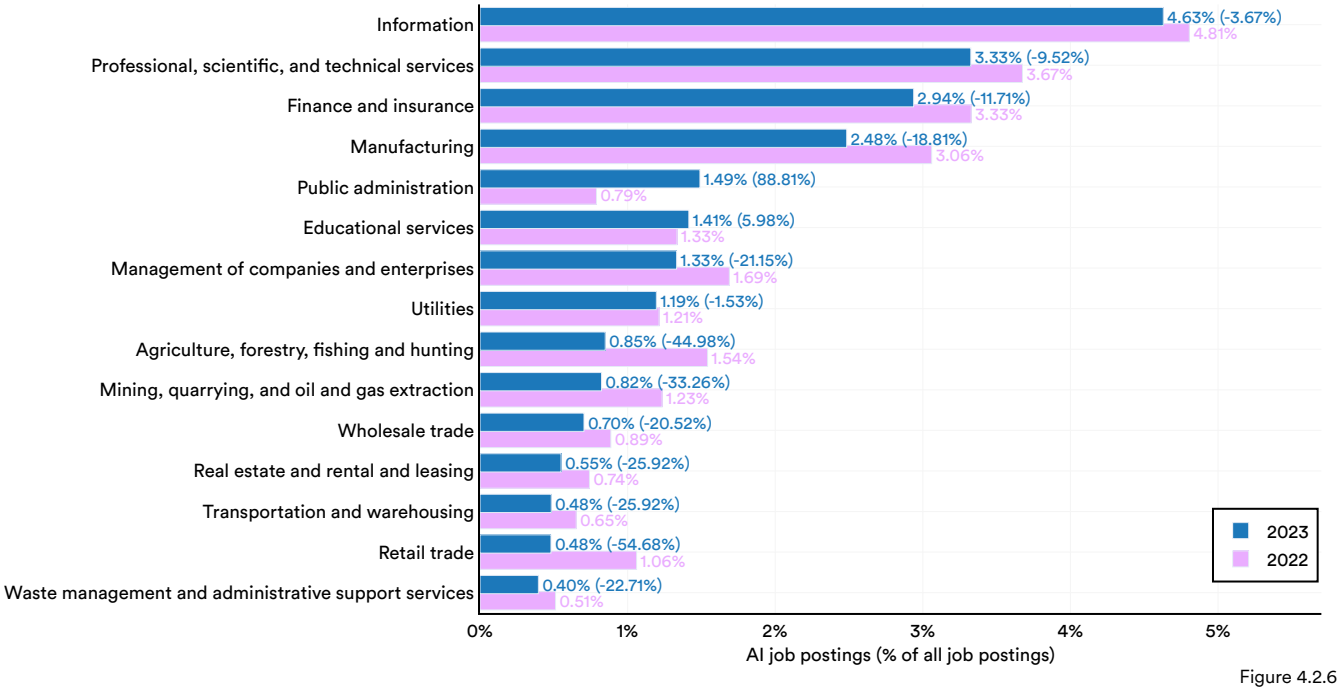


Figure 4.2.6

U.S. AI Labor Demand by State

Figure 4.2.7 highlights the number of AI job postings in the United States by state. The top three states were California (70,630), followed by Texas (36,413) and Virginia (24,417).

Number of AI job postings in the United States by state, 2023
Source: Lightcast, 2023 | Chart: 2024 AI Index report

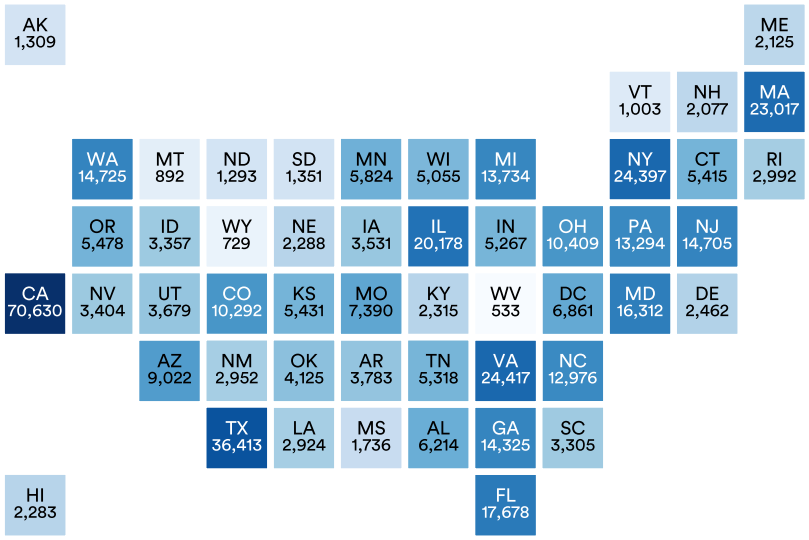


Figure 4.2.7

Figure 4.2.8 demonstrates what percentage of a state's total job postings were AI-related. The top states according to this metric were the District of Columbia (2.7%), followed by Delaware (2.4%) and Maryland (2.1%).

Percentage of US states' job postings in AI, 2023
Source: Lightcast, 2023 | Chart: 2024 AI Index report

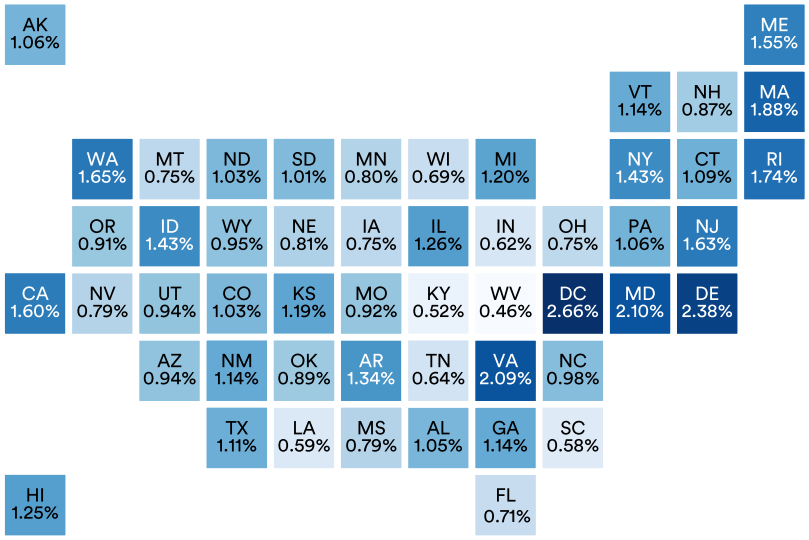


Figure 4.2.8

Figure 4.2.9 examines which U.S. states accounted for the largest proportion of AI job postings nationwide. California was first: In 2023, 15.3% of all AI job postings in the United States were for jobs based in California, followed by Texas (7.9%) and Virginia (5.3%).

Percentage of US AI job postings by state, 2023
Source: Lightcast, 2023 | Chart: 2024 AI Index report

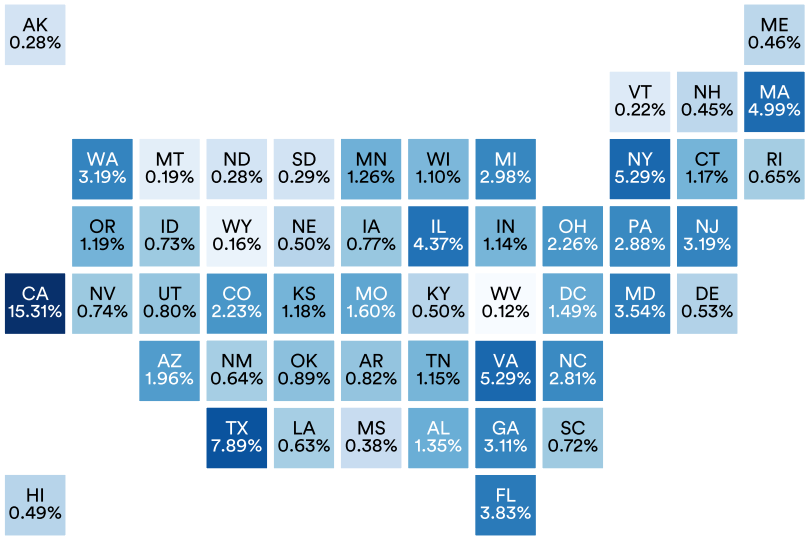


Figure 4.2.9

Figure 4.2.10 illustrates the trends in the four states with highest AI job postings: Washington, California, New York, and Texas. Each experienced a notable decline in the share of total AI-related job postings from 2022 to 2023.

Percentage of US states' job postings in AI by select US state, 2010–23
Source: Lightcast, 2023 | Chart: 2024 AI Index report

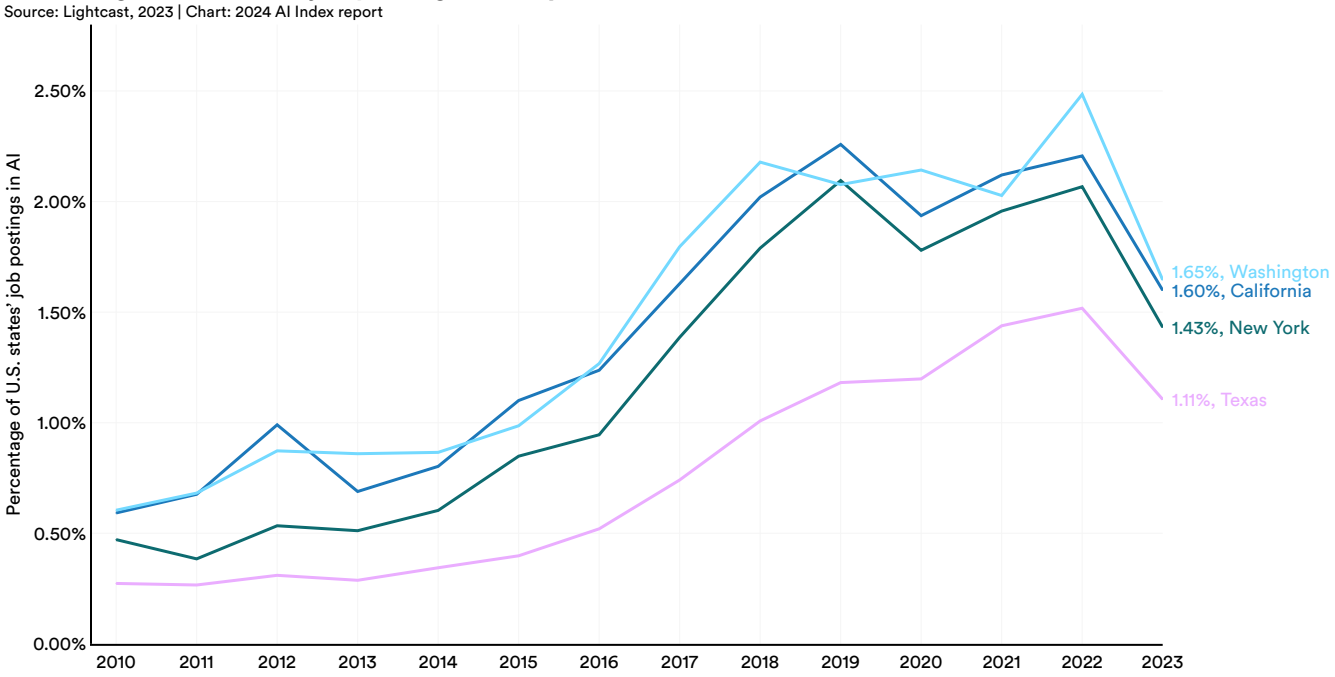


Figure 4.2.10

Figure 4.2.11 shows how AI-related job postings have been distributed across the top four states over time. Since 2019, California's proportion of AI job postings has steadily declined, while Texas has seen a slight increase.

Percentage of US AI job postings by select US state, 2010–23
Source: Lightcast, 2023 | Chart: 2024 AI Index report

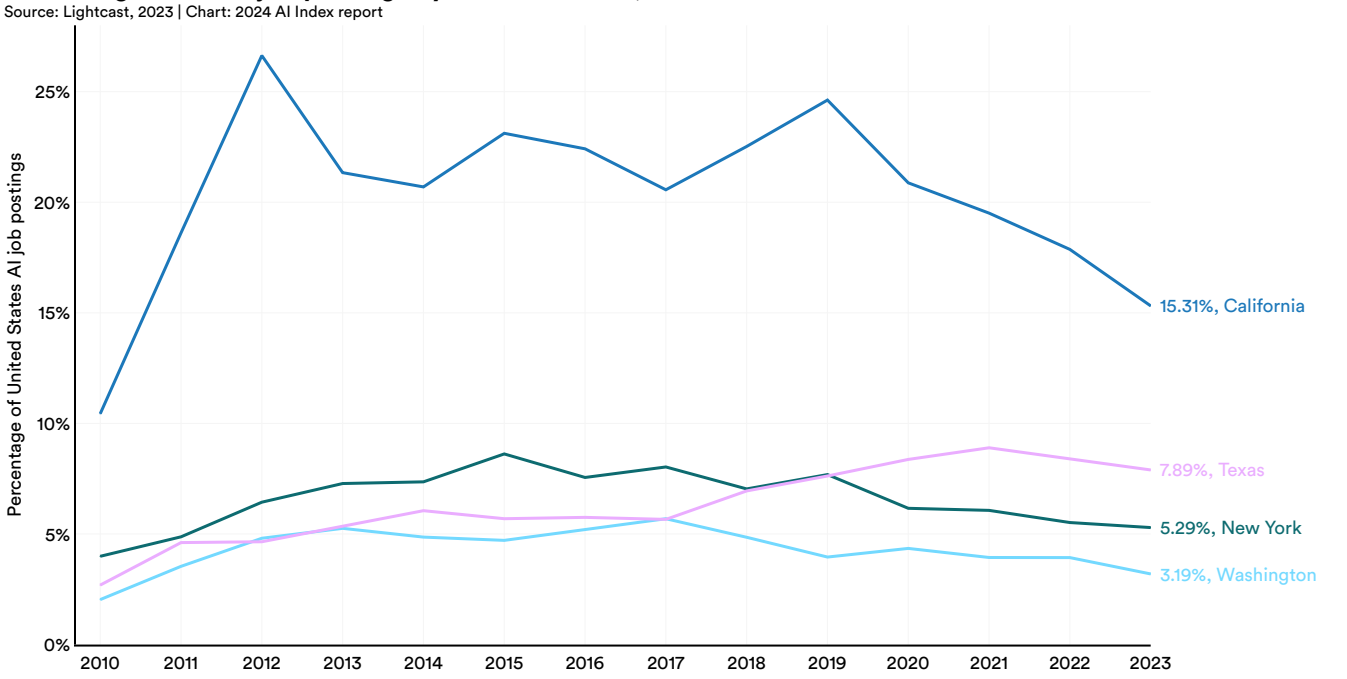


Figure 4.2.11

AI Hiring

The hiring data presented in the AI Index is based on a LinkedIn dataset of skills and jobs that appear on their platform. The geographic areas included in the sample make at least 10 AI hires each month and have LinkedIn covering a substantial portion of the labor force. LinkedIn's coverage of India's and South Korea's sizable labor forces fall below this threshold, so insights drawn about these countries should be interpreted with particular caution.

Figure 4.2.12 reports the relative AI hiring rate year-over-year ratio by geographic area. The overall hiring rate is computed as the percentage of LinkedIn members who added a new employer in the same period the job began, divided by the total number of LinkedIn members in the corresponding location. Conversely, the relative AI talent hiring rate is the year-over-year change in AI hiring relative to overall hiring rate in the same geographic area.[3] Therefore, figure 4.2.12 illustrates which specific regions have experienced the most significant rise in AI talent recruitment compared to the overall hiring rate, serving as an indicator of AI hiring vibrancy. In 2023, the regions with the greatest relative AI hiring rates year over year were Hong Kong (28.8%), followed by Singapore (18.9%) and Luxembourg (18.9%). This means, for example, that in 2023 in Hong Kong, the ratio of AI talent hiring relative to overall hiring grew 28.8%.

Relative AI hiring rate year-over-year ratio by geographic area, 2023
Source: LinkedIn, 2023 | Chart: 2024 AI Index report

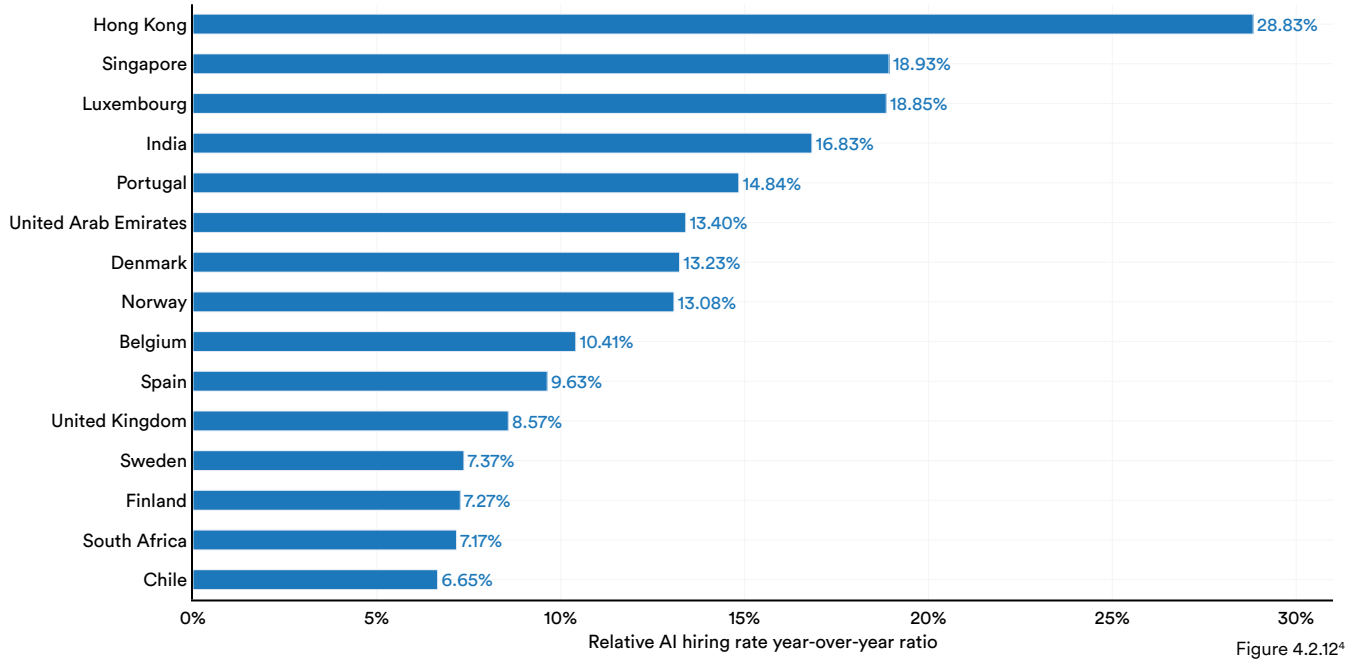


Figure 4.2.12[4]

Figure 4.2.13 showcases the year-over-year ratio of AI hiring by geographic areas over the past five years. Starting from the beginning of 2023, countries including Australia, Canada, Singapore, and India have experienced a noticeable uptick in AI hiring.

3 For each month, LinkedIn calculates the AI hiring rate in the geographic area, divides the AI hiring rate by overall hiring rate in that geographic area, calculates the year-over-year change of this ratio, and then takes the 12-month moving average using the last 12 months.

4 For brevity, the visualization only includes the top 15 countries for this metric.

Relative AI hiring rate year-over-year ratio by geographic area, 2018–23

Source: LinkedIn, 2023 | Chart: 2024 AI Index report

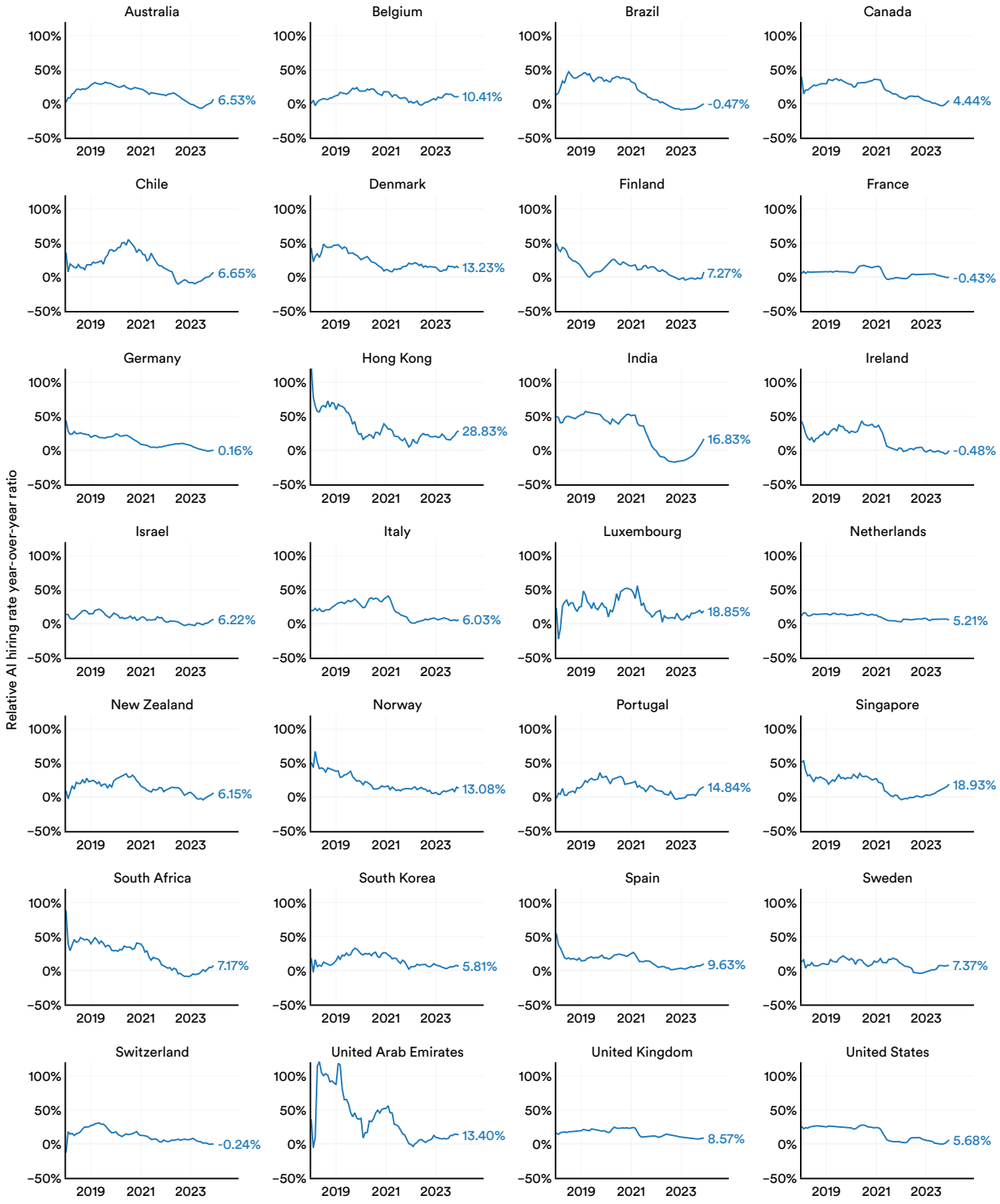


Figure 4.2.13

AI Skill Penetration

Figures 4.2.14 and 4.2.15 highlight relative AI skill penetration. The aim of this indicator is to measure the intensity of AI skills in an entity (such as a particular country, industry, or gender). The AI skill penetration rate signals the prevalence of AI skills across occupations or the intensity with which LinkedIn members utilize AI skills in their jobs. For example, the top 50 skills for the occupation of engineer are calculated based on the weighted frequency with which they appear in LinkedIn members' profiles. If, for instance, four of the skills that engineers possess belong to the AI skill group, the penetration of AI skills among engineers is estimated to be 8% (4/50).

For the period from 2015 to 2023, the countries with the highest AI skill penetration rates were India (2.8), the United States (2.2), and Germany (1.9). In the United States, therefore, the relative penetration of AI skills was 2.2 times greater than the global average across the same set of occupations.

Relative AI skill penetration rate by geographic area, 2015–23
Source: LinkedIn, 2023 | Chart: 2024 AI Index report

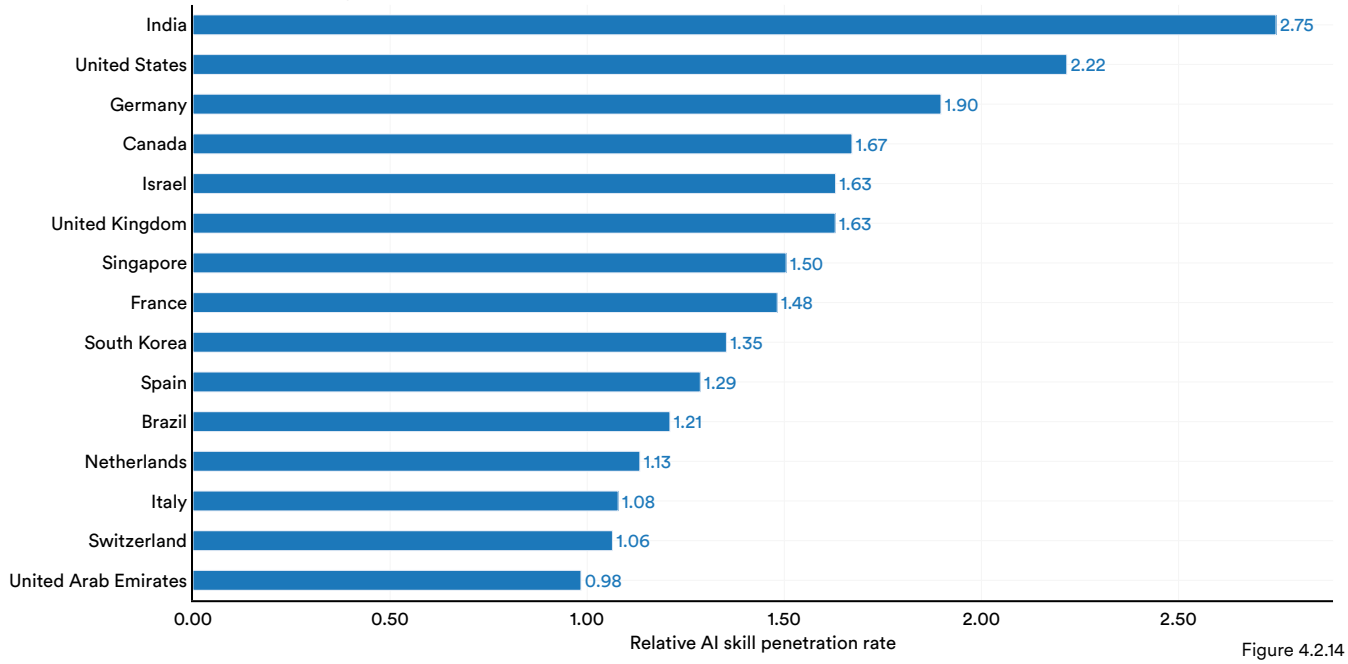


Figure 4.2.14

Figure 4.2.15 disaggregates AI skill penetration rates by gender across different countries or regions. A country's rate of 1.5 for women means female members in that country are 1.5 times more likely to list AI skills than the average member in all countries pooled together across the same set of occupations in the country. For all countries in the sample, the relative AI skill penetration rate is greater for men than women. India (1.7), the United States (1.2), and Israel (0.9) have the highest reported relative AI skill penetration rates for women.

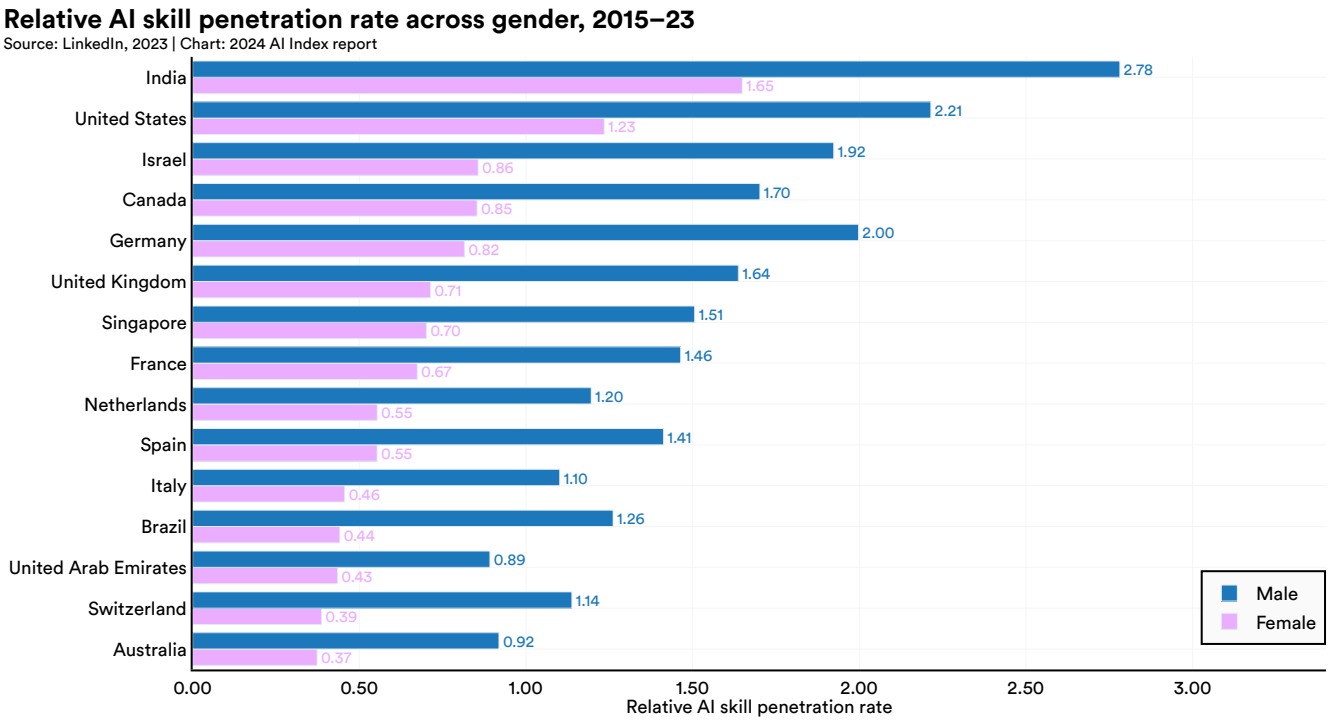


Figure 4.2.15

AI Talent

Figures 4.2.16 to 4.2.18 examine AI talent by country. A LinkedIn member is considered AI talent if they have explicitly added AI skills to their profile or work in AI. Counts of AI talent are used to calculate talent concentration, or the portion of members who are AI talent. Note that concentration metrics may be influenced by LinkedIn coverage in these countries and should be used with caution.

Figure 4.2.16 shows AI talent concentration in various countries. In 2023, the countries with the highest concentrations of AI talent included Israel (1.1%), Singapore (0.9%), and South Korea (0.8%). Figure 4.2.17 looks at the percent change in AI talent concentration for a selection of countries since 2016. During that time period, several major economies registered substantial increases in their AI talent pools. The countries showing the greatest increases are India (263%), Cyprus (229%), and Denmark (213%).

AI talent concentration by geographic area, 2023
Source: LinkedIn, 2023 | Chart: 2024 AI Index report

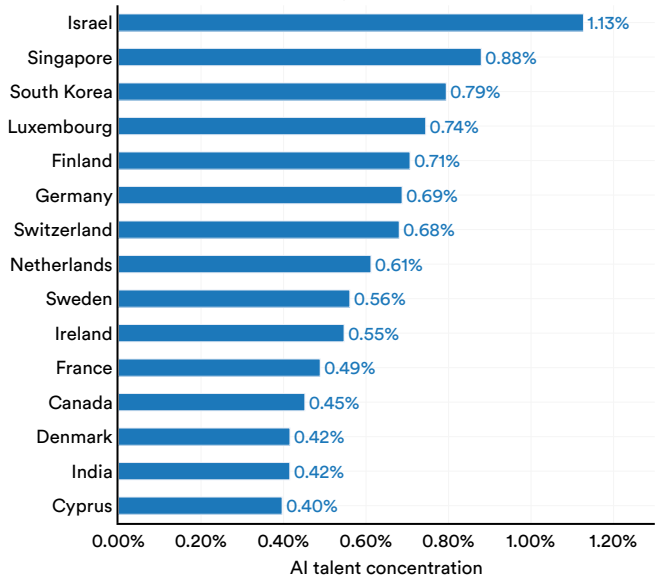


Figure 4.2.16

Percentage change in AI talent concentration by geographic area, 2016 vs. 2023
Source: LinkedIn, 2023 | Chart: 2024 AI Index report

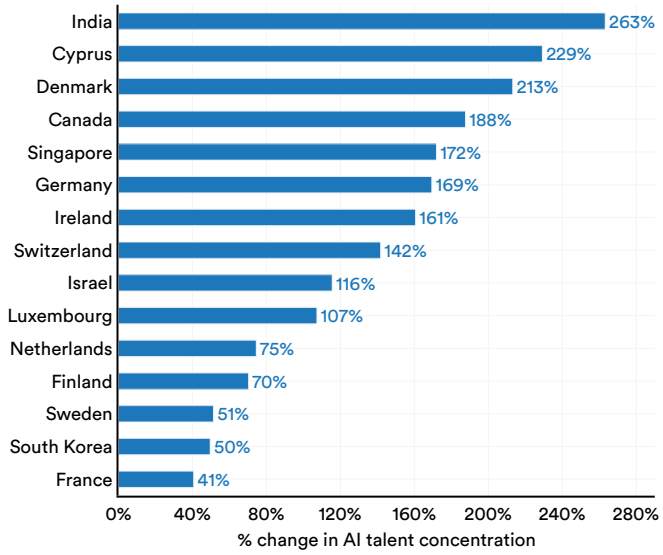


Figure 4.2.17

AI talent concentration by gender, 2016–23

Source: LinkedIn, 2023 | Chart: 2024 AI Index report

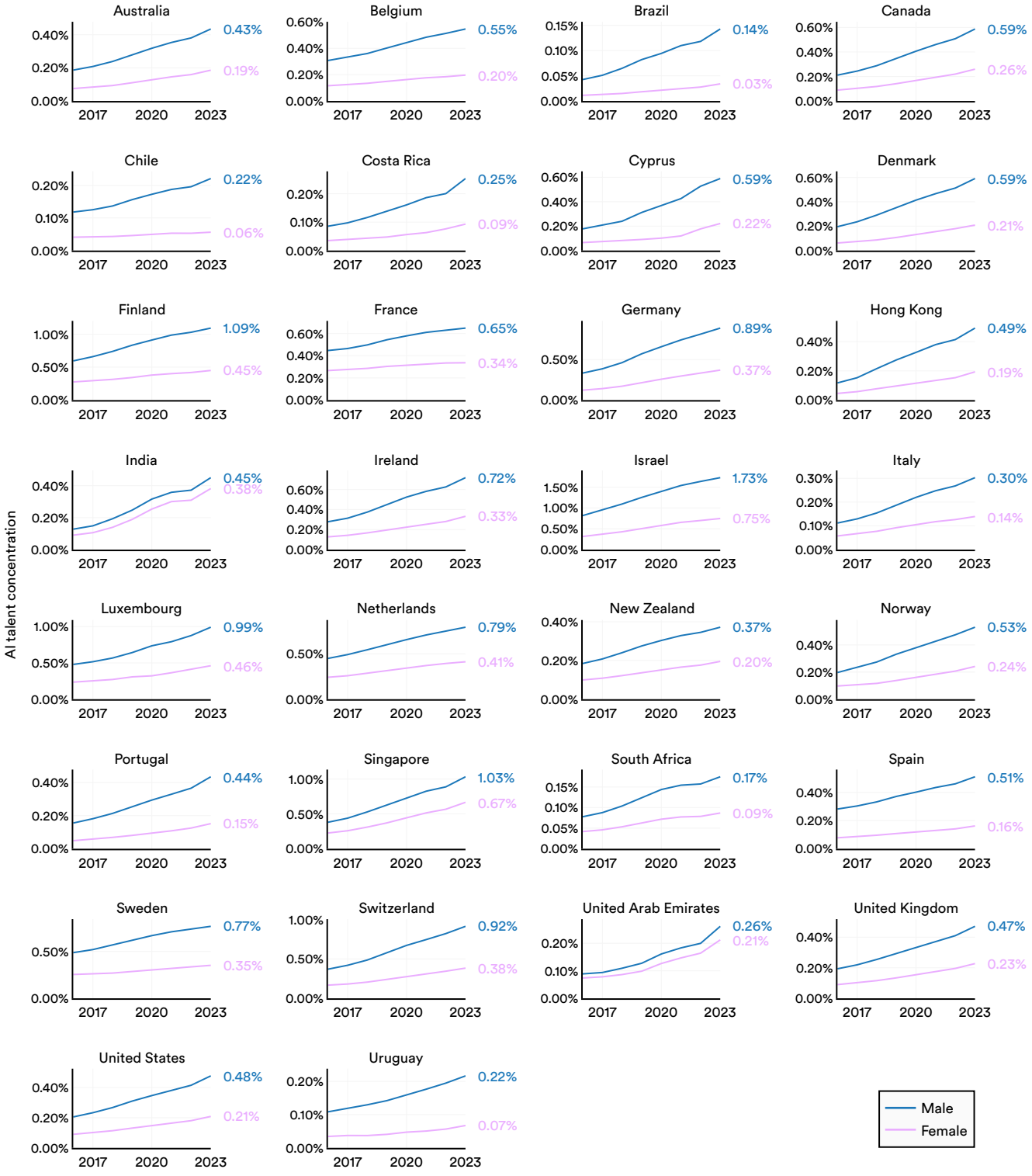


Figure 4.2.18

LinkedIn data provides insights on the AI talent gained or lost due to migration trends.[5] Net flows are defined as total arrivals minus departures within the given time period. Figure 4.2.19 examines net AI talent migration per 10,000 LinkedIn members by geographic area. The countries that report the greatest incoming migration of AI talent are Luxembourg, Switzerland, and the United Arab Emirates.

Net AI talent migration per 10,000 LinkedIn members by geographic area, 2023
Source: LinkedIn, 2023; World Bank Group, 2023 | Chart: 2024 AI Index report

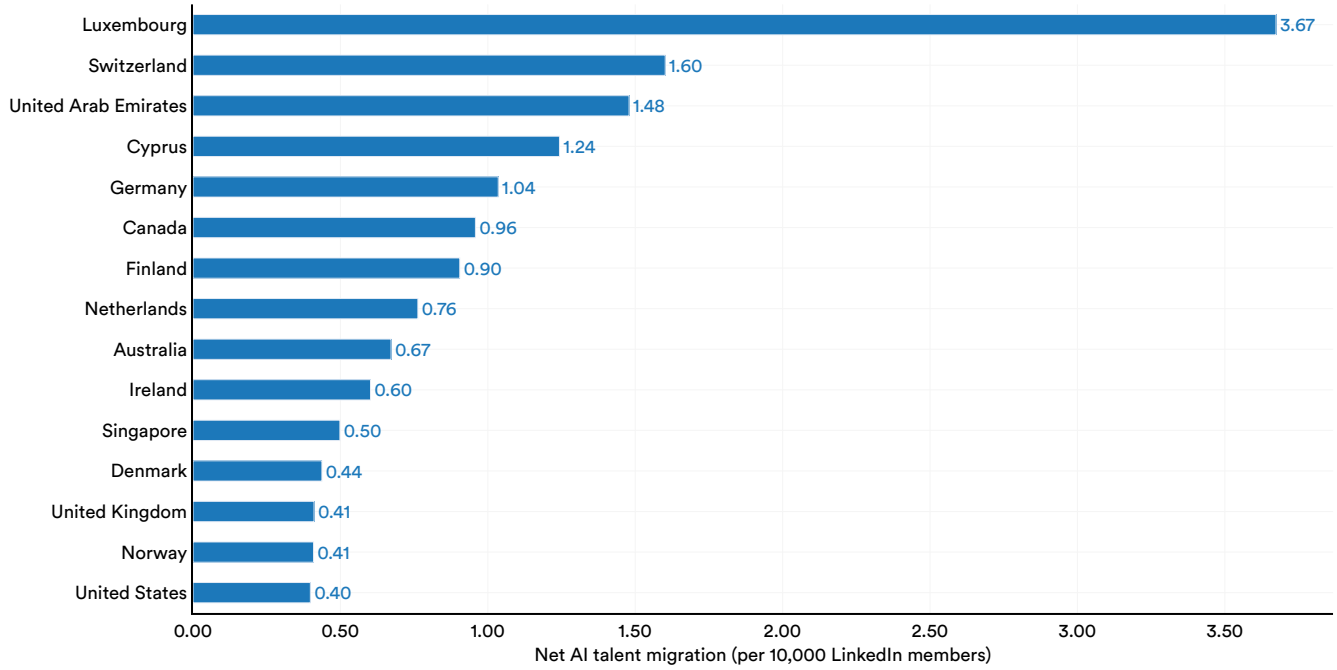


Figure 4.2.19

Figure 4.2.20 documents AI talent migration data over time. In the last few years, Israel, India, and South Korea have seen declining net AI talent migration figures, suggesting that AI talent has been increasingly flowing out of these countries.

5 LinkedIn membership varies considerably between countries, which makes interpreting absolute movements of members from one country to another difficult. To compare migration flows between countries fairly, migration flows are normalized for the country of interest. For example, if country A is the country of interest, all absolute net flows into and out of country A (regardless of origin and destination countries) are normalized based on LinkedIn membership in country A at the end of each year and multiplied by 10,000. Hence, this metric indicates relative talent migration of all other countries to and from country A.

Net AI talent migration per 10,000 LinkedIn members by geographic area, 2019–23

Source: LinkedIn, 2023; World Bank Group, 2023 | Chart: 2024 AI Index report

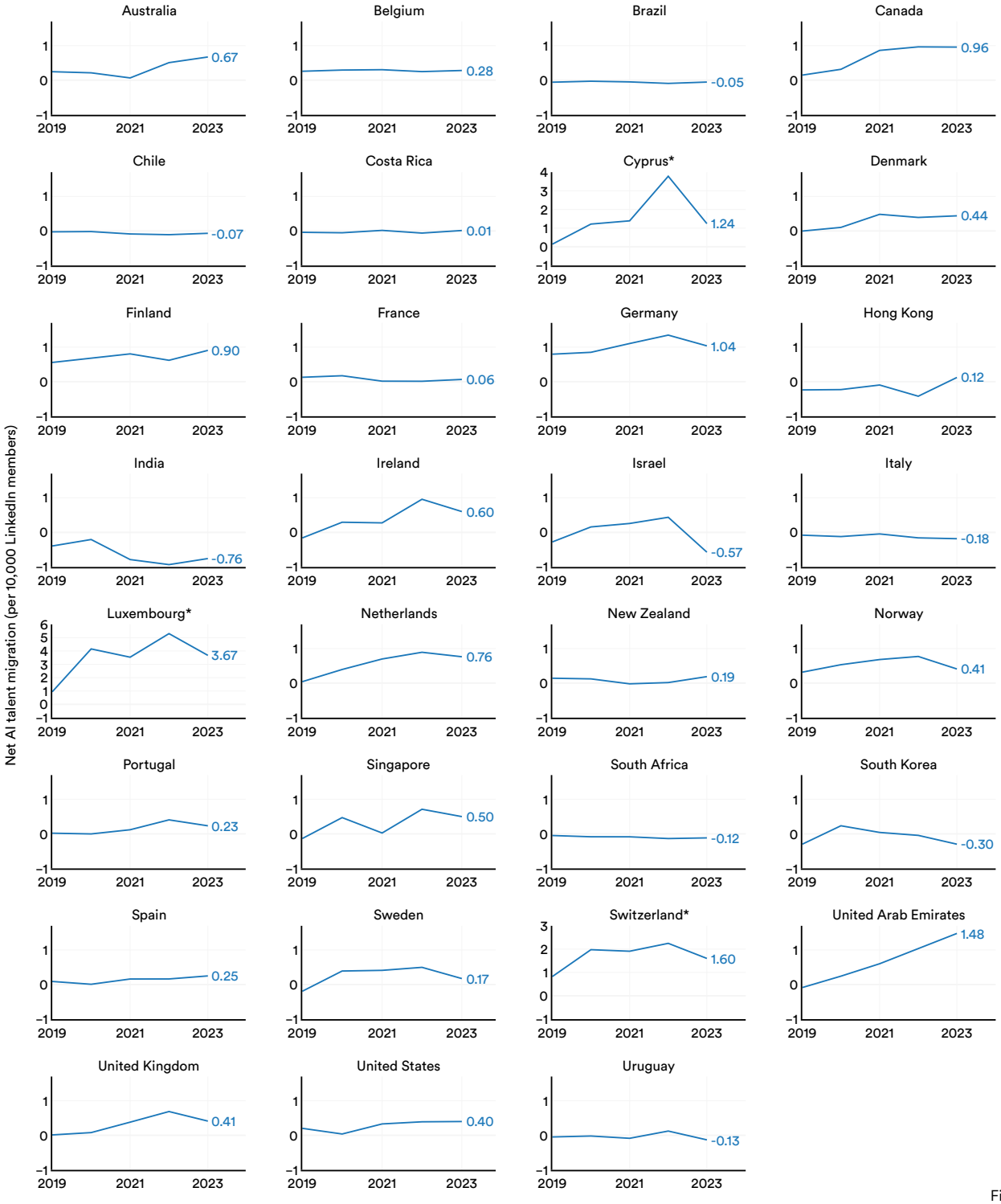


Figure 4.2.20[6]

6 Asterisks indicate that a country's y-axis label is scaled differently than the y-axis label for the other countries.

Highlight:

How Much Do Computer Scientists Earn?

Every year, Stack Overflow conducts a survey of its community of professional developers who use their tools. The latest iteration of the survey profiled over 90,000 developers.

Through this survey, respondents were asked about their income. It is important to note that these respondents do not work exclusively with AI. However, examining developer salaries can serve as a means to approximate the compensation of talent in AI-adjacent industries. Figure 4.2.21 examines the salaries of professional developers disaggregated by position.

Salaries vary by position and geography. For instance, the average global salary for a cloud infrastructure engineer is $105,000. In the United States, the average salary for such a position is $185,000. Both globally and in the United States, the highest compensated roles are senior executives, followed by engineering managers. For all surveyed positions, salaries are significantly higher in the United States than in other countries.

Highlight:

How Much Do Computer Scientists Earn? (cont'd)

Median yearly salary by professional developer type, 2023

Source: Stack Overflow Developer Survey, 2023 | Chart: 2024 AI Index report

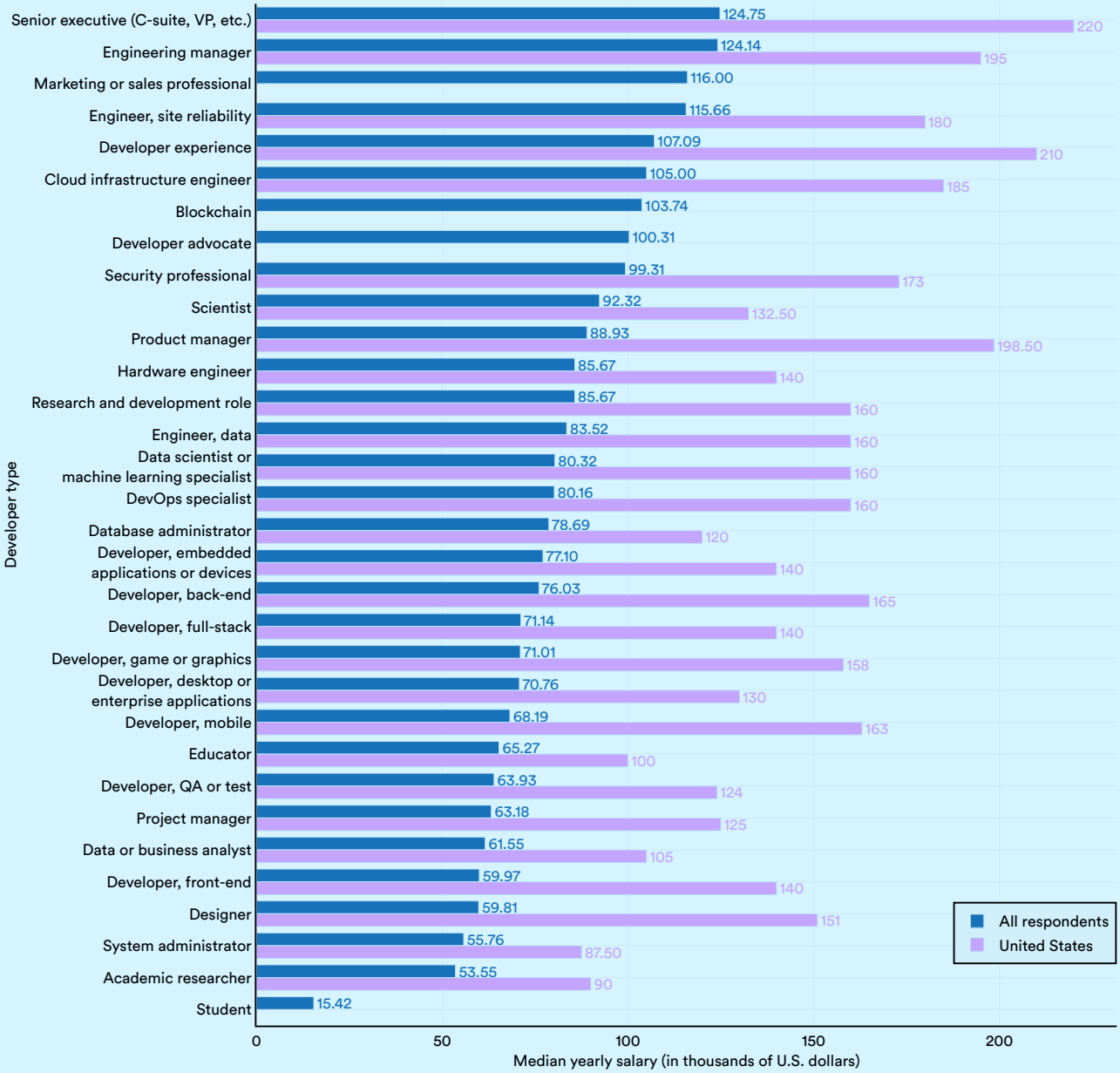


Figure 4.2.21

This section monitors AI investment trends, leveraging data from Quid, which analyzes investment data from more than 8 million companies worldwide, both public and private. Employing natural language processing, Quid sifts through vast unstructured datasets—including news aggregations, blogs, company records, and patent databases—to detect patterns and insights. Additionally, Quid is constantly expanding its database to include more companies, sometimes resulting in higher reported investment volumes for specific years. For the first time, this year's investment section in the AI Index includes data on generative AI investments.

4.3 Investment

Corporate Investment

Figure 4.3.1 illustrates the trend in global corporate AI investment from 2013 to 2023, including mergers and acquisitions, minority stakes, private investments, and public offerings. For the second consecutive year, global corporate investment in AI has seen a decline.

In 2023, the total investment dropped to $189.2 billion, a decrease of approximately 20% from 2022. Despite a slight reduction in private investment, the most significant downturn occurred in mergers and acquisitions, which fell by 31.2% from the previous year. However, over the past decade, AI-related investments have increased thirteenfold.

Global corporate investment in AI by investment activity, 2013–23

Source: Quid, 2023 | Chart: 2024 AI Index report

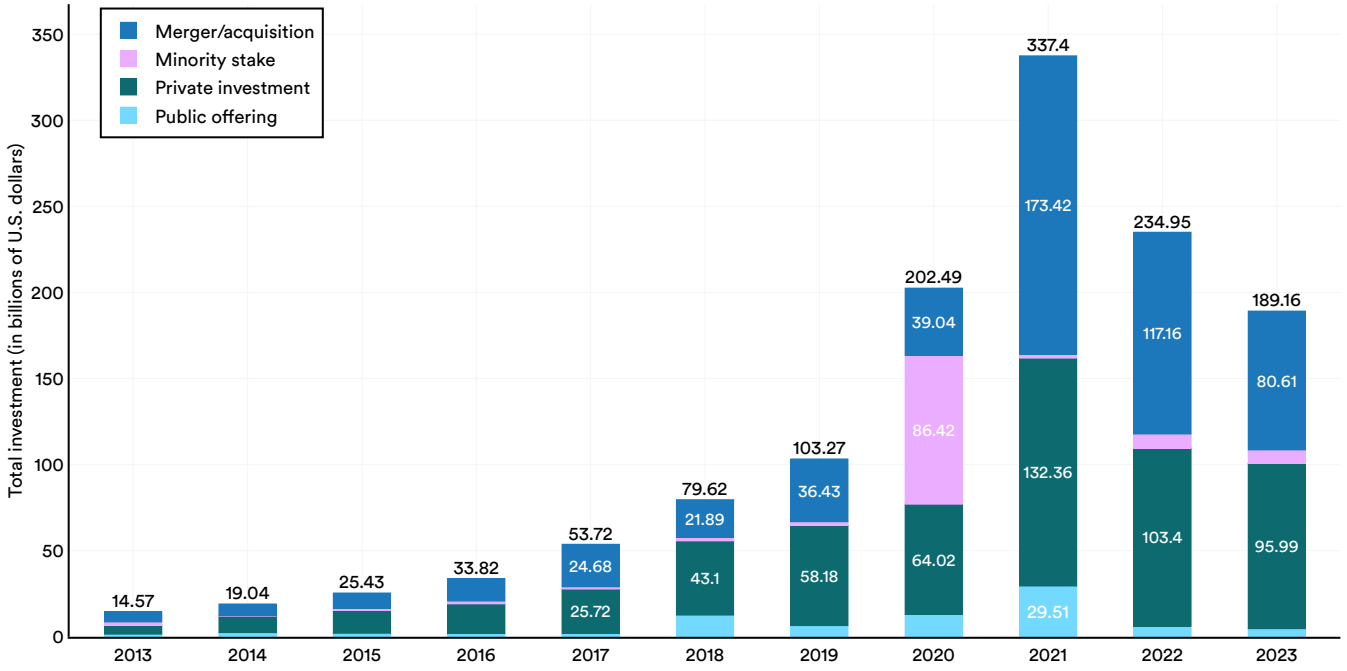


Figure 4.3.1

Startup Activity

This section analyzes private investment trends in artificial intelligence startups that have received over $1.5 million in investment since 2013.

Global Trends

Global private AI investment has declined for the second consecutive year (Figure 4.3.2). However, the decrease from 2022 was small (-7.2%) and smaller than the drop observed from 2021 to 2022. Despite recent declines, private AI investment globally has grown substantially in the last decade.

Private investment in AI, 2013–23
Source: Quid, 2023 | Chart: 2024 AI Index report

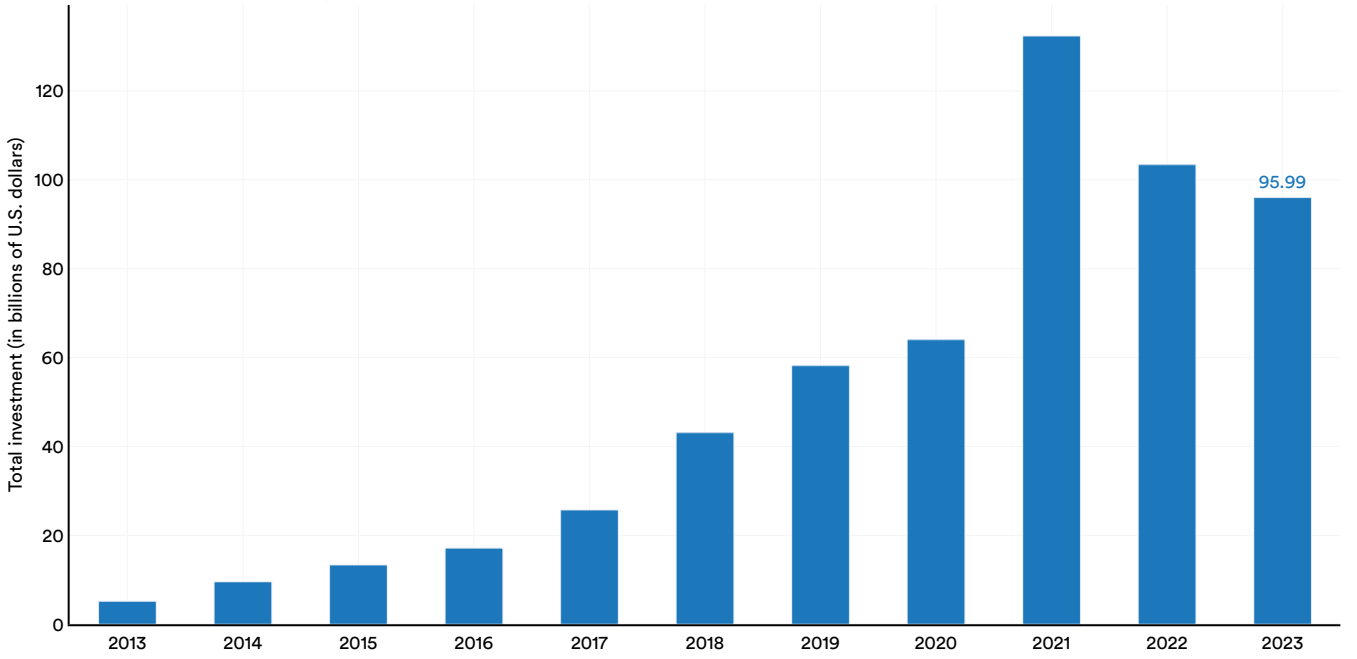


Figure 4.3.2

While overall AI private investment decreased last year, funding for generative AI sharply increased (Figure 4.3.3). In 2023, the sector attracted $25.2 billion, nearly nine times the investment of 2022 and about 30 times the amount from 2019. Furthermore, generative AI accounted for over a quarter of all AI-related private investment in 2023.

Private investment in generative AI, 2019–23

Source: Quid, 2023 | Chart: 2024 AI Index report

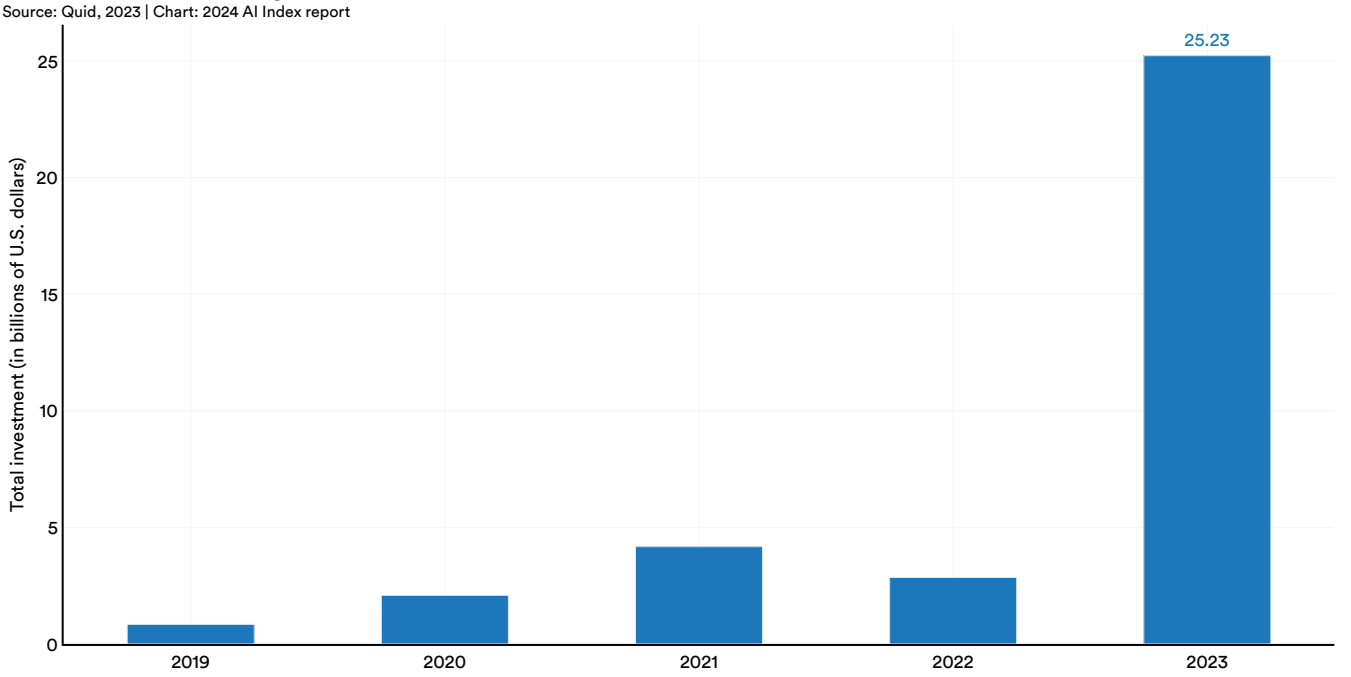


Figure 4.3.3

Interestingly, the number of newly funded AI companies jumped to 1,812, a 40.6% increase over the previous year (Figure 4.3.4). Figure 4.3.5 visualizes the average size of AI private investment events, calculated by dividing the total yearly AI private investment by the total number of AI private investment events. From 2022 to 2023, the average increased marginally, growing from $31.3 million to $32.4 million.

Number of newly funded AI companies in the world, 2013–23

Source: Quid, 2023 | Chart: 2024 AI Index report

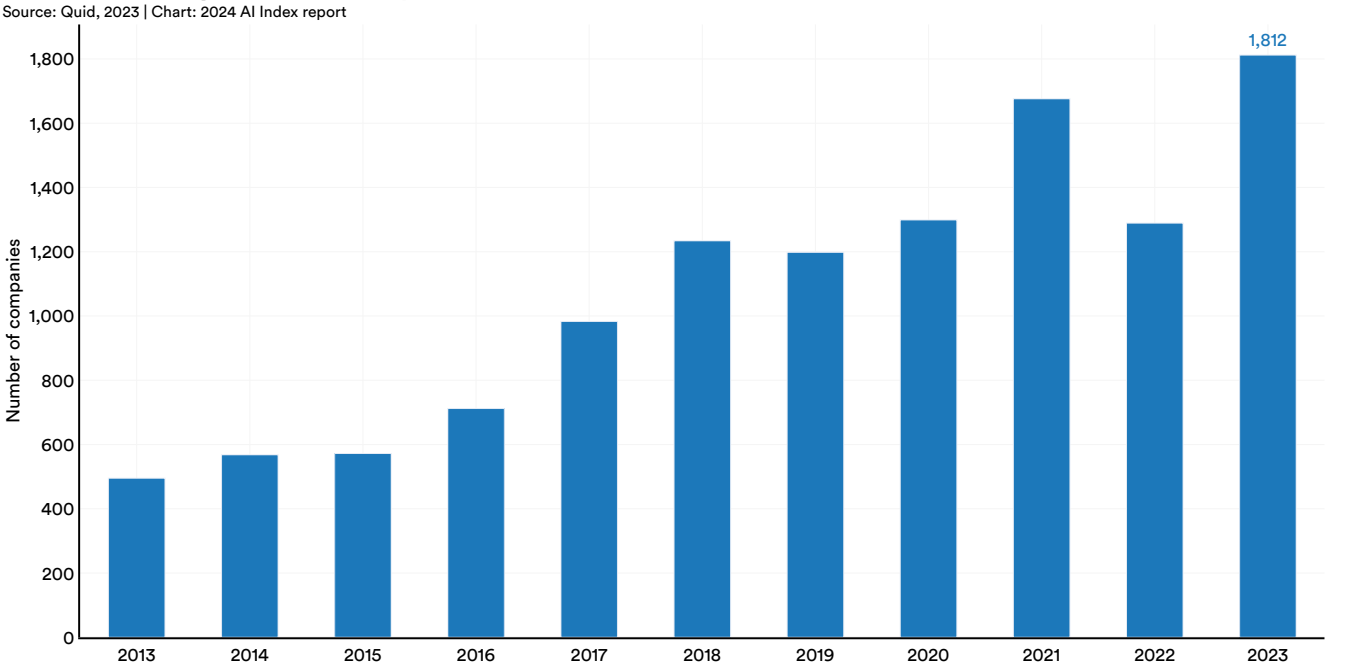


Figure 4.3.4

Average size of AI private investment events, 2013–23

Source: Quid, 2023 | Chart: 2024 AI Index report

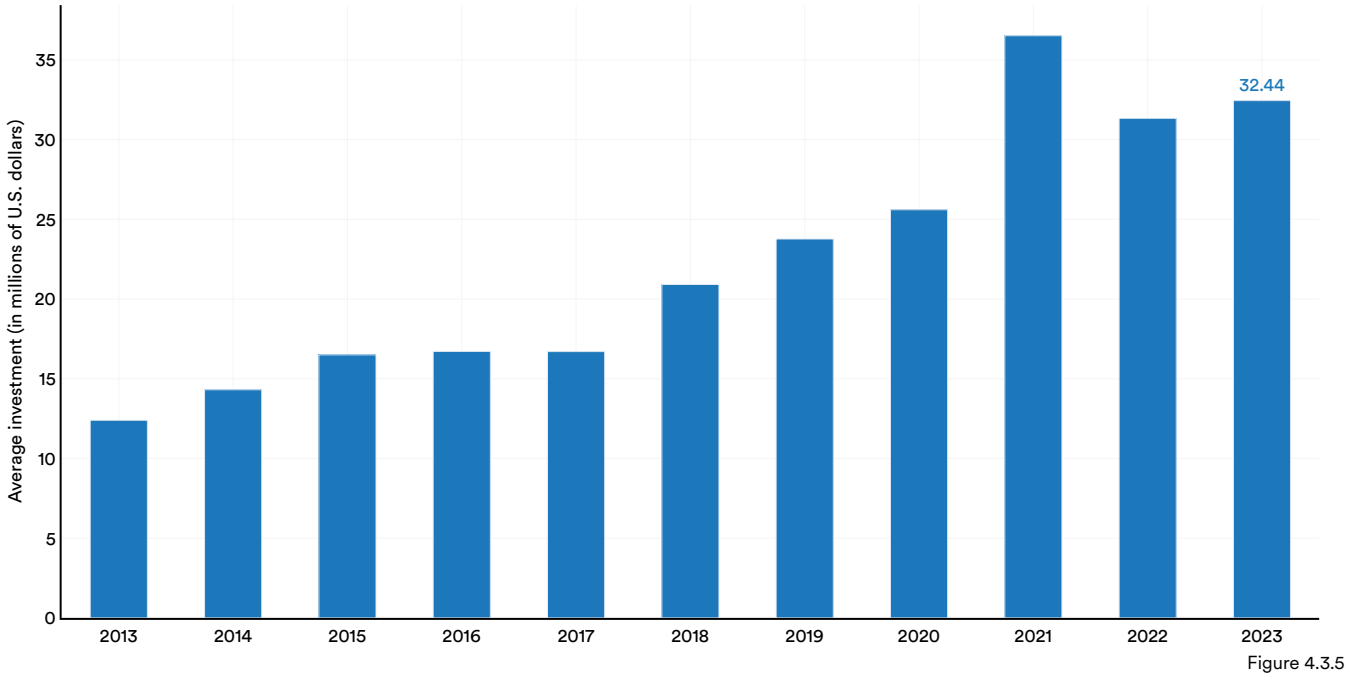


Figure 4.3.5

2023 marked a significant increase in the number of newly funded generative AI companies, with 99 new startups receiving funding, compared to 56 in 2022, and 31 in 2019 (Figure 4.3.6).

Number of newly funded generative AI companies in the world, 2019–23
Source: Quid, 2023 | Chart: 2024 AI Index report

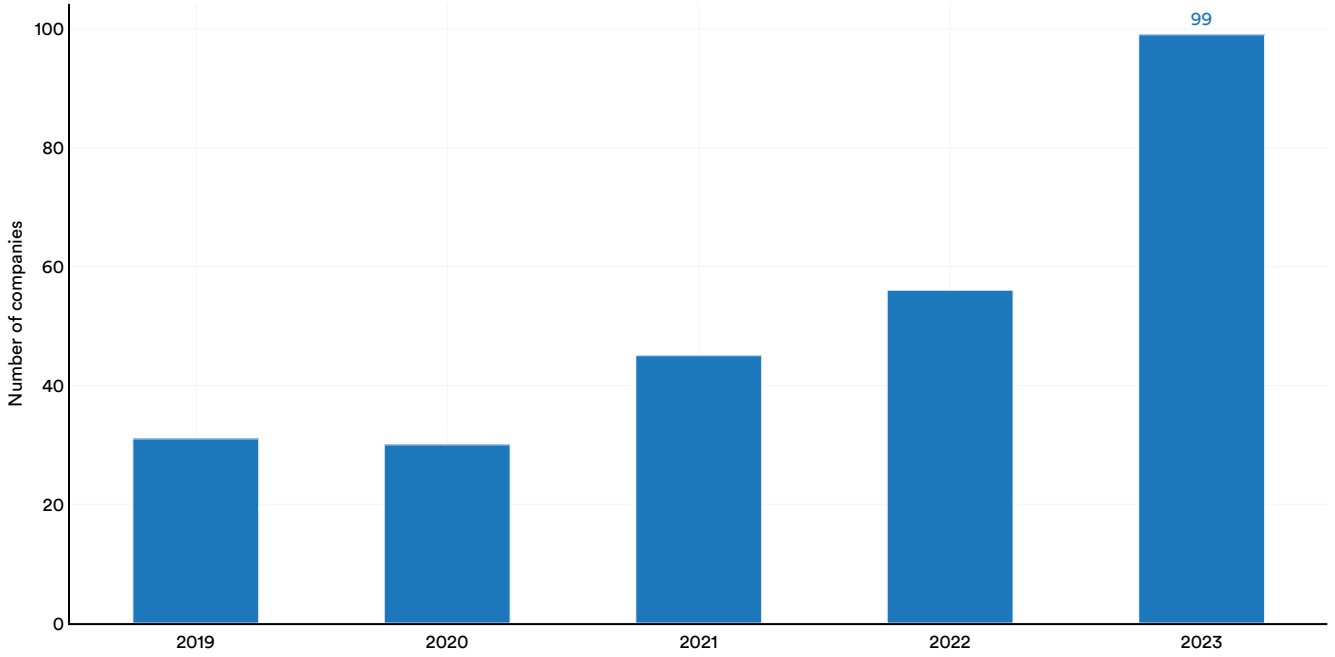


Figure 4.3.6

Figure 4.3.7 reports AI funding events disaggregated by size. In 2023, AI private investment events decreased across nearly all funding size categories, except for those exceeding $500 million.

AI private investment events by funding size, 2022 vs. 2023
Source: Quid, 2023 | Table: 2024 AI Index report

Funding Size	2022	2023
Over $1 billion	7	9
$500 million – $1 billion	6	7
$100 million – $500 million	187	120
$50 million – $100 million	260	182
Under $50 million	2,840	2,641
Undisclosed	694	680
Total	3,994	3,639

Figure 4.3.7

Regional Comparison by Funding Amount

The United States once again led the world in terms of total AI private investment. In 2023, the $67.2 billion invested in the United States was roughly 8.7 times greater than the amount invested in the next highest country, China ($7.8 billion), and 17.8 times the amount invested in the United Kingdom ($3.8 billion) (Figure 4.3.8).

Private investment in AI by geographic area, 2023
Source: Quid, 2023 | Chart: 2024 AI Index report

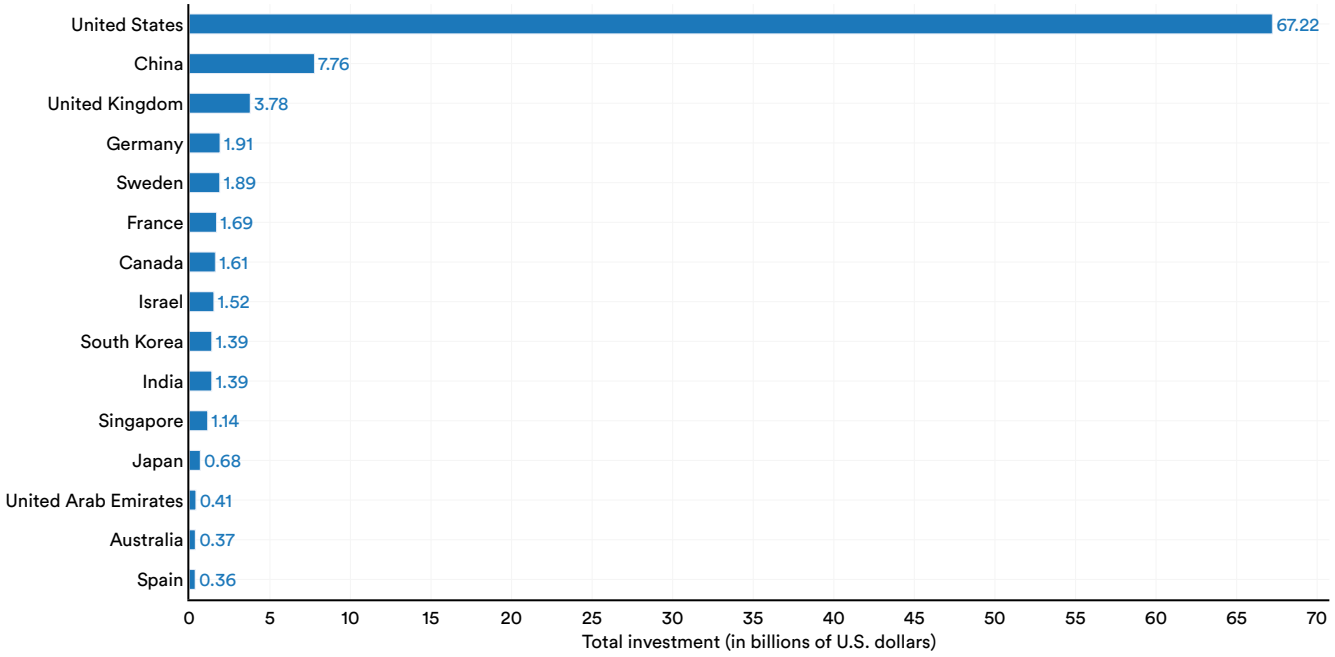


Figure 4.3.8

When aggregating private AI investments since 2013, the country rankings remain the same: The United States leads with $335.2 billion invested, followed by China with $103.7 billion, and the United Kingdom at $22.3 billion (Figure 4.3.9).

Private investment in AI by geographic area, 2013–23 (sum)
Source: Quid, 2023 | Chart: 2024 AI Index report

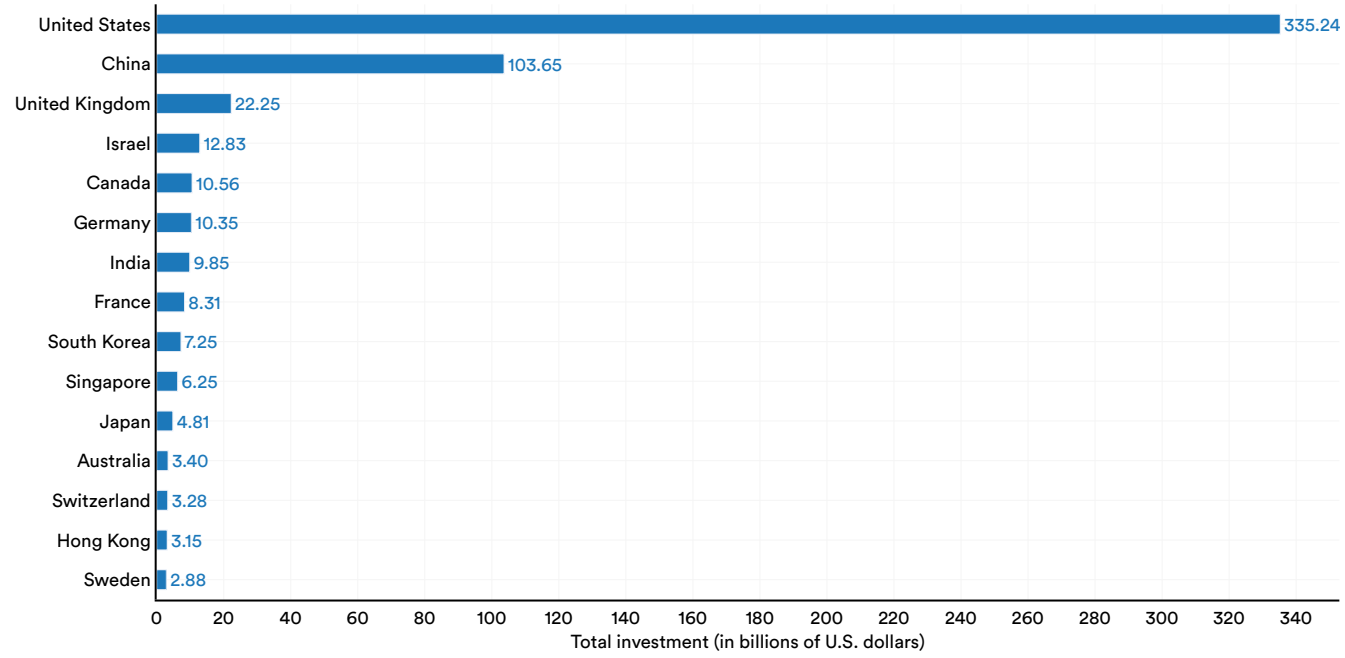


Figure 4.3.9

Figure 4.3.10, which looks at AI private investment over time by geographic area, suggests that the gap in private investments between the United States and other regions is widening over time. While AI private investments have decreased in China (-44.2%) and the European Union plus the United Kingdom (-14.1%) since 2022, the United States has seen a significant increase (22.1%) during the same period.

Private investment in AI by geographic area, 2013–23
Source: Quid, 2023 | Chart: 2024 AI Index report

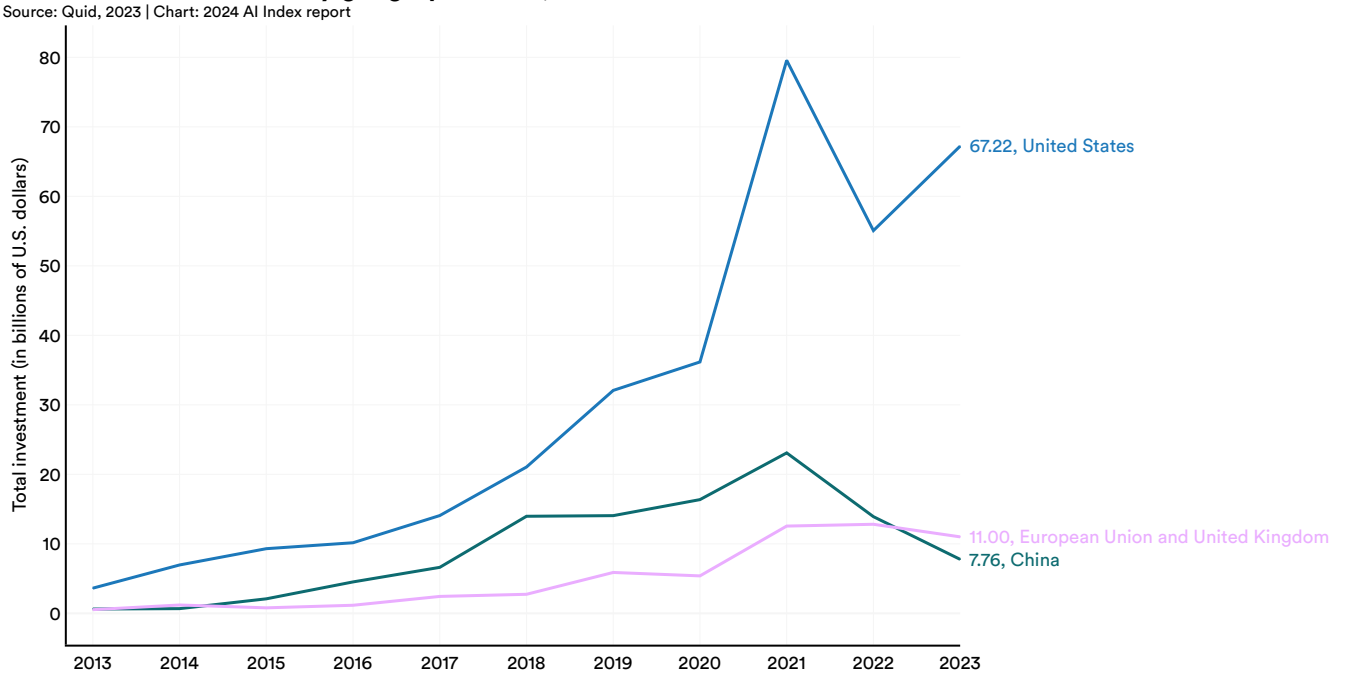


Figure 4.3.10

The disparity in regional AI private investment becomes particularly pronounced when examining generative AI-related investments. For instance, in 2022, the United States outpaced the combined investments of the European Union plus United Kingdom in generative AI by approximately $1.9 billion (Figure 4.3.11). By 2023, this gap widened to $21.1 billion.

Private investment in generative AI by geographic area, 2019–23
Source: Quid, 2023 | Chart: 2024 AI Index report

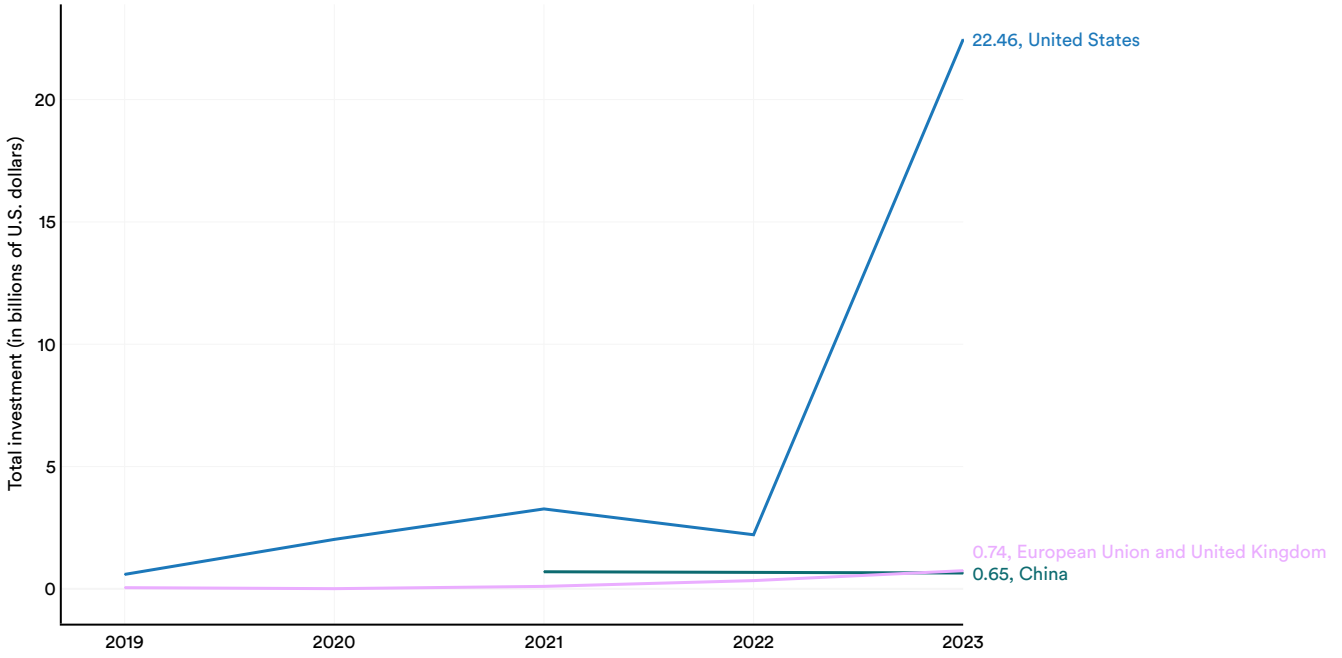


Figure 4.3.11

Regional Comparison by Newly Funded AI Companies

This section examines the number of newly funded AI companies across different geographic regions.

Consistent with trends in private investment, the United States leads all regions with 897 new AI companies, followed by China with 122, and the United Kingdom with 104 (Figure 4.3.12).

Number of newly funded AI companies by geographic area, 2023

Source: Quid, 2023 | Chart: 2024 AI Index report

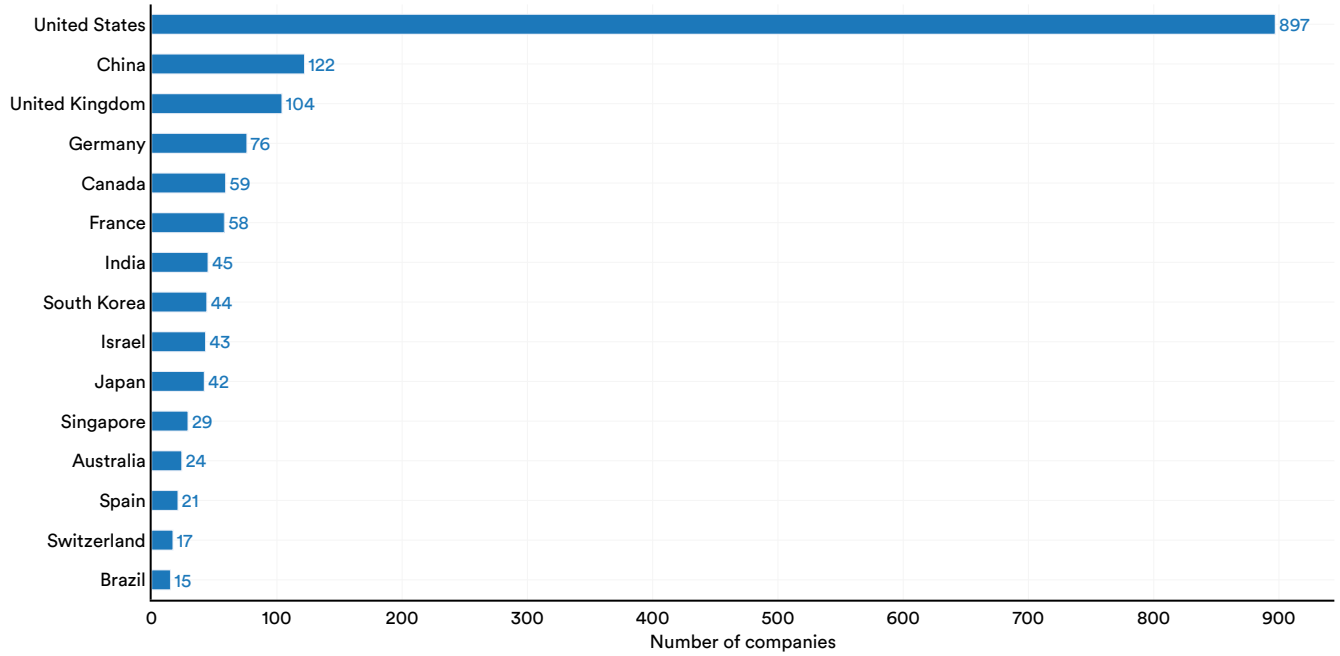


Figure 4.3.12

A similar trend is evident in the aggregate data since 2013. In the last decade, the number of newly funded AI companies in the United States is around 3.8 times the amount in China, and 7.6 times the amount in the United Kingdom (Figure 4.3.13).

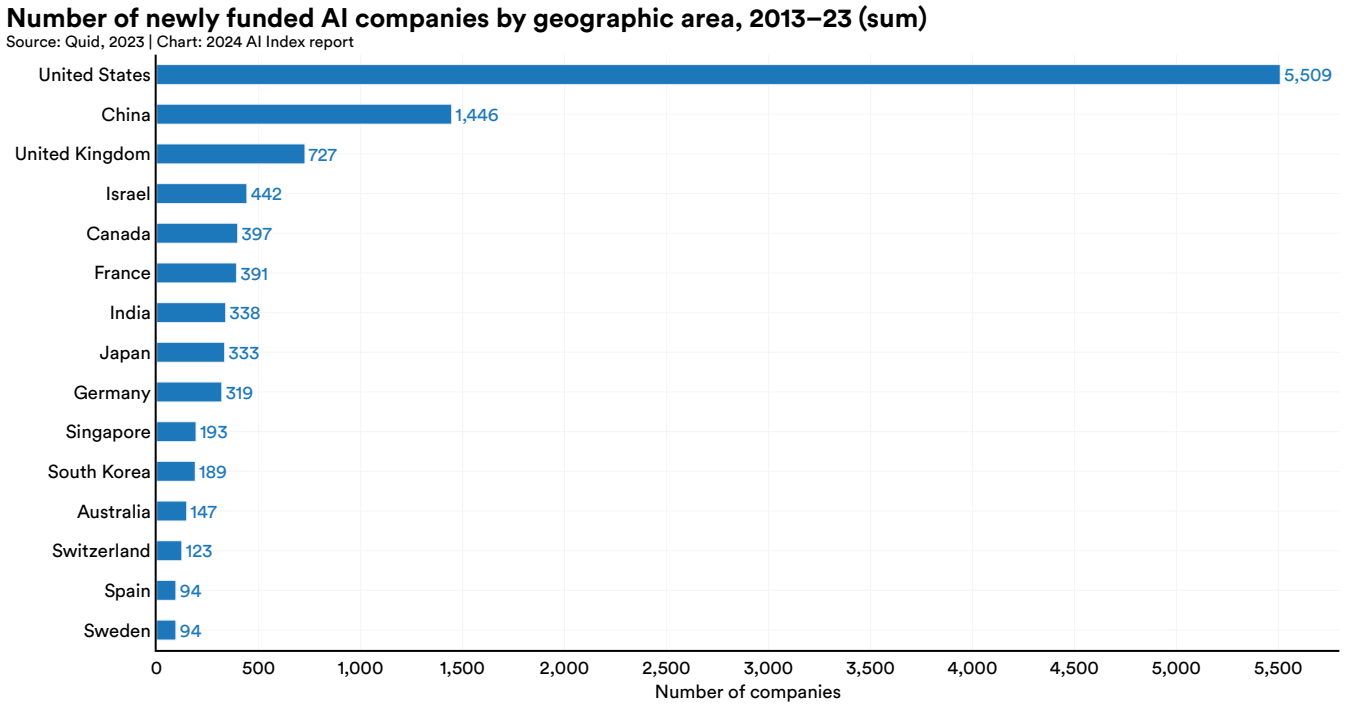


Figure 4.3.13

Figure 4.3.14 presents data on newly funded AI companies in specific geographic regions, highlighting a decade-long trend where the United States consistently surpasses both the European Union and the United Kingdom, as well as China. Since 2022, the United States, along with the European Union and the United Kingdom, have seen significant increases in the number of new AI companies, in contrast to China, which experienced a slight year-over-year decrease.

Number of newly funded AI companies by geographic area, 2013–23

Source: Quid, 2023 | Chart: 2024 AI Index report

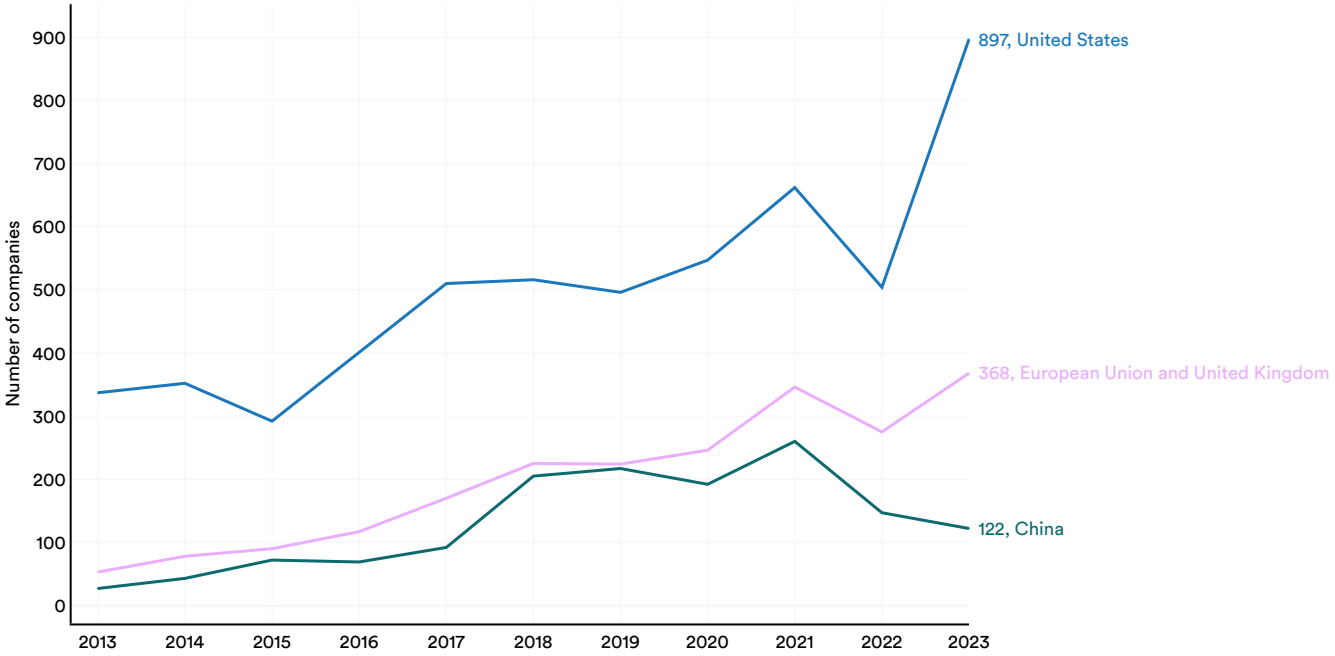


Figure 4.3.14

Focus Area Analysis

Quid also disaggregates private AI investment by focus area. Figure 4.3.15 compares global private AI investment by focus area in 2023 versus 2022. The focus areas that attracted the most investment in 2023 were AI infrastructure/research/governance ($18.3 billion); NLP and customer support ($8.1 billion); and data management and processing ($5.5 billion). The prominence of AI infrastructure, research, and governance reflects large investments in companies specifically building AI applications, such as OpenAI, Anthropic, and Inflection AI.

Figure 4.3.16 presents trends over time in AI focus area investments. As noted earlier, most focus areas saw declining investments in the last year. Conversely, some of the areas that saw growth since 2022 include AI infrastructure/research/governance and data management, processing. Although now still substantial, investments in medical and healthcare as well as NLP, customer support peaked in 2021 and have since then declined.

Private investment in AI by focus area, 2022 vs. 2023
Source: Quid, 2023 | Chart: 2024 AI Index report

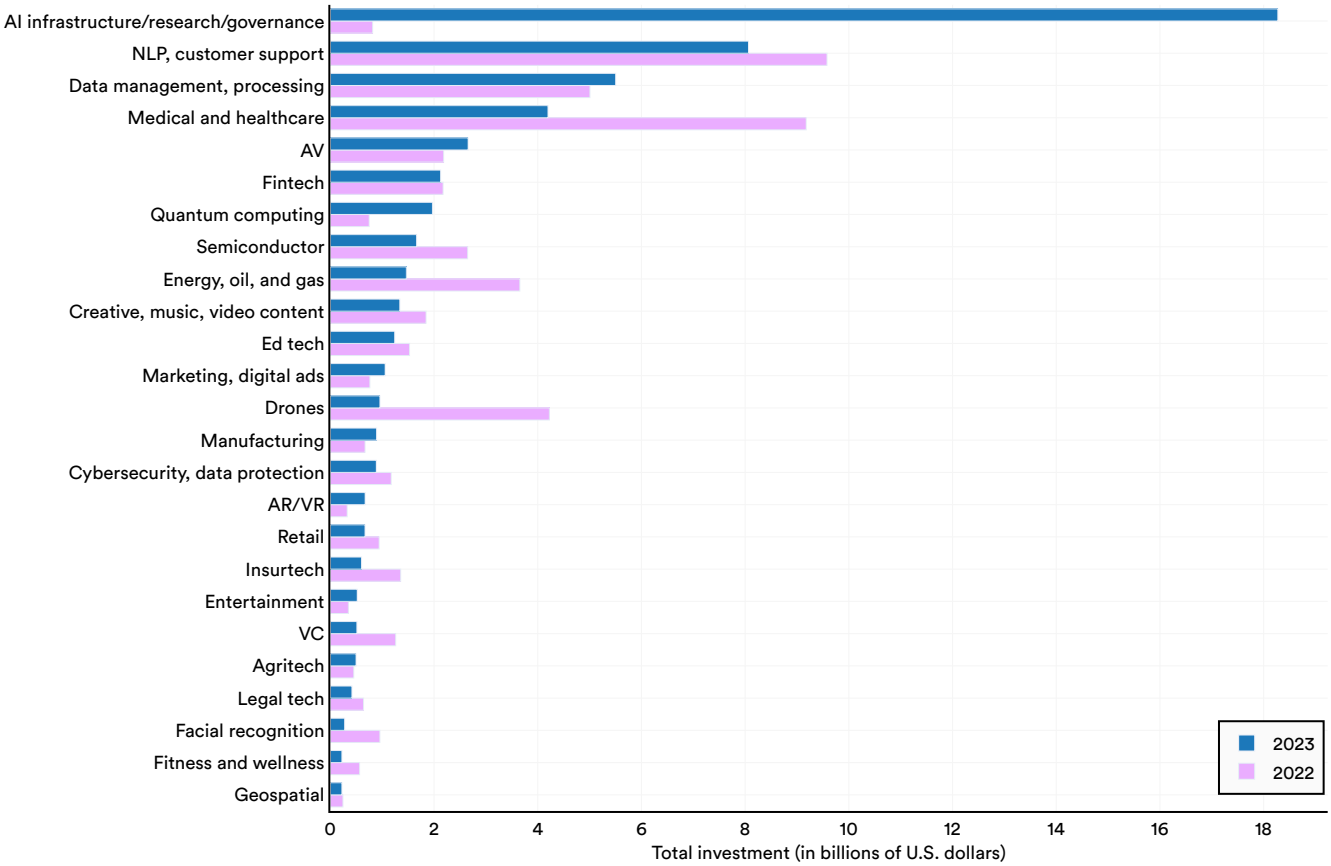


Figure 4.3.15

Private investment in AI by focus area, 2017–23

Source: Quid, 2023 | Chart: 2024 AI Index report

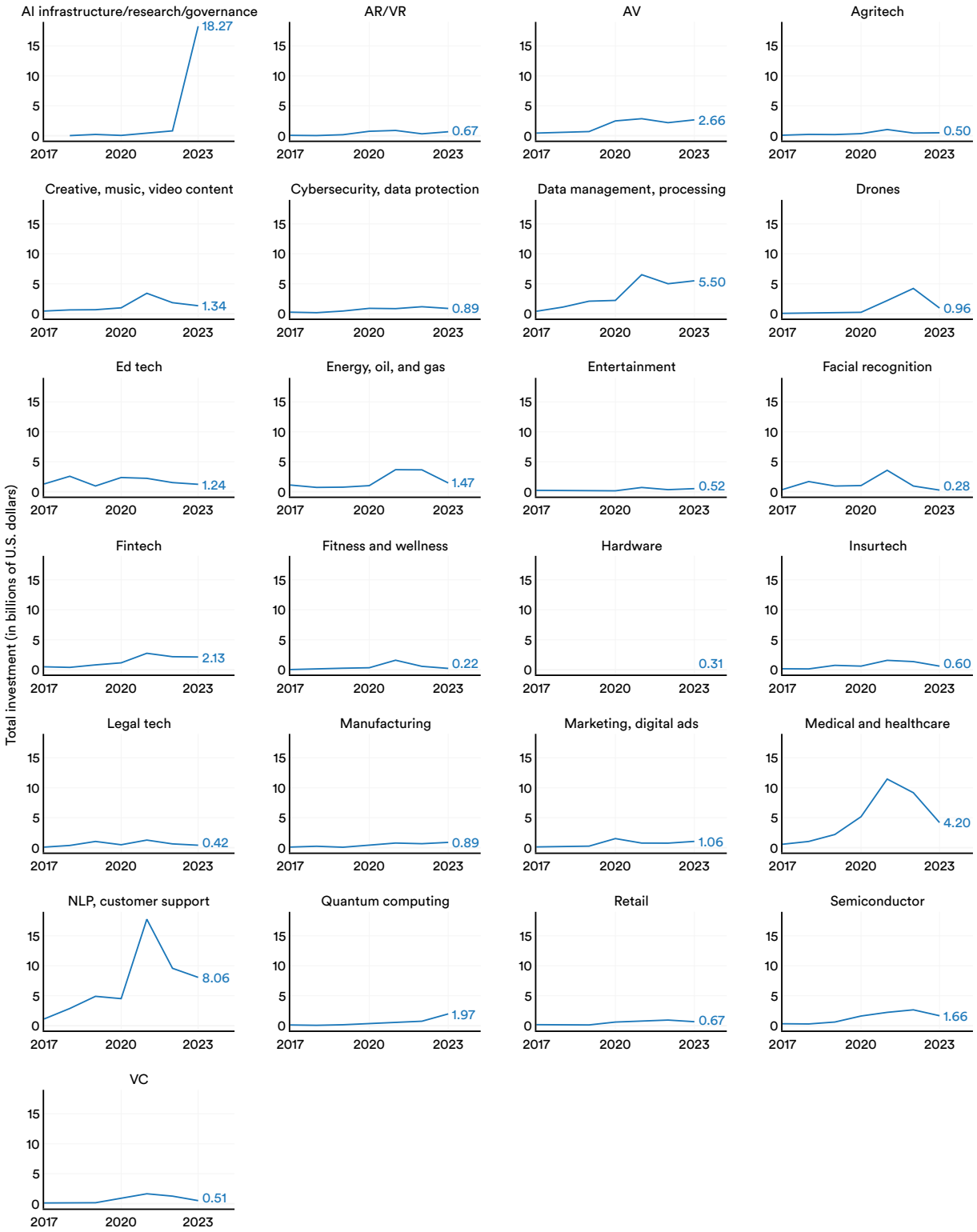


Figure 4.3.16

Finally, 4.3.17 shows private investment in AI by focus area over time within select geographic regions, highlighting how private investment priorities in AI differ across geographies. The significant increases observed in AI infrastructure/research/governance were mostly driven by investment in the United States. The United States significantly outpaces China and the European Union and United Kingdom in investment in almost all focus area categories. A notable exception is facial recognition, where 2023 investment totals were $90 million in the United States and $130 million in China. Likewise, in semiconductor investments, China ($630 million) is not far behind the United States ($790 million).

Private investment in AI by focus area and geographic area, 2017–23

Source: Quid, 2023 | Chart: 2024 AI Index report

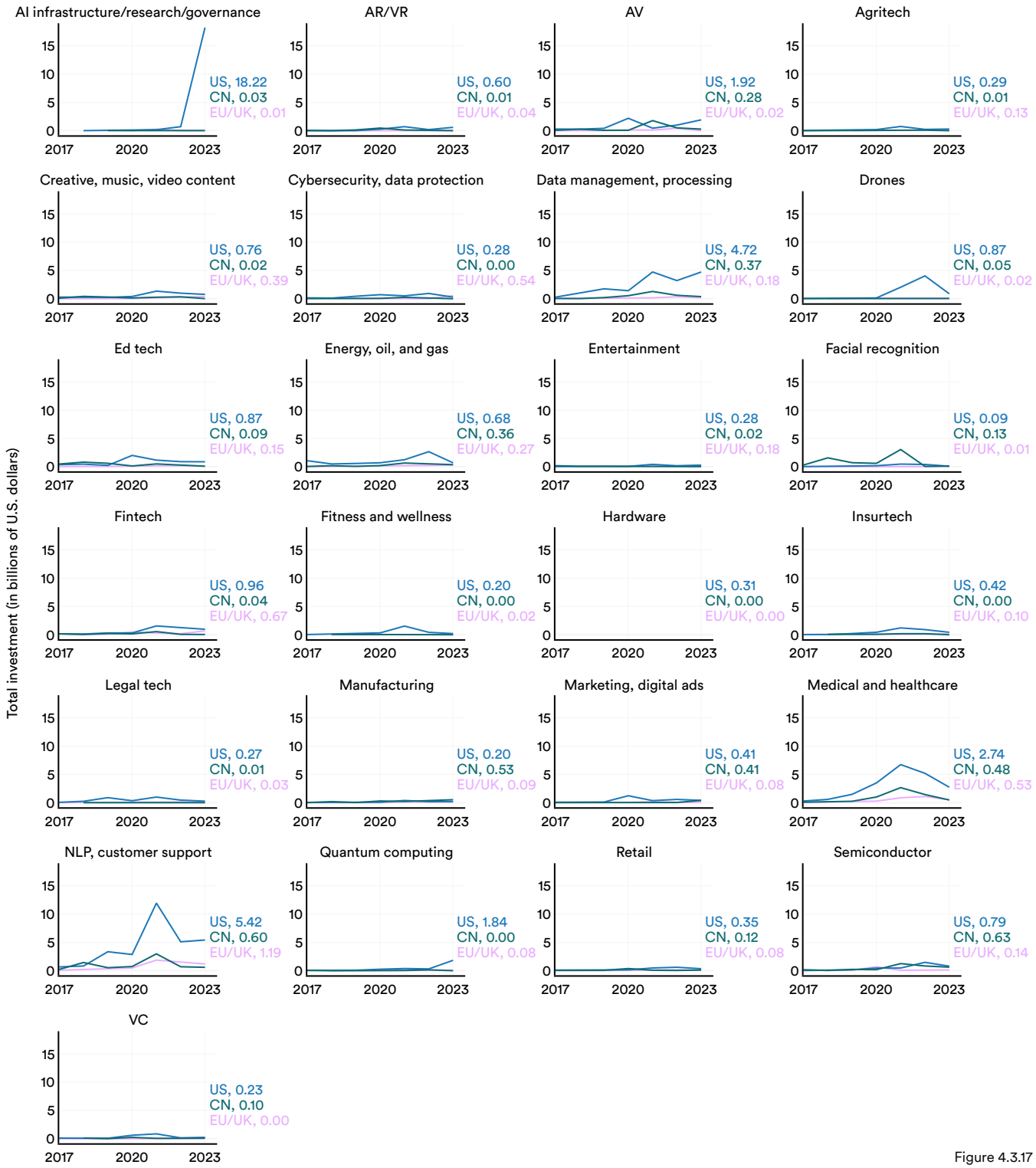


Figure 4.3.17

This section examines the practical application of AI by corporations, highlighting industry adoption trends, how businesses are integrating AI, the specific AI technologies deemed most beneficial, and the impact of AI adoption on financial performance.

4.4 Corporate Activity

Industry Adoption

This section incorporates insights from McKinsey's "The State of AI in 2023: Generative AI's Breakout Year," alongside data from prior editions. The 2023 McKinsey analysis is based on a survey of 1,684 respondents across various regions, industries, company sizes, functional areas, and tenures. For the first time, this year's version of the McKinsey survey included detailed questions about generative AI adoption and hiring trends for AI-related positions.

Adoption of AI Capabilities

The latest McKinsey report reveals that in 2023, 55% of organizations surveyed have implemented AI in at least one business unit or function, marking a slight increase from 50% in 2022 and a significant jump from 20% in 2017 (Figure 4.4.1). AI adoption has spiked over the past five years, and in the future, McKinsey expects to see even greater changes happening at higher frequencies, given the rate of both AI technical advancement and adoption.

Share of respondents who say their organizations have adopted AI in at least one function, 2017–23
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

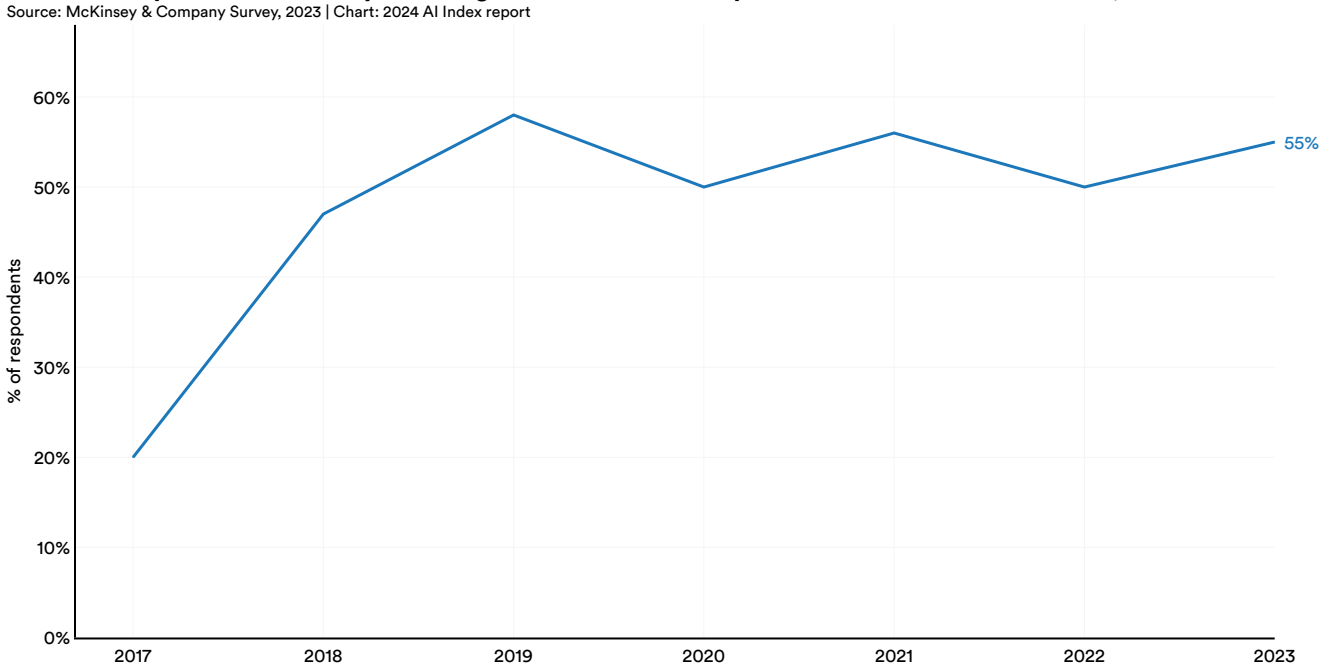


Figure 4.4.1

Figure 4.4.2 shows the proportion of surveyed companies that use AI for specific functions. Companies may report employing AI in multiple capacities. The most commonly adopted AI use case by function among surveyed businesses in 2023 was contact-center automation (26%), followed by personalization (23%), customer acquisition (22%), and AI-based enhancements of products (22%).[7]

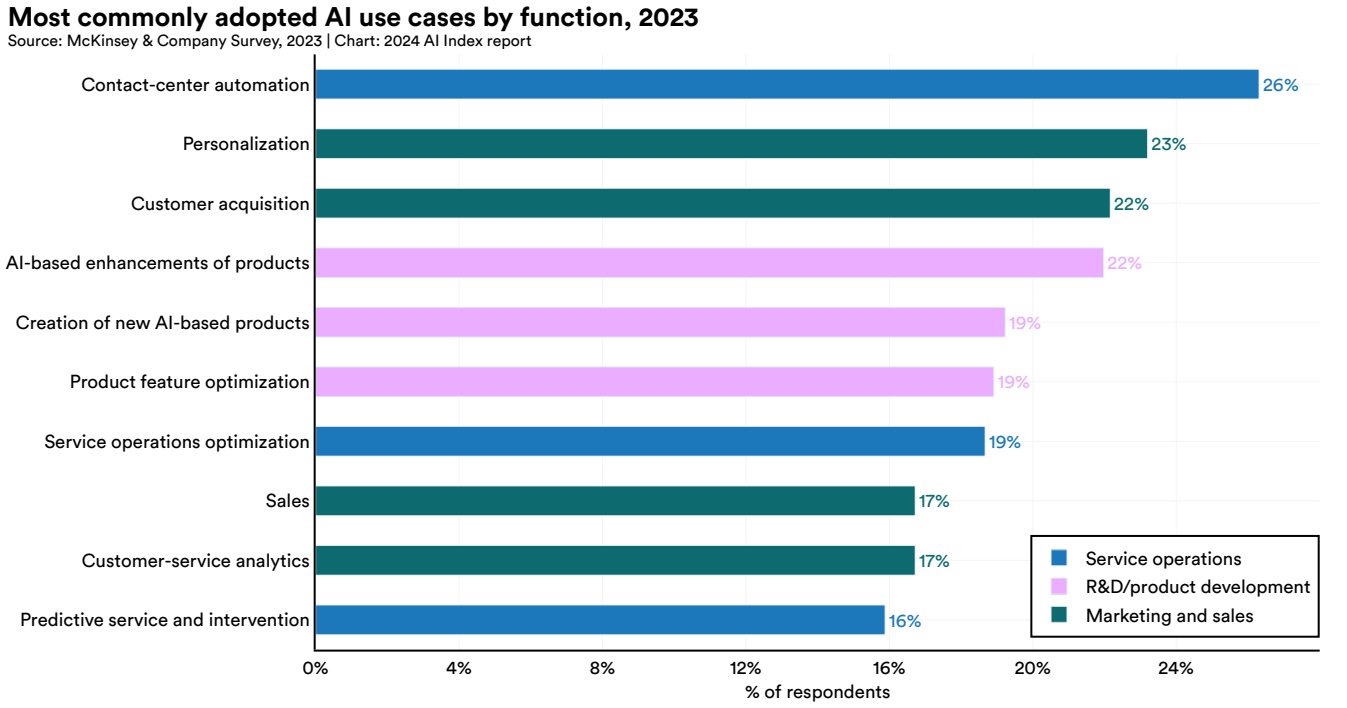


Figure 4.4.2

7 Personalization is the practice of tailoring products, services, content, recommendations, and marketing to the individual preferences of customers or users. For example, personalization can include sending tailored email messages to clients or customers to improve engagement.

With respect to the type of AI capabilities embedded in at least one function or business unit, as indicated by Figure 4.4.3, robotic process automation had the highest rate of embedding within the financial services industry (46%). The next highest rate of embedding was for virtual agents, also in the financial services industry. Across all industries, the most embedded AI technologies were NL text understanding (30%), robotic process automation (30%), and virtual agents (30%).

AI capabilities embedded in at least one function or business unit, 2023
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

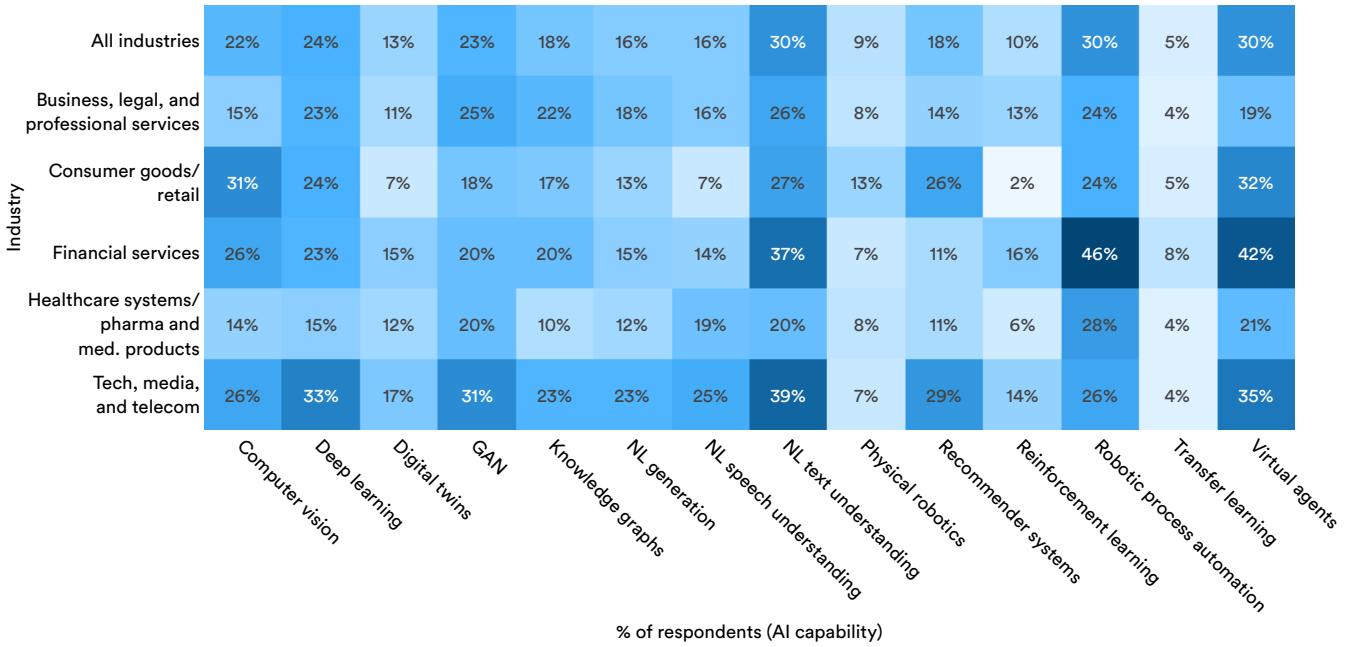


Figure 4.4.3

Figure 4.4.4 shows AI adoption by industry and AI function in 2023. The greatest adoption was in product and/or service development for tech, media, and telecom (44%); followed by service operations for tech, media, and telecom (36%) and marketing and sales for tech, media, and telecom (36%).

AI adoption by industry and function, 2023
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

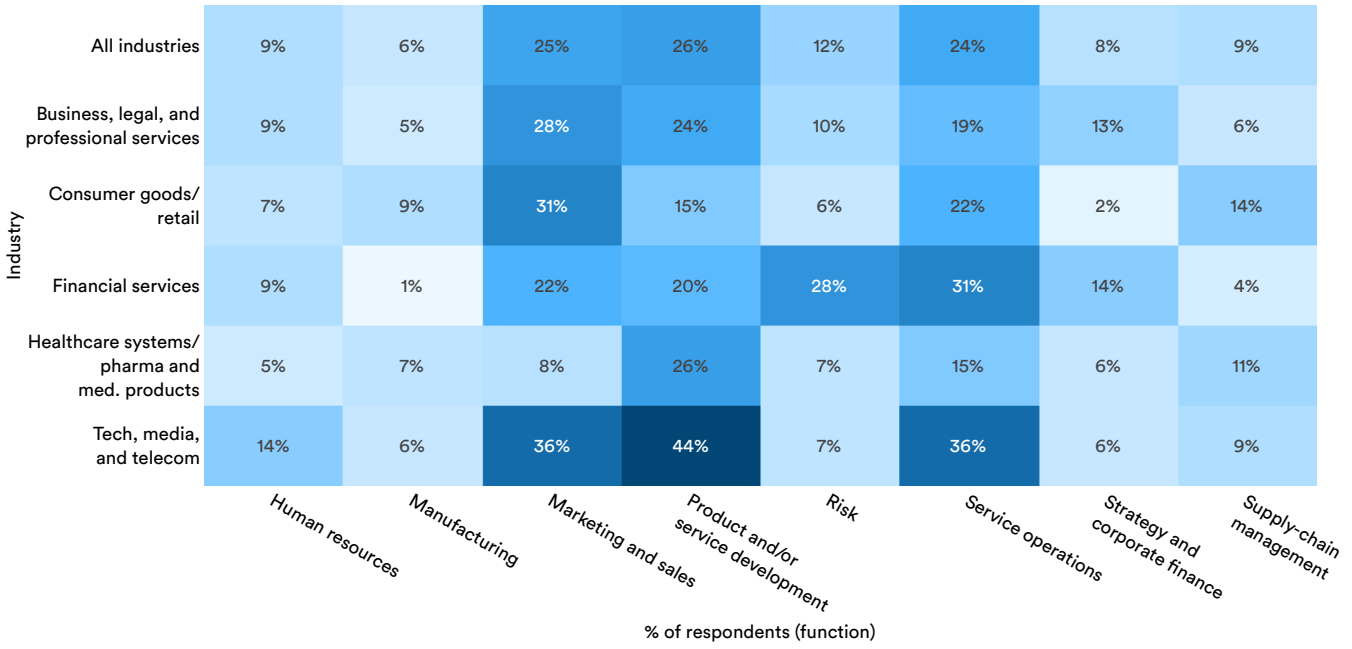


Figure 4.4.4

Figure 4.4.5 illustrates the changes in AI adoption rates by industry and function from 2022 to 2023. The areas with the largest annual gains across all industries include marketing and sales (18 percentage points), product/service development (14), and service operations (4). Conversely, across all industries, the functions experiencing the most significant declines in adoption include strategy and corporate finance (-12 percentage points), risk (-9), and human resources (-2).

Percentage point change in responses of AI adoption by industry and function, 2022 vs. 2023
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

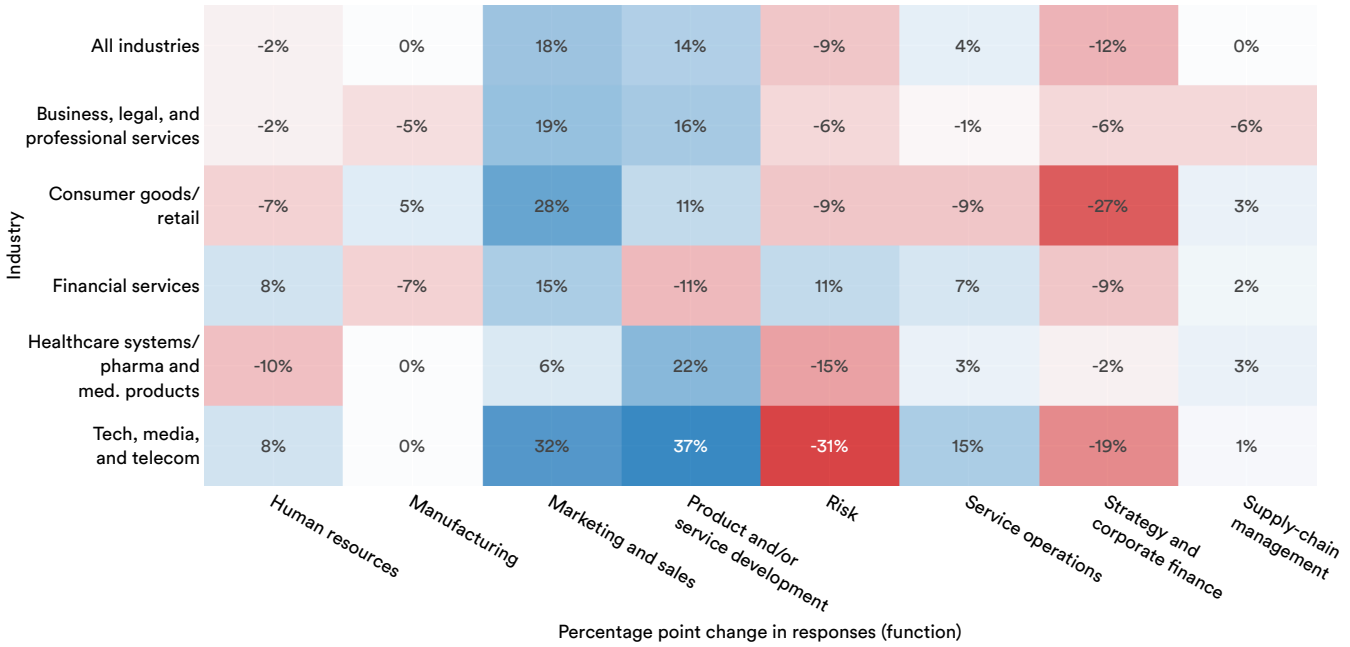


Figure 4.4.5

Figure 4.4.6 shows the percentage of surveyed respondents across industries who reported hiring for various AI positions. Across all industries, respondents reported hiring data engineers (36%), AI data scientists (31%), and machine-learning engineers (31%) to the greatest degree. Notably, a significant portion of respondents within the financial services (44%) and the tech, media, and telecom sectors (44%) reported a high rate of hiring machine-learning engineers.

AI-related roles that organizations hired in the last year by industry, 2023
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

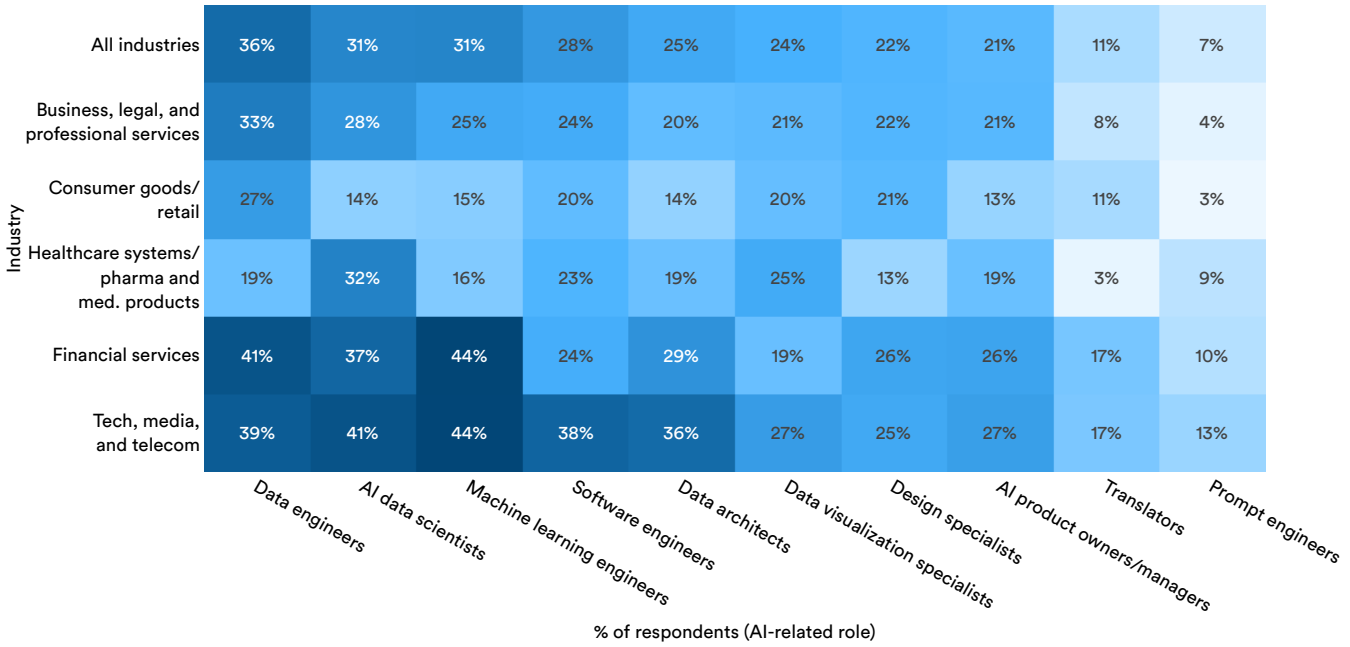


Figure 4.4.6

Organizations have experienced both cost reductions and revenue increases due to AI adoption (Figure 4.4.7). The areas where respondents most frequently reported cost savings were manufacturing (55%), service operations (54%), and risk (44%). For revenue gains, the functions benefiting the most from AI included manufacturing (66%), marketing and sales (65%), and risk (64%). Figure 4.4.7 shows a substantial number of respondents reporting cost decreases (42%) and revenue gains (59%) as a result of using AI, suggesting that AI tangibly helps businesses improve their bottom line. Comparing this and last year's averages reveals a 10 percentage point increase for cost decreases and a four percentage point decrease for revenue increases across all activities.

Cost decrease and revenue increase from AI adoption by function, 2022
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

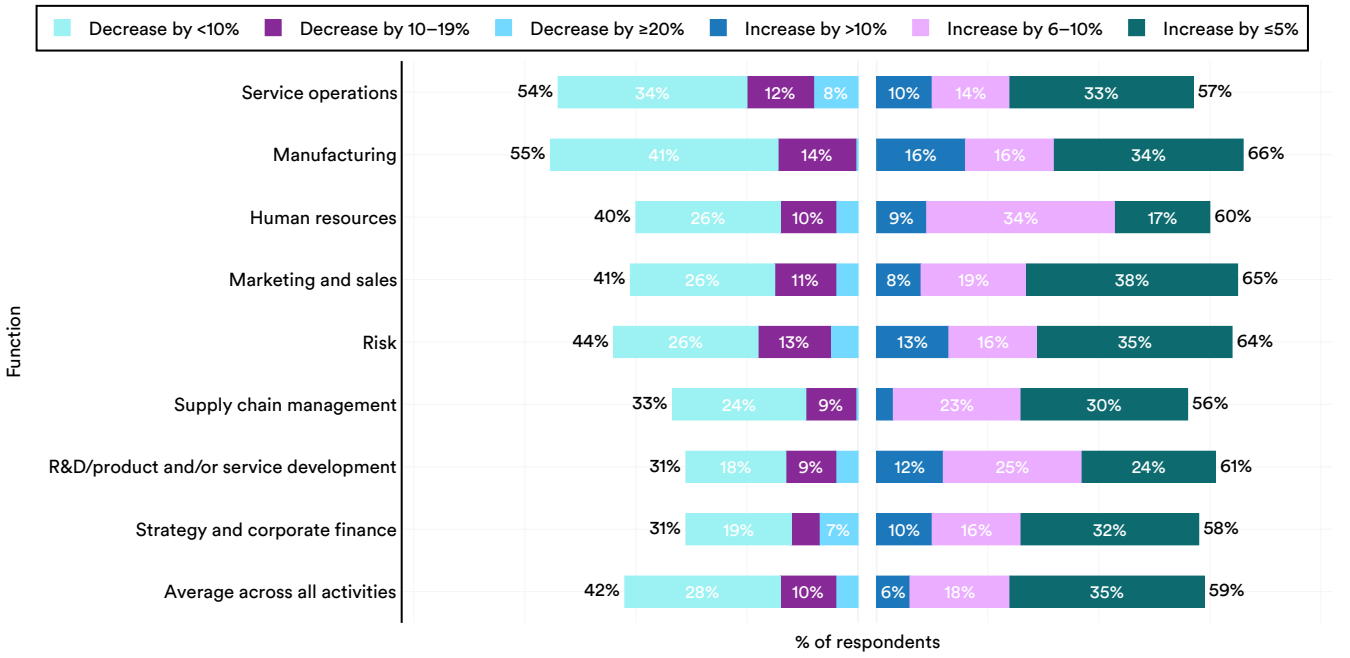


Figure 4.4.7

Figure 4.4.8 presents global AI adoption by organizations, segmented by world regions. In 2023, every surveyed region reported higher AI adoption rates than in 2022. The most significant year-over-year growth was seen in Europe, where organization adoption grew by 9 percentage points. North America remains the leader in AI adoption. Greater China also experienced a significant increase in AI adoption rates, growing by 7 percentage points over the previous year.

AI adoption by organizations in the world, 2022 vs. 2023
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

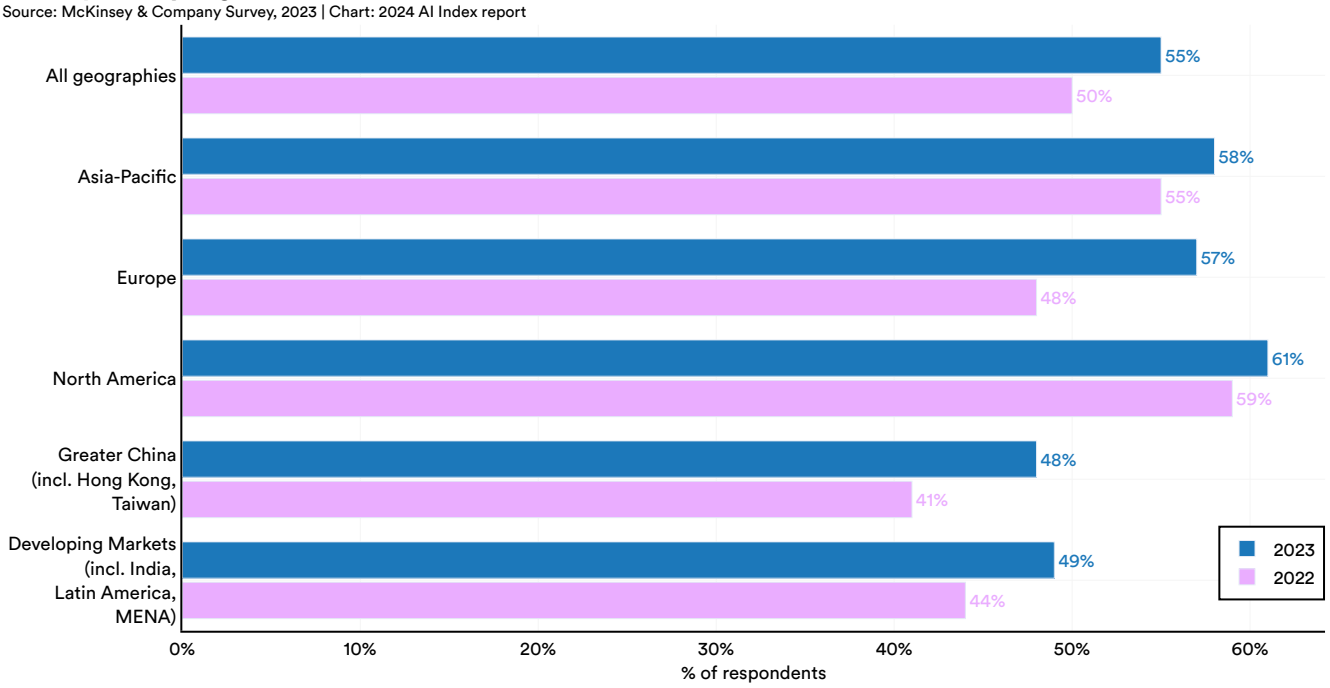


Figure 4.4.8

Adoption of Generative AI Capabilities

How are organizations deploying generative AI?[8] Figure 4.4.9 highlights the proportion of total surveyed respondents that report using generative AI for a particular function. It is possible for respondents to indicate that they deploy AI for multiple purposes.

The most frequent application is generating initial drafts of text documents (9%), followed closely by personalized marketing (8%), summarizing text documents (8%), and creating images and/or videos (8%). Most of the reported leading use cases are within the marketing and sales function.

Most commonly adopted generative AI use cases by function, 2023
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

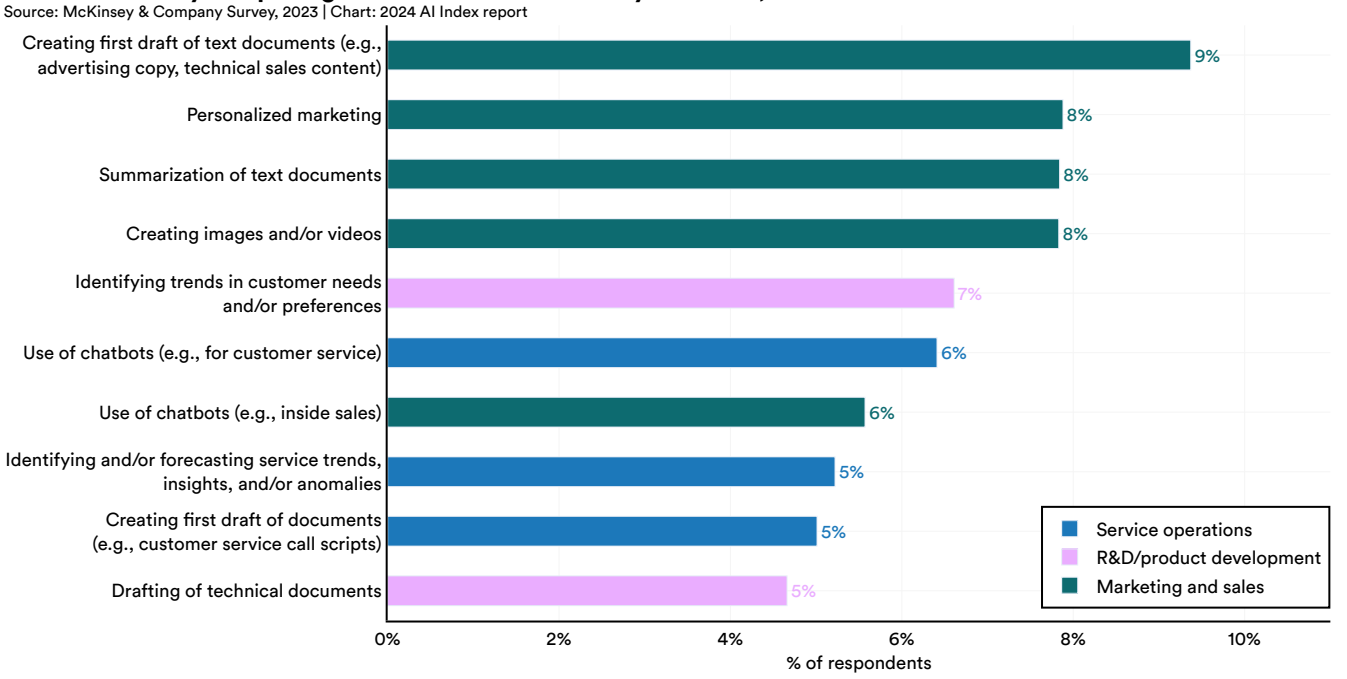


Figure 4.4.9

8 The adoption of generative AI capabilities is presented separately from the charts on the adoption of general AI capabilities earlier in the chapter, as it was a separate question in the survey.

Figure 4.4.10 compares the proportion of respondents who report using AI versus specifically generative AI for a given function.[9] Figure 4.4.10 illustrates the degree to which generative AI has permeated general AI usage patterns among businesses. When analyzed at the functional level, the use of AI and generative AI within organizations shows similar patterns of distribution. Overall, general AI still dominates. The most common functional applications of generative AI are in marketing and sales (14%), product and/or service development (13%), and service operations (10%).

AI vs. generative AI adoption by function, 2023

Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

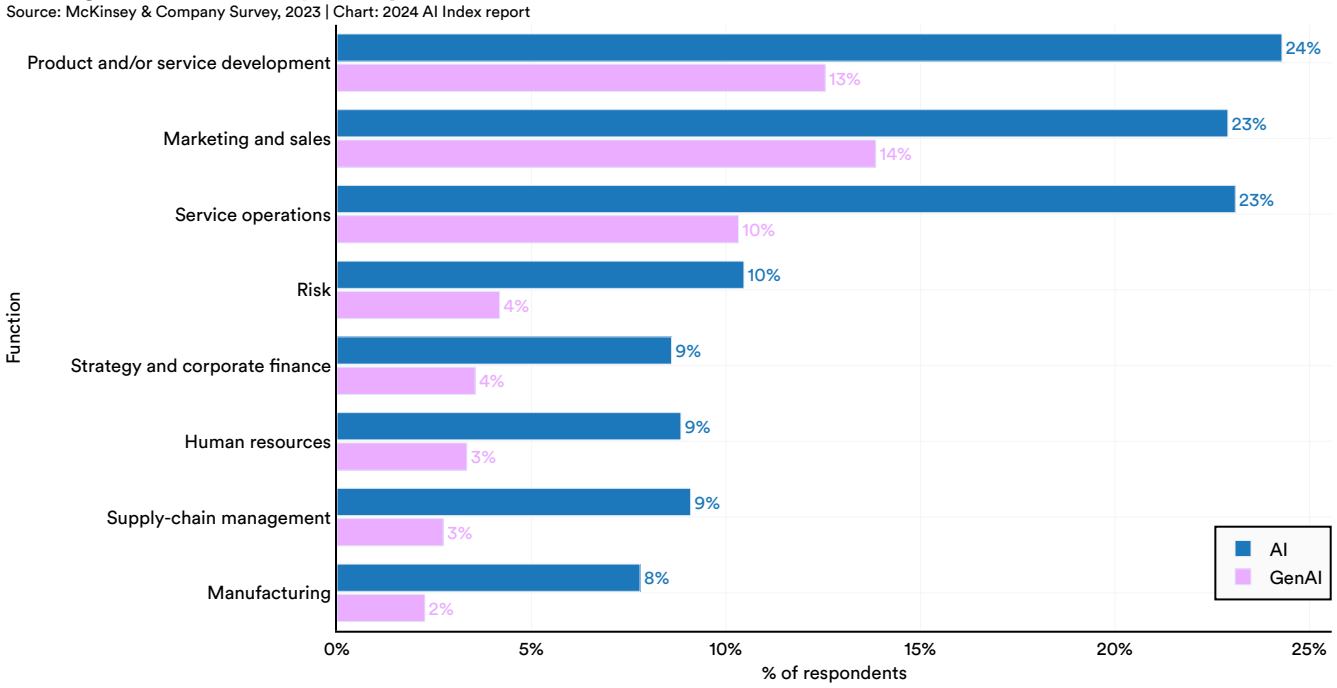


Figure 4.4.10

9 While all generative AI use cases are considered general AI use cases, not all general AI use cases qualify as generative AI use cases.

Figure 4.4.11 depicts the variation in generative AI usage among businesses across different regions of the world. Across all regions, the adoption rate of generative AI by organizations stands at 33%. This amount is meaningfully lower than the percentage of businesses across all geographies (55%) that reported using AI, which was documented earlier in Figure 4.4.8. North America leads in adoption at 40%, followed closely by developing markets (including India, Latin America, and the MENA region).

Generative AI adoption by organizations in the world, 2023

Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

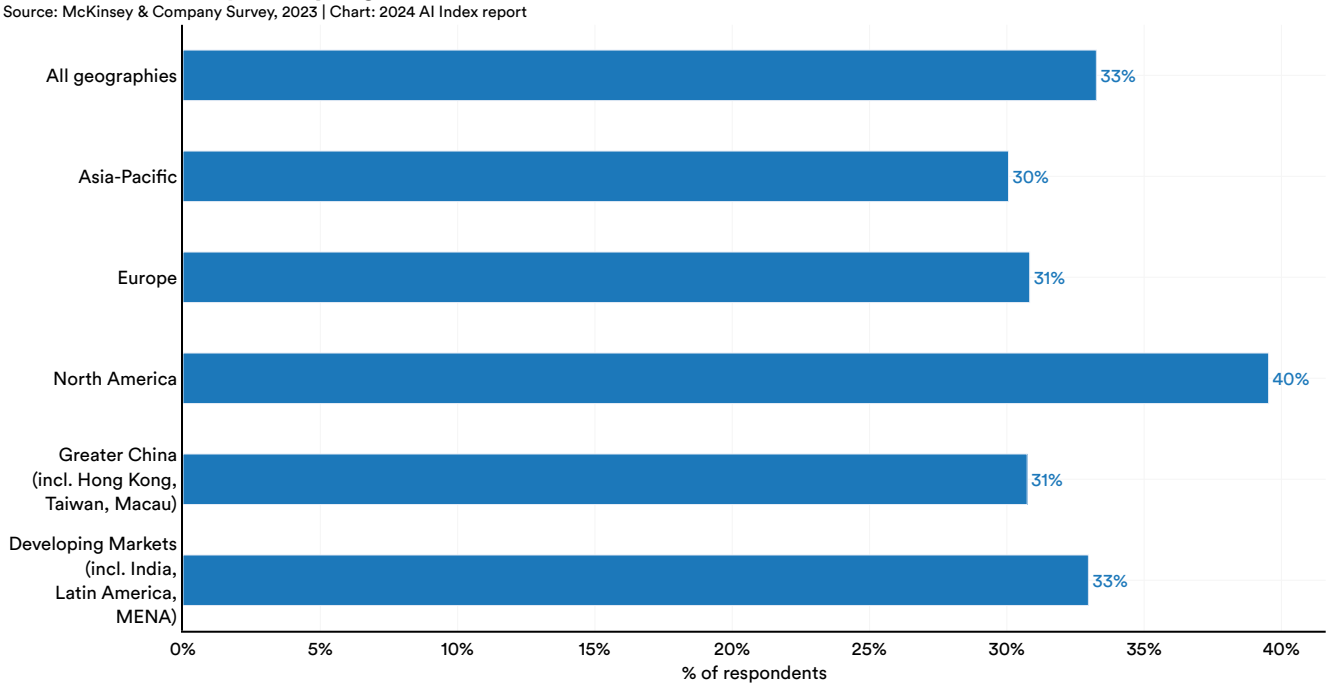


Figure 4.4.11

Use of AI by Developers

Computer developers are among the most likely individuals to use AI in professional settings. As AI becomes more integrated into the economy, tracking how developers utilize and perceive AI is becoming increasingly important.

Stack Overflow, a question-and-answer website for computer programmers, conducts an annual survey of computer developers. The 2023 survey, with responses from over 90,000 developers, included, for the first time, questions on AI tool usage—detailing how developers use these tools, which tools are favored, and their perceptions of the tools used.[10]

Preference

Figure 4.4.12 highlights the proportion of surveyed respondents who report using a specific AI developer tool. According to the survey, 56.0% of respondents report using GitHub's Copilot, followed by Tabnine (11.7%) and AWS CodeWhisperer (4.9%).

Figure 4.4.13 highlights which AI search tools, software applications that use AI to enhance search functionality, are most favored by AI developers. The most popular AI search tools according to professional developers were ChatGPT (83.3%), followed by Bing AI (18.8%) and WolframAlpha (11.2%).

Most popular AI developer tools among professional developers, 2023

Source: Stack Overflow Developer Survey, 2023 | Chart: 2024 AI Index report

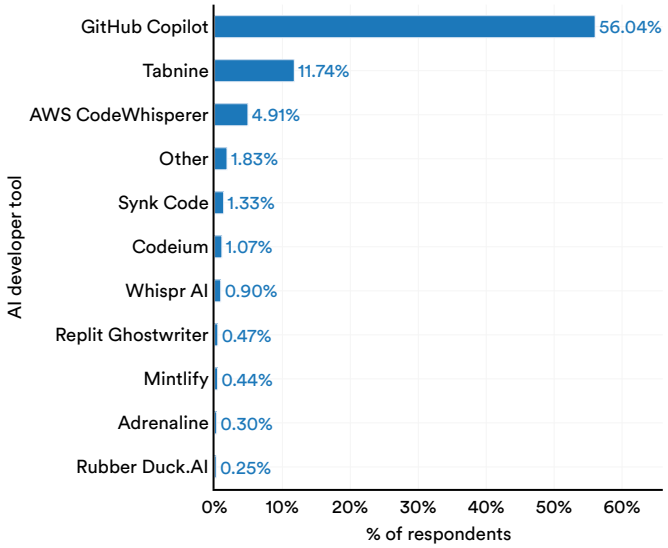


Figure 4.4.12

Most popular AI search tools among professional developers, 2023

Source: Stack Overflow Developer Survey, 2023 | Chart: 2024 AI Index report

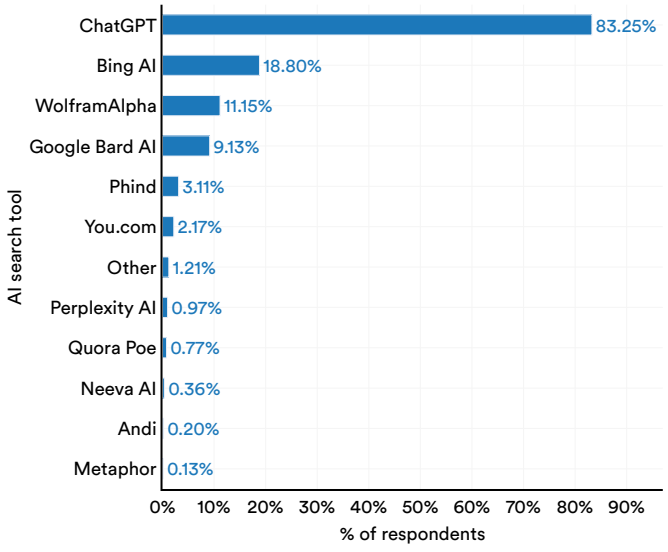


Figure 4.4.13

10 The survey was conducted in May 2023 and, therefore, may not account for the launch of more recently released AI tools such as Gemini and Claude 3.

Cloud platforms are crucial elements of the AI ecosystem, providing cloud computing services that allow developers to perform computationally intensive AI work. Figure 4.4.14 reports the proportion of respondents that have reported extensively using a specific cloud platform. According to the Stack Overflow survey, Amazon Web Services (AWS) is the most commonly used cloud platform among professional developers, with 53.1% reporting regular use. Microsoft Azure follows at 27.8%, with Google Cloud at 24.0%.

Workflow

Figure 4.4.15 explores the current and future integration of AI in developers' workflows. A significant majority of respondents, 82.6%, regularly use AI for code writing, followed by 48.9% for debugging and assistance, and 34.4% for documentation. While only 23.9% currently use AI for code testing, 55.2% express interest in adopting AI for this purpose.

Top 10 most popular cloud platforms among professional developers, 2023

Source: Stack Overflow Developer Survey, 2023 | Chart: 2024 AI Index report

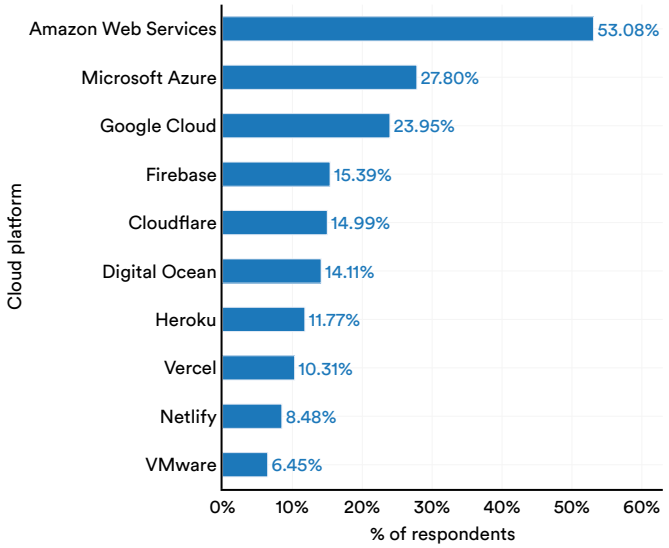


Figure 4.4.14

Adoption of AI tools in development tasks, 2023

Source: Stack Overflow Developer Survey, 2023 | Chart: 2024 AI Index report

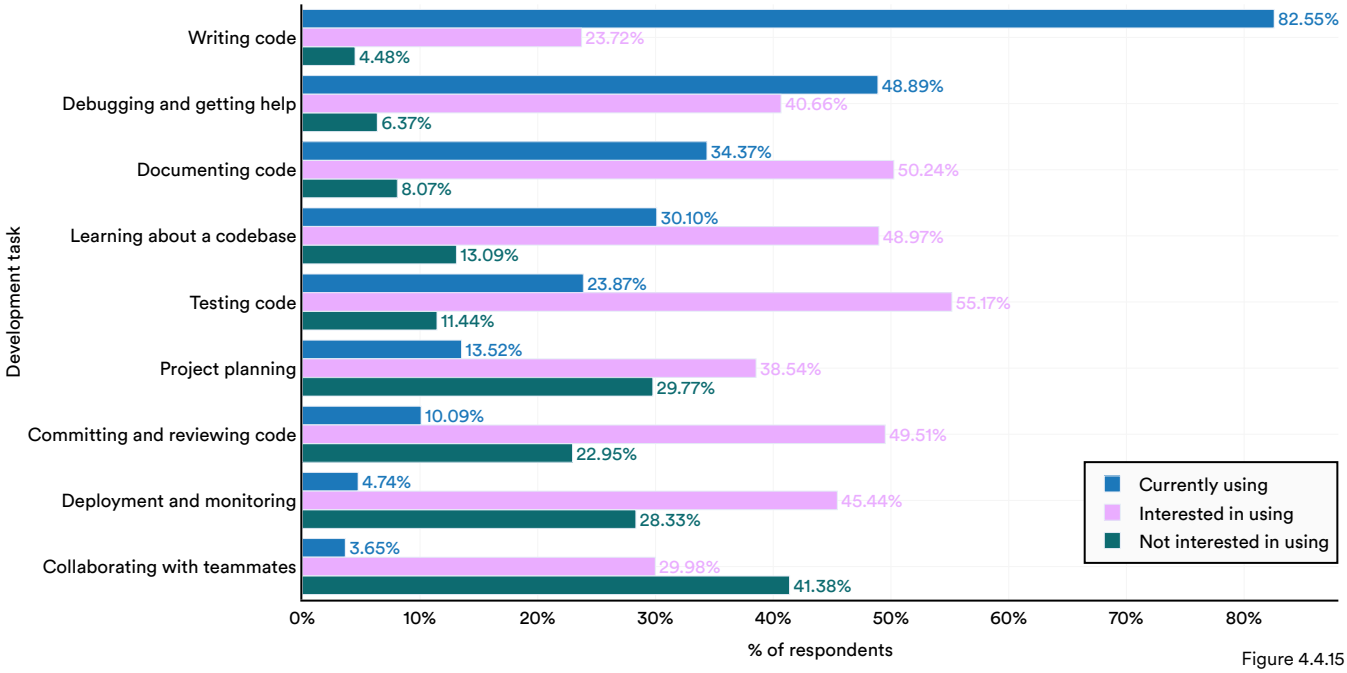


Figure 4.4.15

When asked about the primary advantages of AI tools in professional development, developers responded with increased productivity (32.8%), accelerated learning (25.2%), and enhanced efficiency (25.0%) (Figure 4.4.16).

Figure 4.4.17 displays the sentiments professional developers have toward AI tools. A significant majority of developers hold a positive view of AI tools, with 27.7% feeling very favorably and 48.4% favorably inclined toward them. Only 3.2% express unfavorable opinions about AI development tools.

Figure 4.4.18 highlights the reported level of trust developers have in AI tools. More developers trust AI tools than distrust them, with 42.2% reporting high or moderate trust in these technologies. In contrast, a smaller proportion, 27.2%, express some level of distrust or high distrust in AI tools.

Primary benefits of AI tools for professional developers, 2023

Source: Stack Overflow Developer Survey, 2023 | Chart: 2024 AI Index report

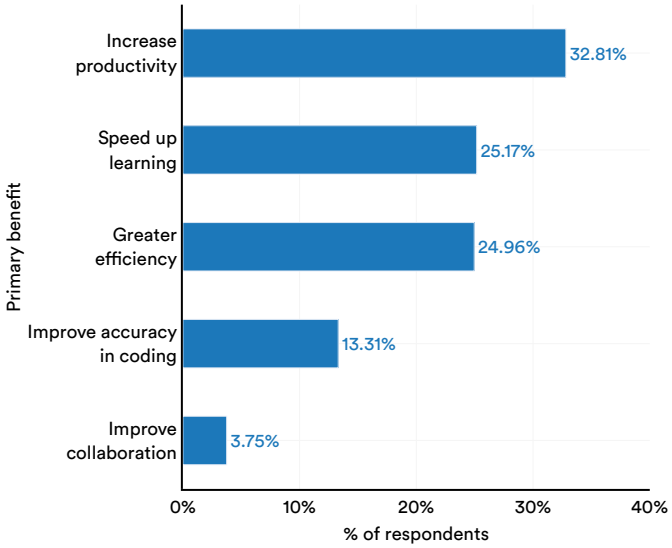


Figure 4.4.16

Sentiment toward AI tools in development among professional developers, 2023

Source: Stack Overflow Developer Survey, 2023 | Chart: 2024 AI Index report

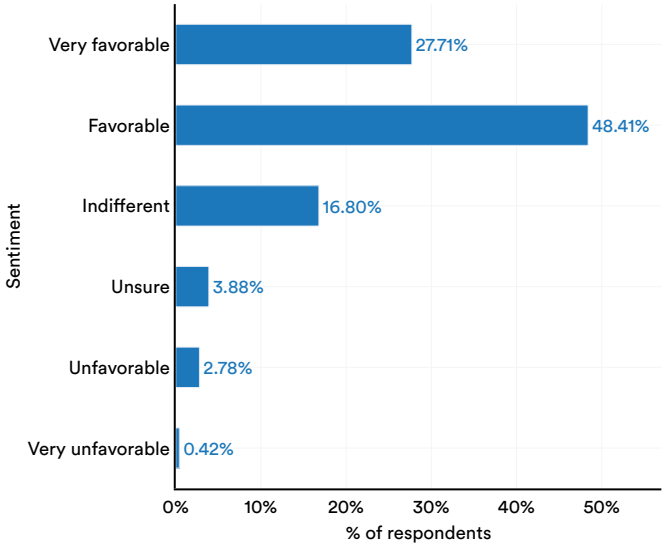


Figure 4.4.17

Trust level in AI tool output accuracy, 2023

Source: Stack Overflow Developer Survey, 2023 | Chart: 2024 AI Index report

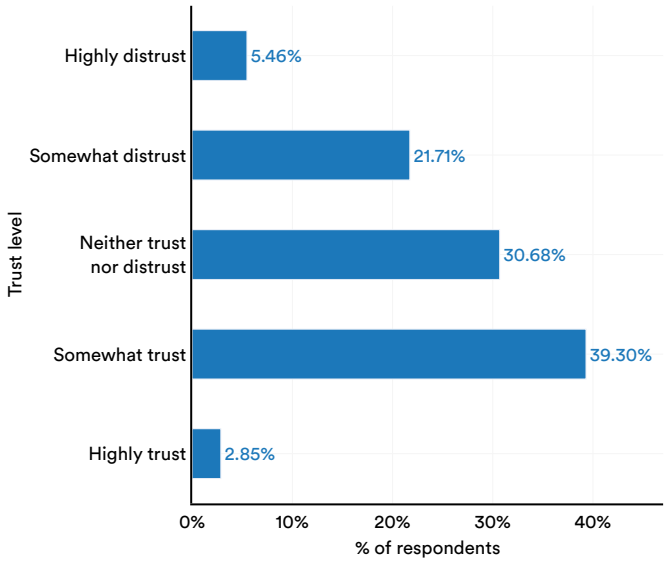


Figure 4.4.18

AI's Labor Impact

Over the last five years, the growing integration of AI into the economy has sparked hopes of boosted productivity. However, finding reliable data confirming AI's impact on productivity has been difficult because AI integration has historically been low. In 2023, numerous studies rigorously examined AI's productivity impacts, offering more conclusive evidence on the topic

First, AI has been shown to enable workers to complete tasks more quickly and produce higher quality work. A meta-review by Microsoft, which aggregated studies comparing the performance of workers using Microsoft Copilot or GitHub's Copilot—LLM-based productivity-enhancing tools—with those who did not, found that Copilot users completed tasks in 26% to 73% less time than their counterparts without AI access (Figure 4.4.19).[11]

Cross-study comparison of task completion speed of Copilot users

Source: Cambon et al., 2023 | Chart: 2024 AI Index report

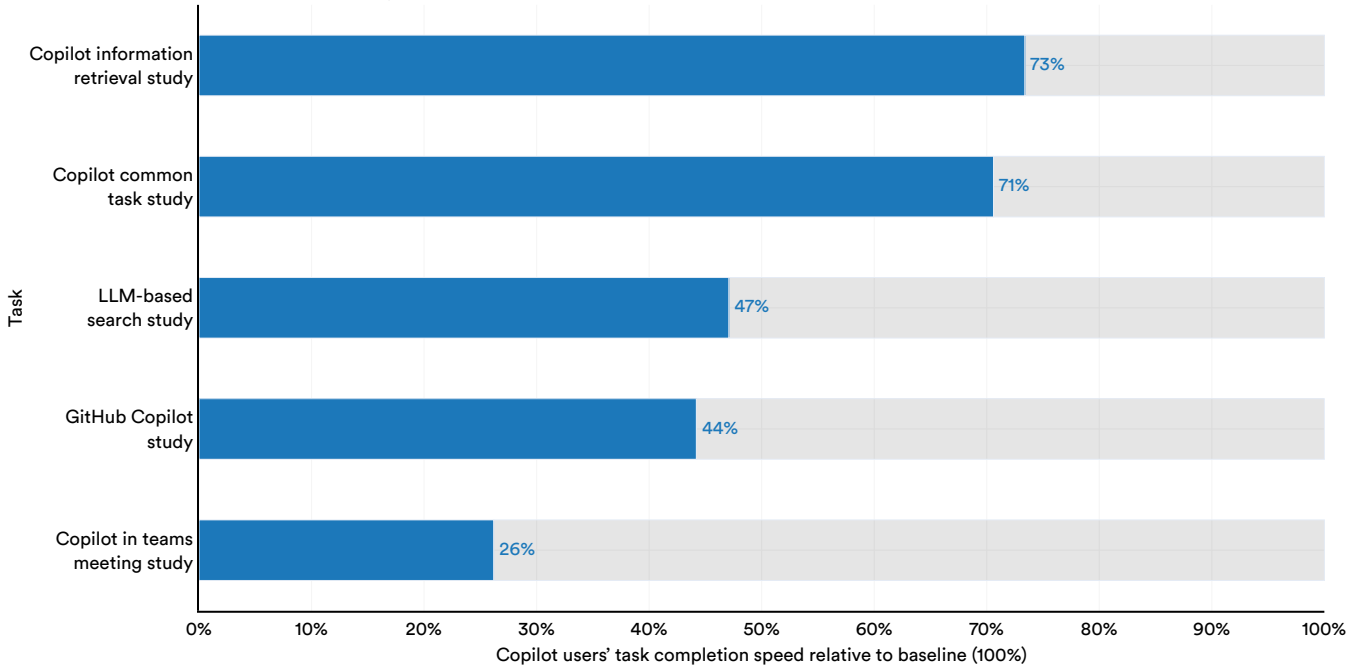


Figure 4.4.19

11 This meta-review analyzed separate surveys of workers using Microsoft's Copilot and GitHub's Copilot tools. These are separate tools. Microsoft Copilot is a broader LLM-based productivity improvement tool, while GitHub's Copilot is a code-writing assistant.

Similarly, a Harvard Business School study revealed that consultants with access to GPT-4 increased their productivity on a selection of consulting tasks by 12.2%, speed by 25.1%, and quality by 40.0%, compared to a control group without AI access (Figure 4.4.20). Likewise, National Bureau of Economic Research research reported that call-center agents using AI handled 14.2% more calls per hour than those not using AI (Figure 4.4.21).

Effect of GPT-4 use on a group of consultants
Source: Dell'Acqua et al., 2023 | Chart: 2024 AI Index report

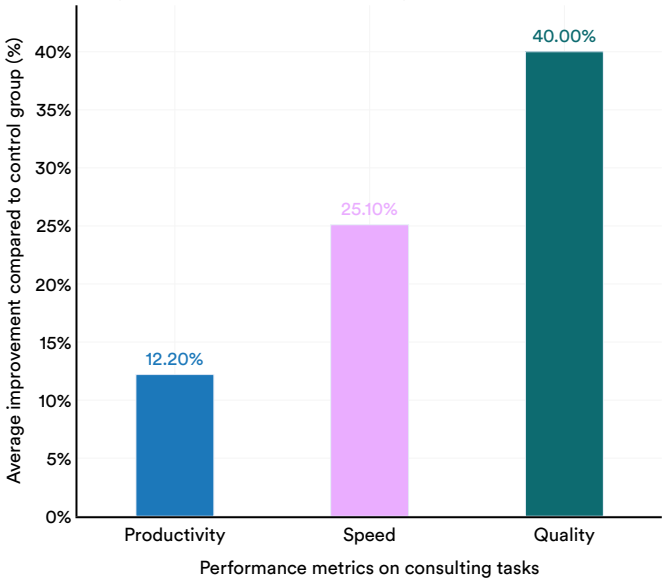


Figure 4.4.20

Impact of AI on customer support agents
Source: Brynjolfsson et al., 2023 | Chart: 2024 AI Index report

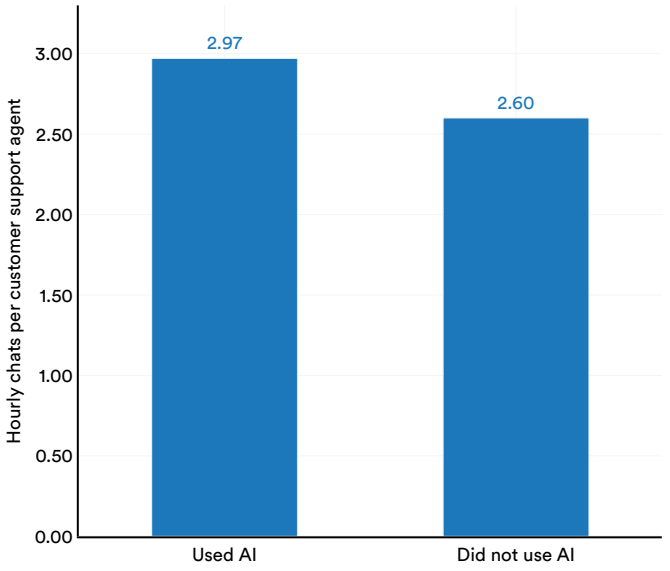


Figure 4.4.21

A study on the impact of AI in legal analysis showed that teams with GPT-4 access significantly improved in efficiency and achieved notable quality improvements in various legal tasks, especially contract drafting. Figure 4.4.22 illustrates the improvements observed in the group of law students who utilized GPT-4, compared to the control group, in terms of both work quality and time efficiency across a range of tasks. Although AI can assist with legal tasks, there are also widespread reports of LLM hallucinations being especially pervasive in legal tasks.

Effect of GPT-4 use on legal analysis by task
Source: Choi et al., 2023 | Chart: 2024 AI Index report

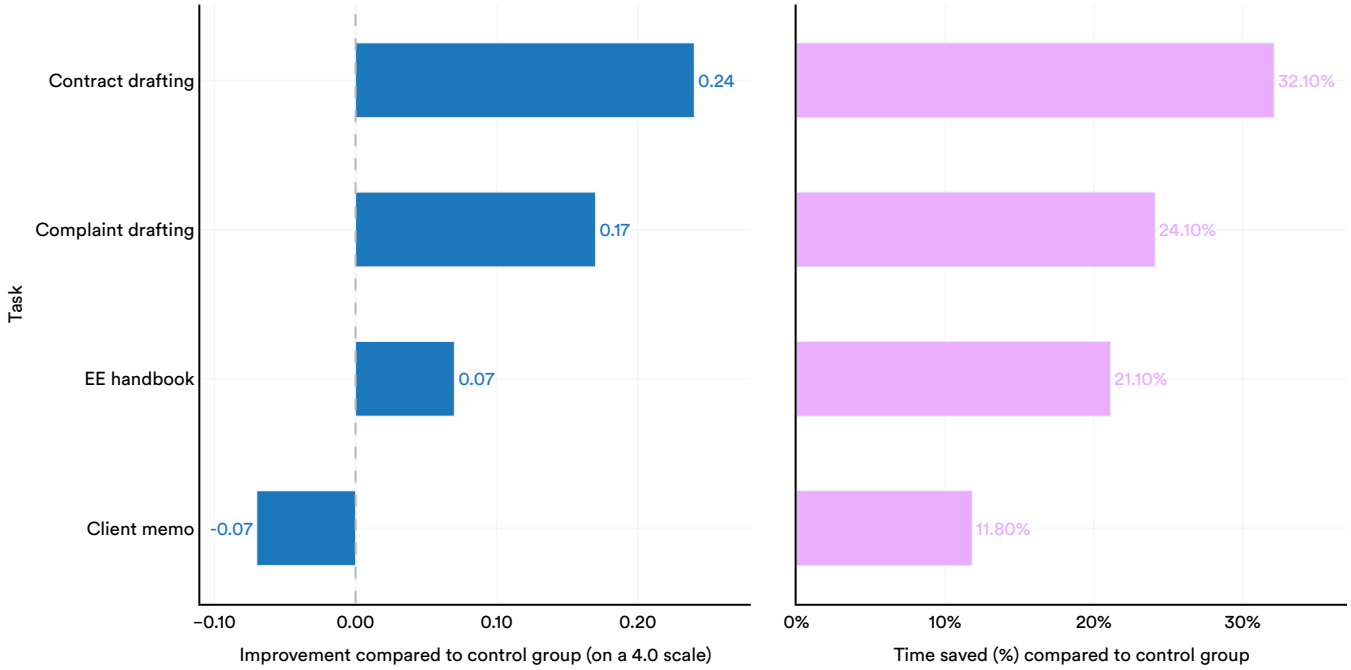


Figure 4.4.22

Second, AI access appears to narrow the performance gap between low- and high-skilled workers. According to the aforementioned Harvard Business School study, both groups of consultants experienced performance boosts after adopting AI, with notably larger gains for lower-skilled consultants using AI compared to higher-skilled consultants. Figure 4.4.23 highlights the performance improvement across a set of tasks for participants of varying skill levels: Lower-skilled (bottom half) participants exhibited a 43.0% improvement, while higher-skilled (top half) participants showed a 16.5% increase. While higher-skilled workers using AI still performed better than their lower-skilled, AI-using counterparts, the disparity in performance between low- and high-skilled workers was markedly lower when AI was utilized compared to when it was not.

Comparison of AI work performance effect by worker skill category
Source: Dell'Acqua et al., 2023 | Chart: 2024 AI Index report

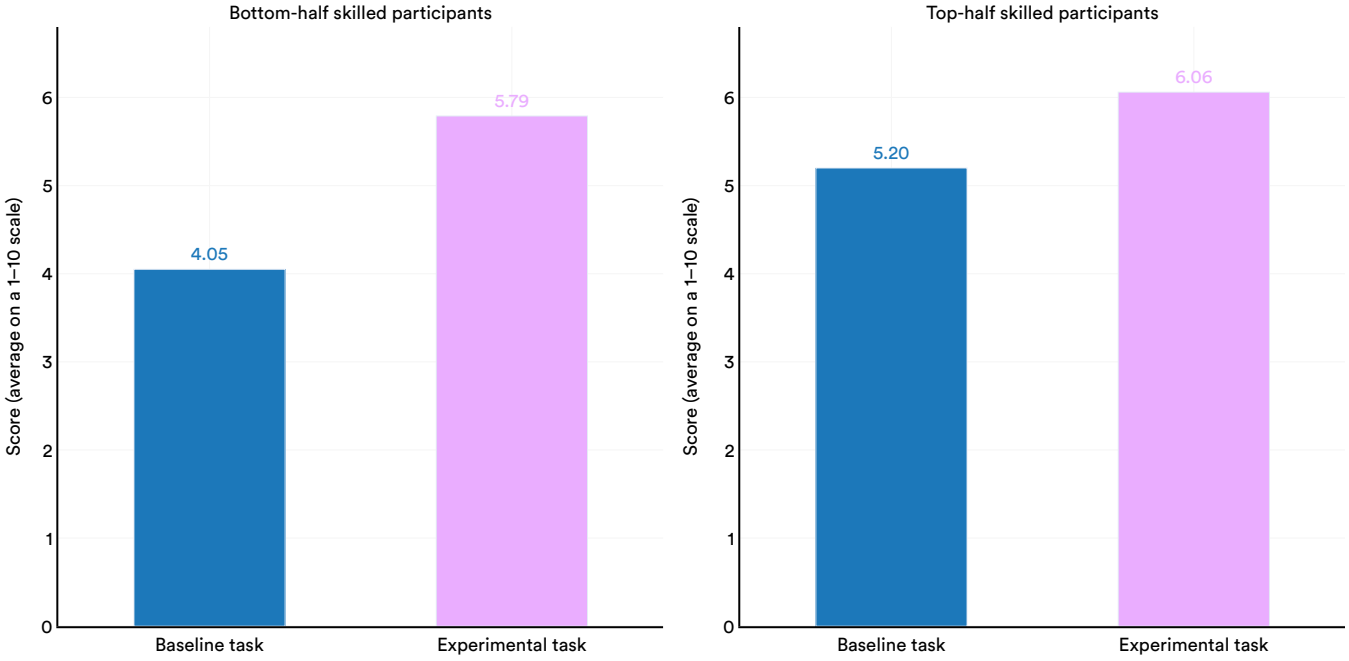


Figure 4.4.23

Finally, while AI tends to enhance quality and productivity, overreliance on the technology can impair worker performance. A study focused on professional recruiters reviewing résumés found that receiving any AI assistance improved task accuracy by 0.6 points compared to not receiving AI assistance. However, recruiters who were provided with "good AI"—believed to be high-performing—actually performed worse than those who received "bad AI," which was capable but known to make errors (Figure 4.4.24). The performance difference between the latter groups was -1.08 points. The study theorizes that recruiters using "good AI" became complacent, overly trusting the AI's results, unlike those using "bad AI," who were more vigilant in scrutinizing AI output.

Effects on job performance of receiving different types of AI advice

Source: Dell'Acqua, 2023 | Chart: 2024 AI Index report

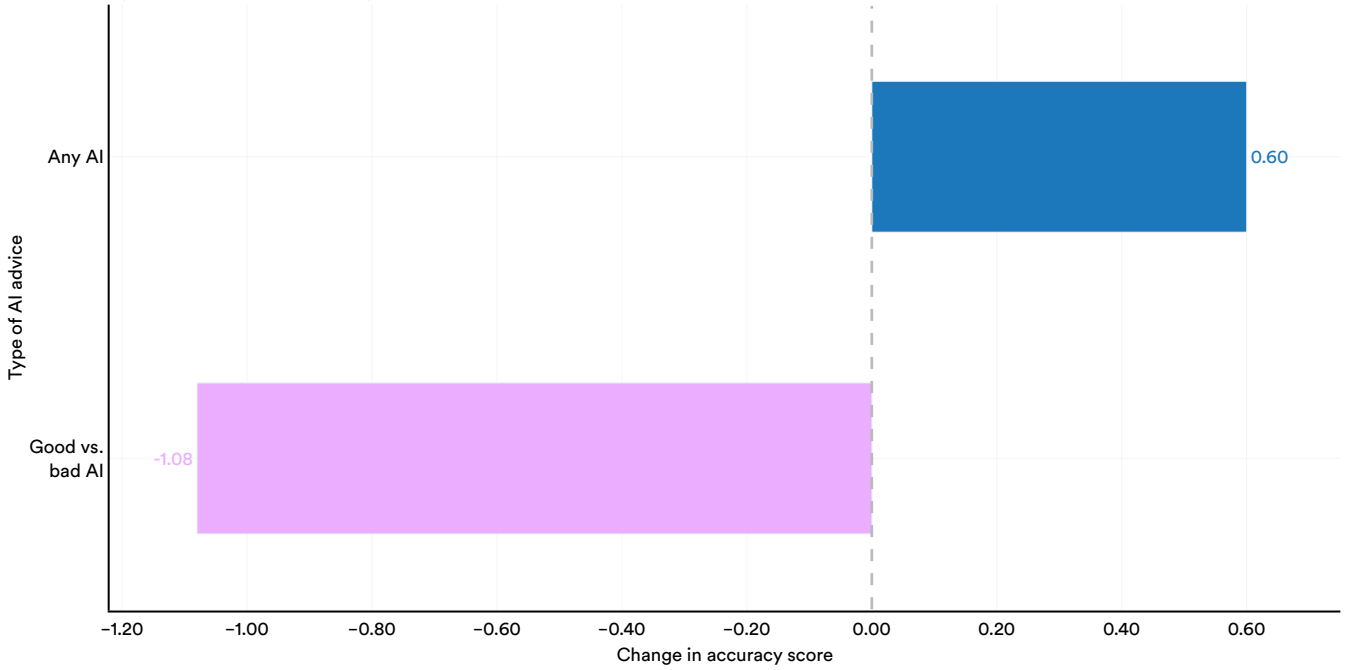


Figure 4.4.24

Earnings Calls

The following section presents data from Quid, which uses natural language processing tools to analyze trends in corporate earnings calls. Quid analyzed all 2023 earnings calls from Fortune 500 companies, identifying all mentions of "artificial intelligence," "AI," "machine learning," "ML," and "deep learning."

Aggregate Trends

The past year has seen a significant rise in the mention of AI in Fortune 500 company earnings calls. In 2023, AI was mentioned in 394 earnings calls (nearly 80% of all Fortune 500 companies), up from 266 mentions in 2022 (Figure 4.4.25). Since 2018, mentions of AI in Fortune 500 earnings calls have nearly doubled.

Number of Fortune 500 earnings calls mentioning AI, 2018–23
Source: Quid, 2023 | Chart: 2024 AI Index report

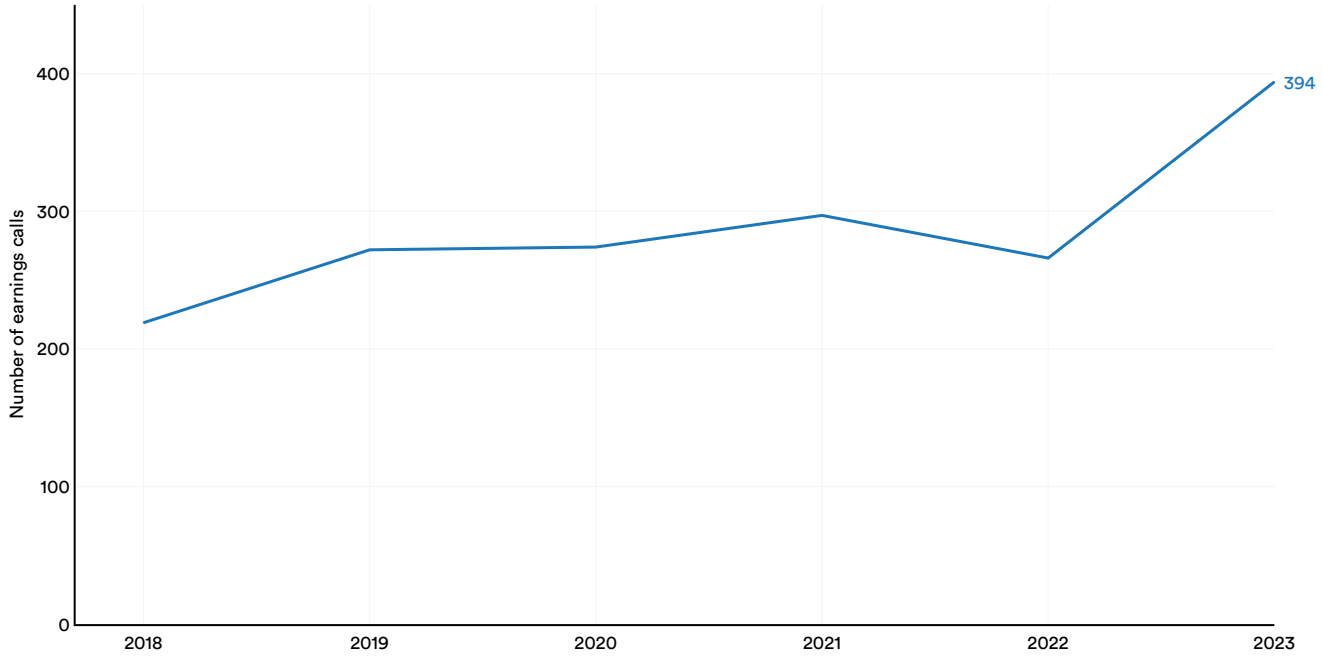


Figure 4.4.25

Specific Themes

Mentions of AI in Fortune 500 earnings calls were associated with a wide range of themes in 2023. The most frequently cited theme, appearing in 19.7% of all earnings calls, was generative AI (Figure 4.4.26).

Mentions of generative AI grew from 0.31% in 2022. The next most mentioned theme was investments in AI, expansion of AI capabilities, and AI growth initiatives (15.2%), followed by company/brand AIs (7.6%).

Themes of AI mentions in Fortune 500 earnings calls, 2018 vs. 2023

Source: Quid, 2023 | Chart: 2024 AI Index report

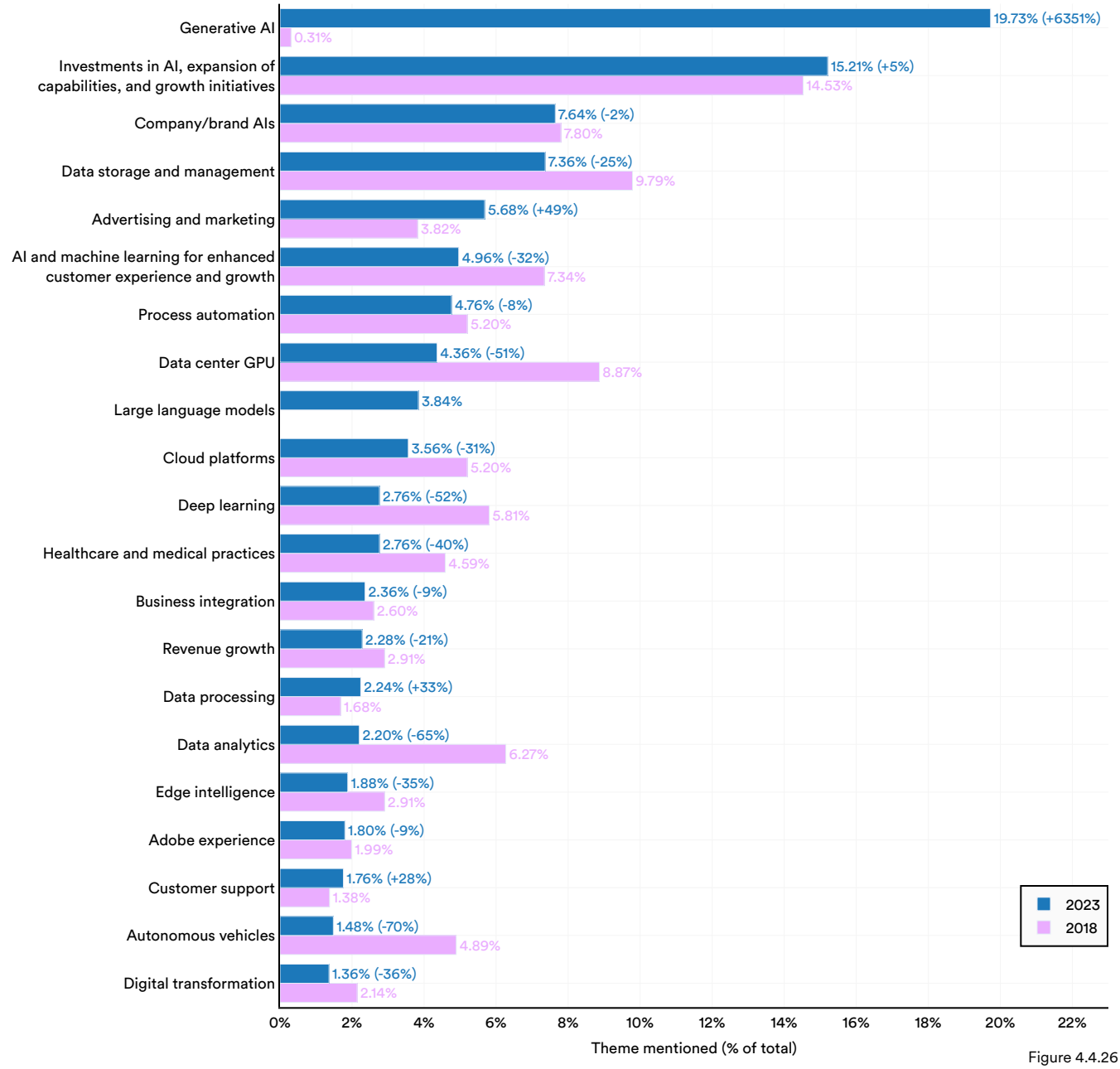


Figure 4.4.26

Highlight:

Projecting AI's Economic Impact

In 2023, some newly published analyses aimed to project and better understand the future economic impact of AI. A recent McKinsey report examined the degree to which generative AI might impact revenues across industries. Figure 4.4.27 features the projected impact range per industry, both as a percentage of total industry revenue and in total dollar amounts. The report projects that the high-tech industry could see its revenue increase by 4.8% to 9.3%, corresponding to an additional $240 billion to $460 billion, as a result of generative AI. Banking, pharmaceuticals and medical products, and education are other industries estimated to grow due to the adoption of generative AI.

Anticipated impact of generative AI on revenue by industry, 2023
Source: McKinsey & Company, 2023 | Chart: 2024 AI Index report

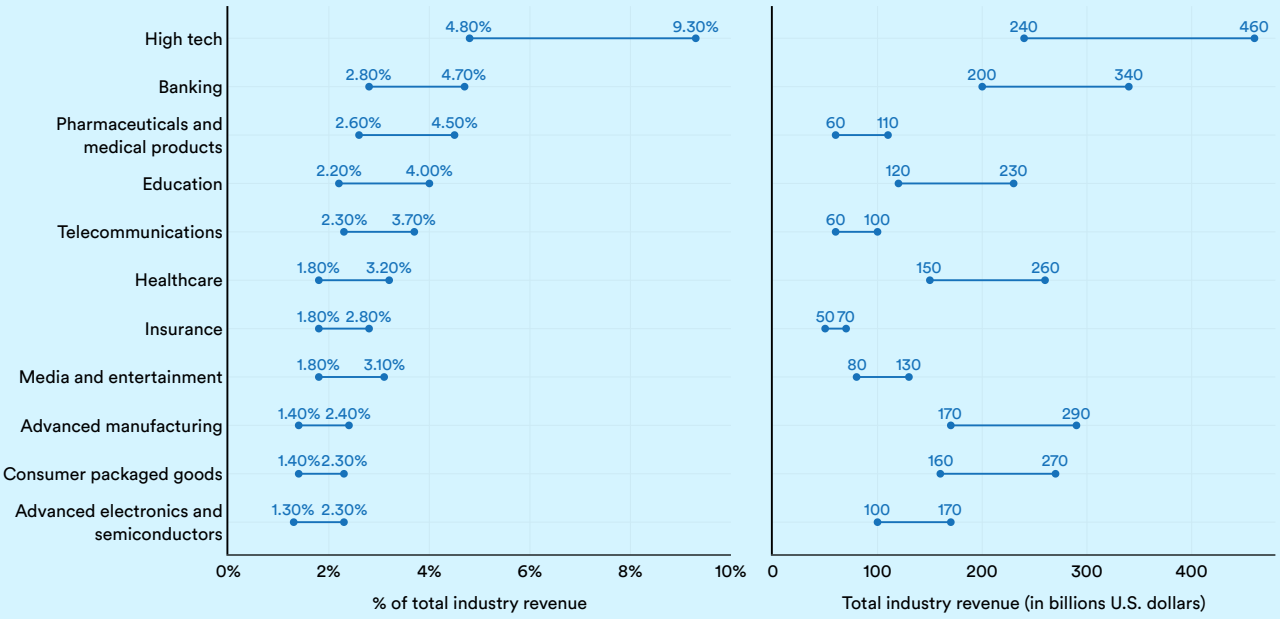


Figure 4.4.27

Highlight:

Projecting AI's Economic Impact (cont'd)

The McKinsey survey cited above, the "State of AI in 2023," asked business professionals about their expectations of AI's impact on organizational workforces in the next three years. Although a large proportion (30%) expected little to no change in the number of employees, 43% felt that staff size would decrease (Figure 4.4.28). Only 15% felt that generative AI would lead to increases in the number of employees. There were also widespread predictions that AI would lead to significant employee reskilling.

Expectations about the impact of AI on organizations' workforces in the next 3 years, 2023
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

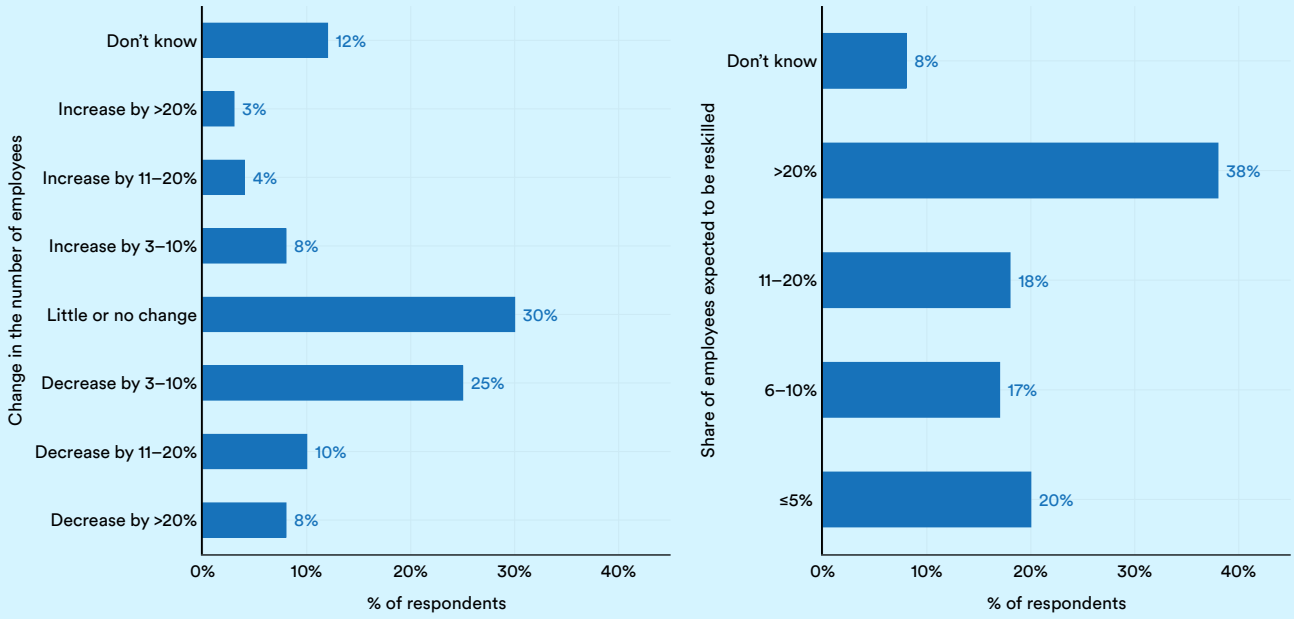


Figure 4.4.28

Highlight:

Projecting AI's Economic Impact (cont'd)

Perspectives differ on the anticipated effect of generative AI on employment per business function. Certain functions, like service operations (54%), supply chain management (45%), and HR (41%), are especially likely, according to respondents, to experience decreasing employment (Figure 4.4.29).

Anticipated effect of generative AI on number of employees in the next 3 years by business function, 2023
Source: McKinsey & Company Survey, 2023 | Chart: 2024 AI Index report

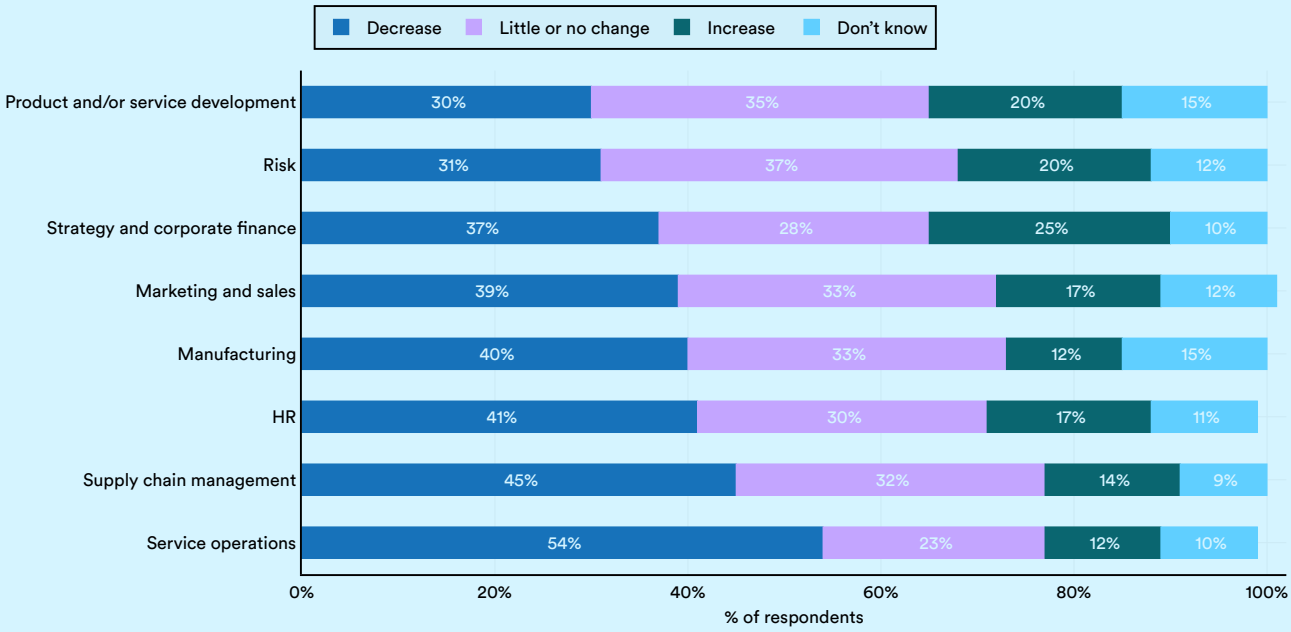


Figure 4.4.29

Highlight:

Projecting AI's Economic Impact (cont'd)

Finally, a Goldman Sachs investment report released in 2023 projects that, globally, AI could lead to productivity growth over 10-year periods ranging between 1.0% and 1.5% (Figure 4.4.30).

Although the report projects that many countries will benefit from AI-driven productivity growth, certain geographic areas, like Hong Kong, Israel, and Japan, are especially well-positioned.

Estimated impact of AI adoption on annual productivity growth over a ten-year period

Source: Goldman Sachs Global Investment Research, 2023 | Chart: 2024 AI Index report

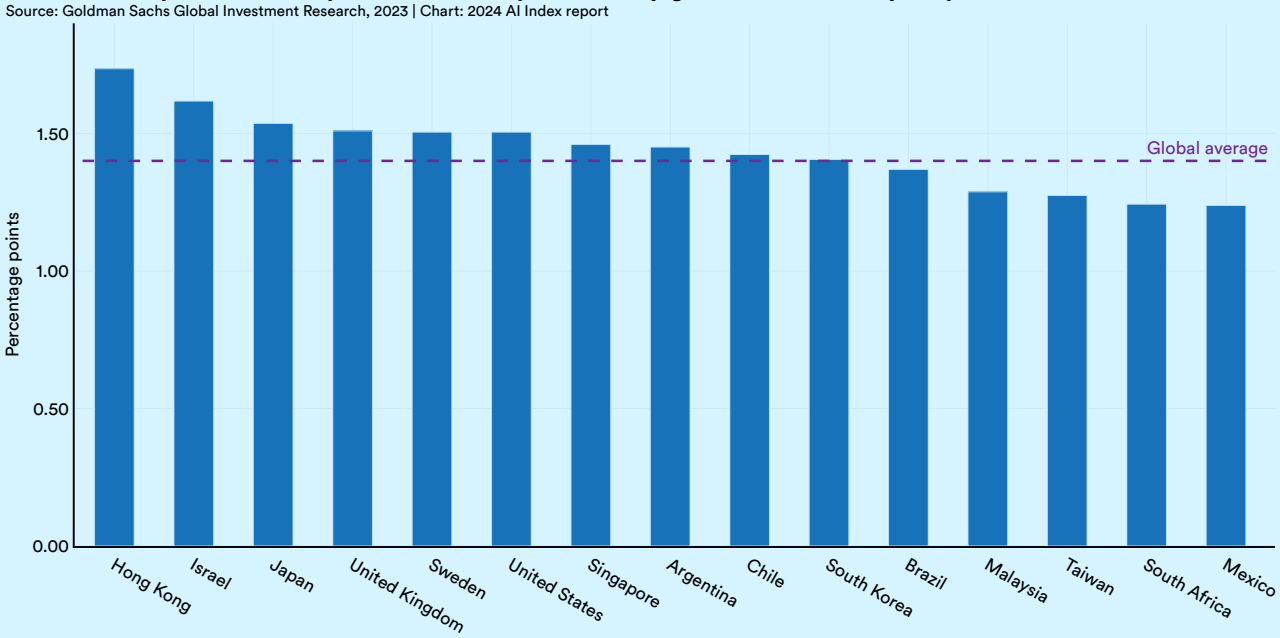


Figure 4.4.30

The deployment of robots equipped with AI-based software technologies offers a window into the real-world application of AI-ready infrastructure. This section draws on data from the International Federation of Robotics (IFR), a nonprofit organization dedicated to advancing the robotics industry. Annually, the IFR publishes the World Robotics Reports, which track global robot installation trends.[12]

4.5 Robot Installations

Aggregate Trends

The following section includes data on the installation and operation of industrial robots, which are defined as an "automatically controlled, reprogrammable, multipurpose manipulator, programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications."

Figure 4.5.1 reports the total number of industrial robots installed worldwide by year. In 2022, industrial robot installations increased slightly, with 553,000 units marking a 5.1% increase from 2021. This growth reflects more than a threefold rise in installations since 2012.

Number of industrial robots installed in the world, 2012–22
Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

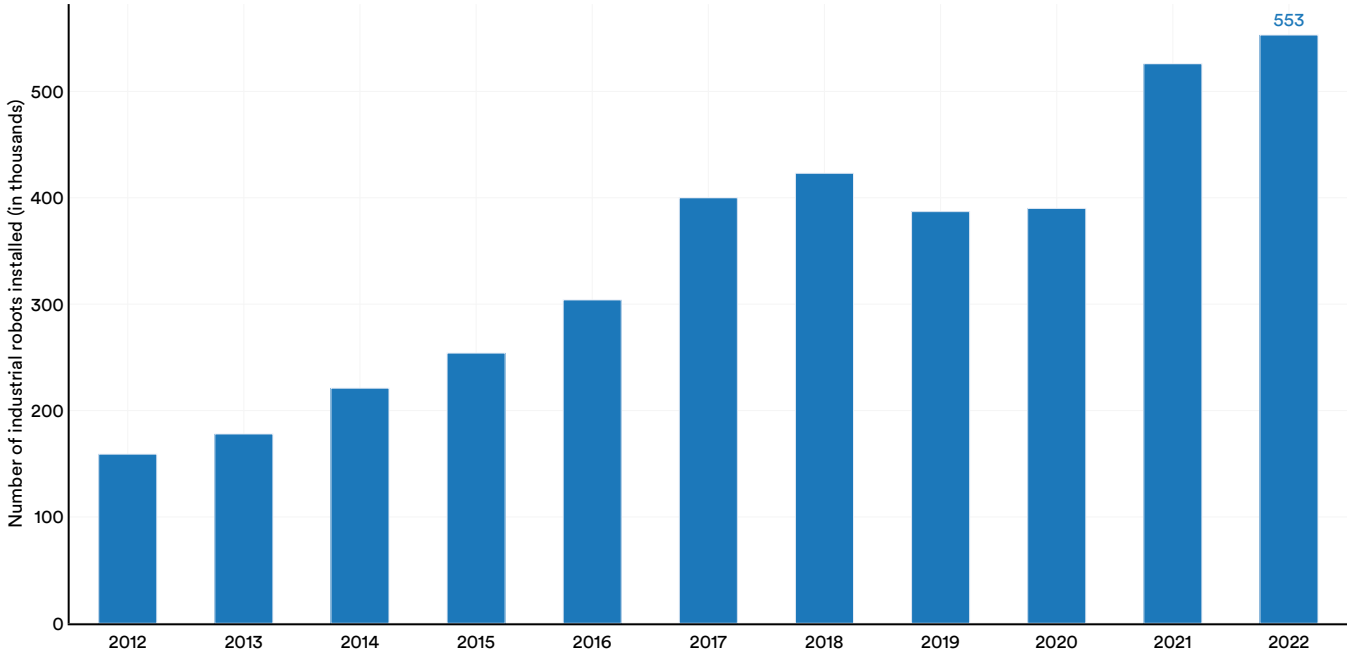


Figure 4.5.1

12 Due to the timing of the IFR report, the most recent data is from 2022. Every year, the IFR revisits data collected for previous years and will occasionally update the data if more accurate figures become available. Therefore, some of the data reported in this year's report might differ slightly from data reported in previous years.

The global operational stock of industrial robots reached 3,904,000 in 2022, up from 3,479,000 in 2021 (Figure 4.5.2). Over the past decade, both the installation and utilization of industrial robots have steadily increased.

Operational stock of industrial robots in the world, 2012–22
Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

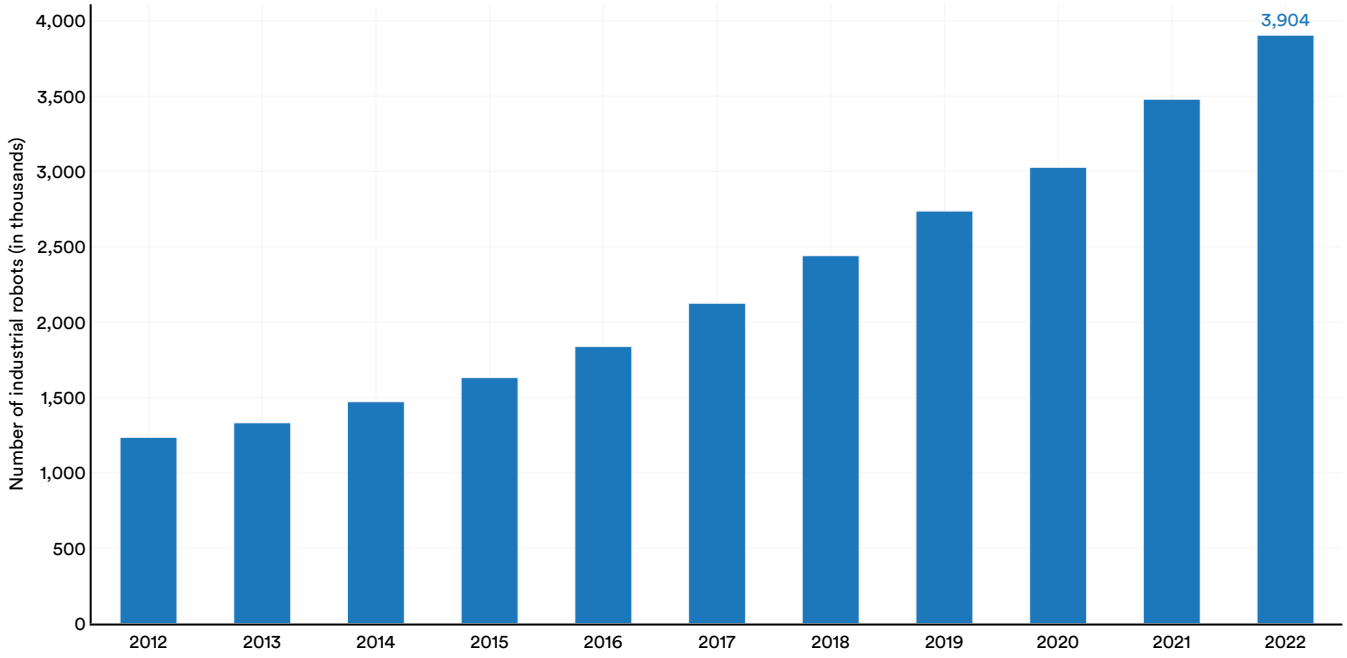


Figure 4.5.2

Industrial Robots: Traditional vs. Collaborative Robots

There is a distinction between traditional robots, which operate for humans, and collaborative robots, designed to work alongside them. The robotics community is increasingly enthusiastic about collaborative robots due to their safety, flexibility, scalability, and ability to learn iteratively.

Figure 4.5.3 reports the number of industrial robots installed in the world by type. In 2017, collaborative robots accounted for just 2.8% of all new industrial robot installations. By 2022, the number rose to 9.9%.

Number of industrial robots installed in the world by type, 2017–22

Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

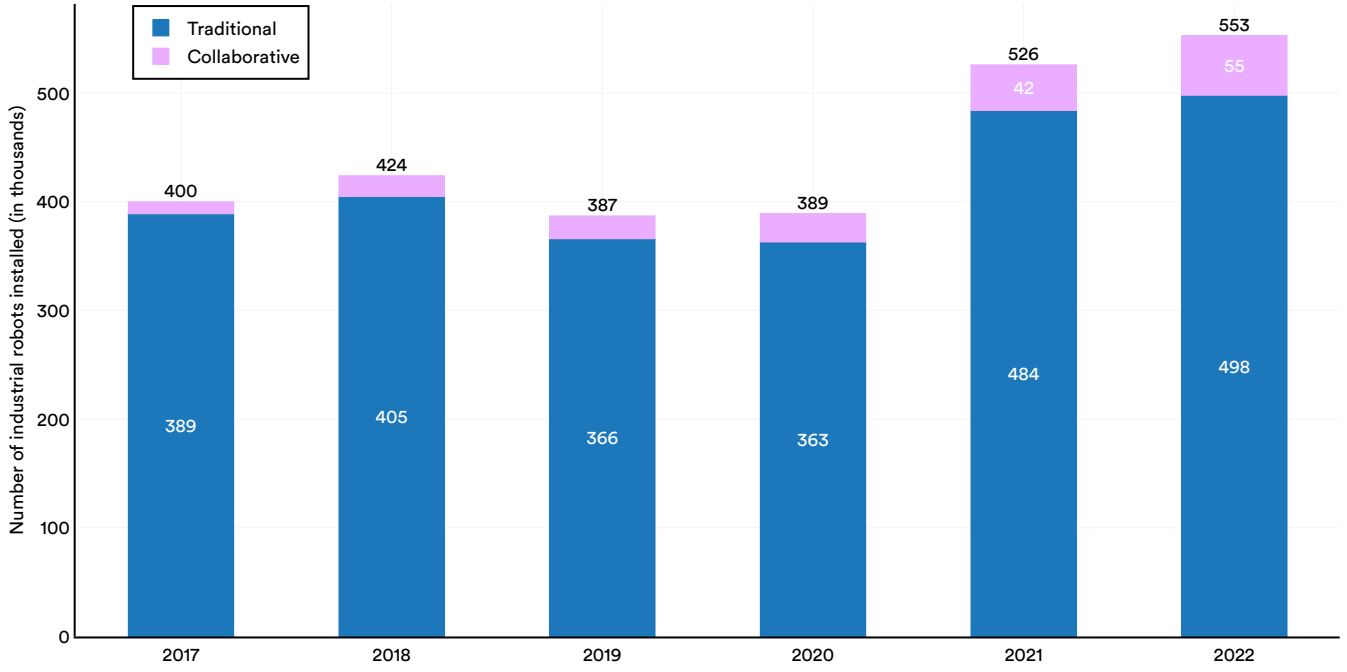


Figure 4.5.3

By Geographic Area

Country-level data on robot installations can suggest which nations prioritize robot integration into their economies. In 2022, China led the world with 290,300 industrial robot installations, 5.8 times more than Japan's 50,400 and 7.4 times more than the United States' 39,500 (Figure 4.5.4). South Korea and Germany followed with 31,170 and 25,600 installations, respectively.

Number of industrial robots installed by country, 2022

Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

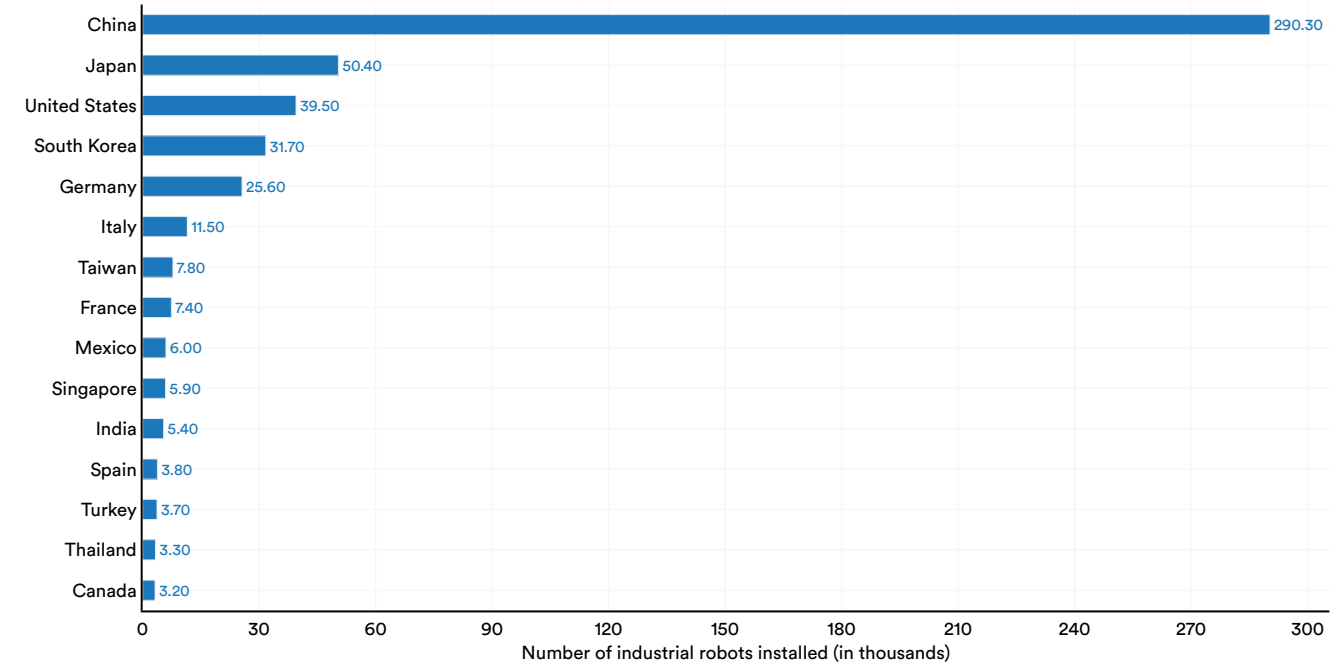


Figure 4.5.4

Since surpassing Japan in 2013 as the leading installer of industrial robots, China has significantly widened the gap with the nearest country. In 2013, China's installations accounted for 20.8% of the global total, a share that rose to 52.4% by 2022 (Figure 4.5.5).

Number of new industrial robots installed in top 5 countries, 2012–22

Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

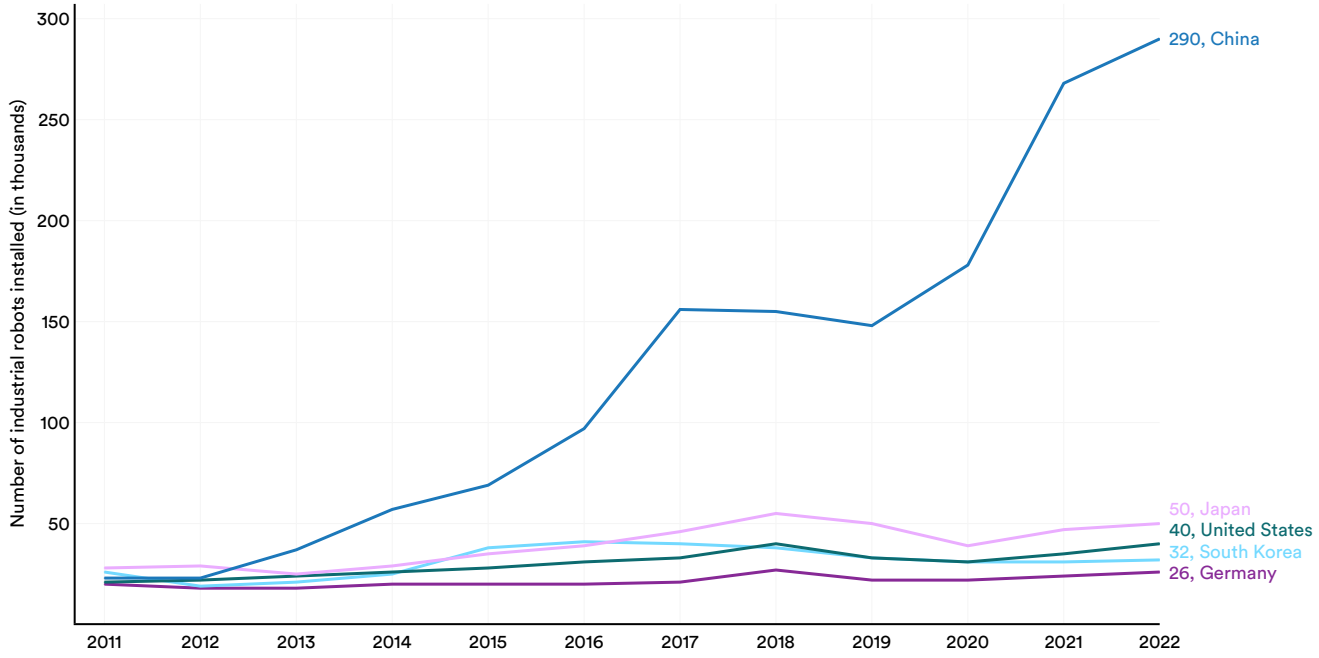


Figure 4.5.5

Since 2021, China has installed more industrial robots than the rest of the world combined, with the gap widening further in the last year (Figure 4.5.6). This increasing gap underscores China's growing dominance in industrial robot installations.

Number of industrial robots installed (China vs. rest of the world), 2016–22
Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

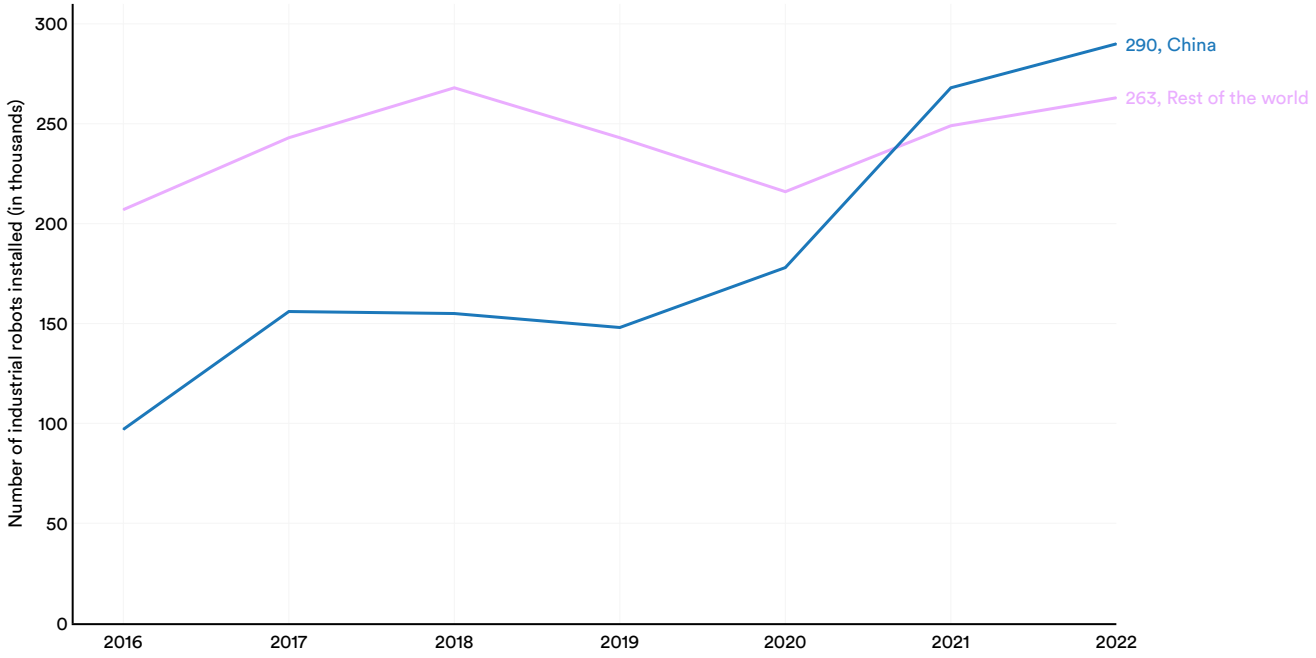


Figure 4.5.6

According to the IFR report, most countries reported an annual increase in industrial robot installations from 2021 to 2022 (Figure 4.5.7). The countries with the highest growth rates include Singapore (68%), Turkey (22%), and Mexico (13%). Canada (-24%), Taiwan (-21%), Thailand (-18%), and Germany (-1%) reported installing fewer robots in 2022 than in 2021.

Annual growth rate of industrial robots installed by country, 2021 vs. 2022

Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

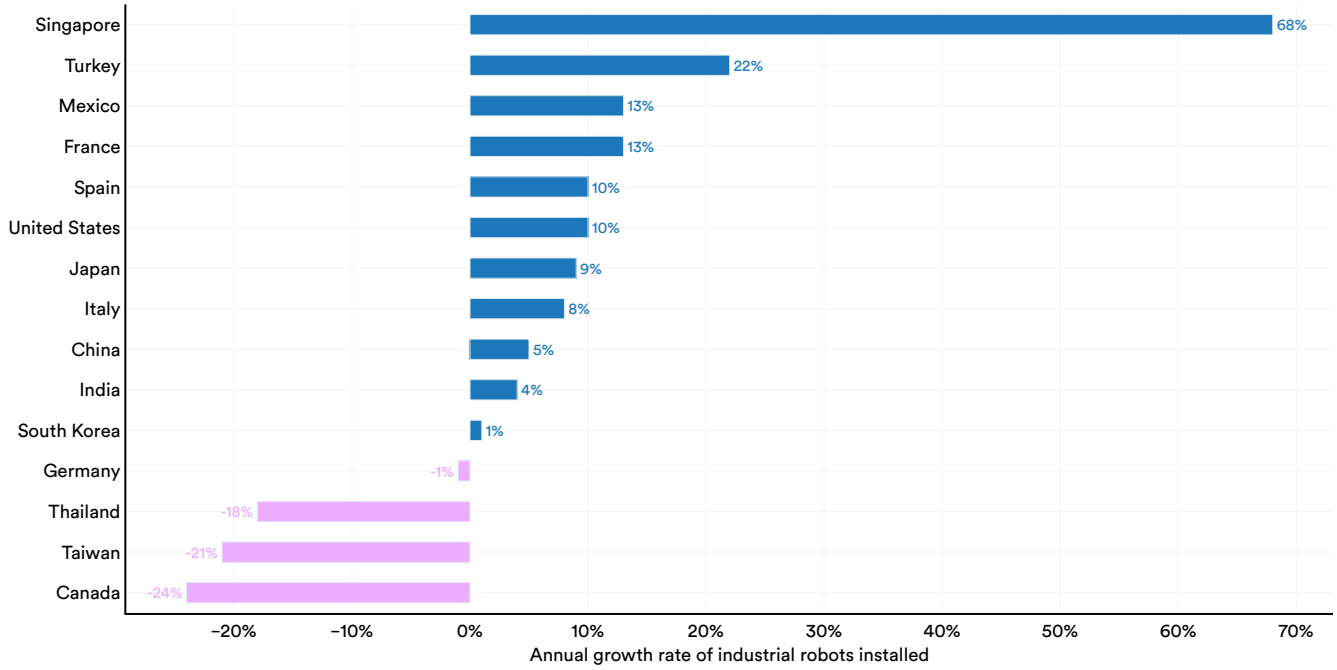


Figure 4.5.7

Country-Level Data on Service Robotics

Another important class of robots are service robots, which the ISO defines as a robot "that performs useful tasks for humans or equipment excluding industrial automation applications."[13] Such robots can, for example, be used in medicine and professional cleaning. In 2022, more service robots were installed for every application category than in 2021, with the exception of medical robotics (Figure 4.5.8). More specifically, the number of service robots installed in hospitality and in transportation and logistics increased 2.3 and 1.4 times, respectively.

Number of professional service robots installed in the world by application area, 2021 vs. 2022
Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

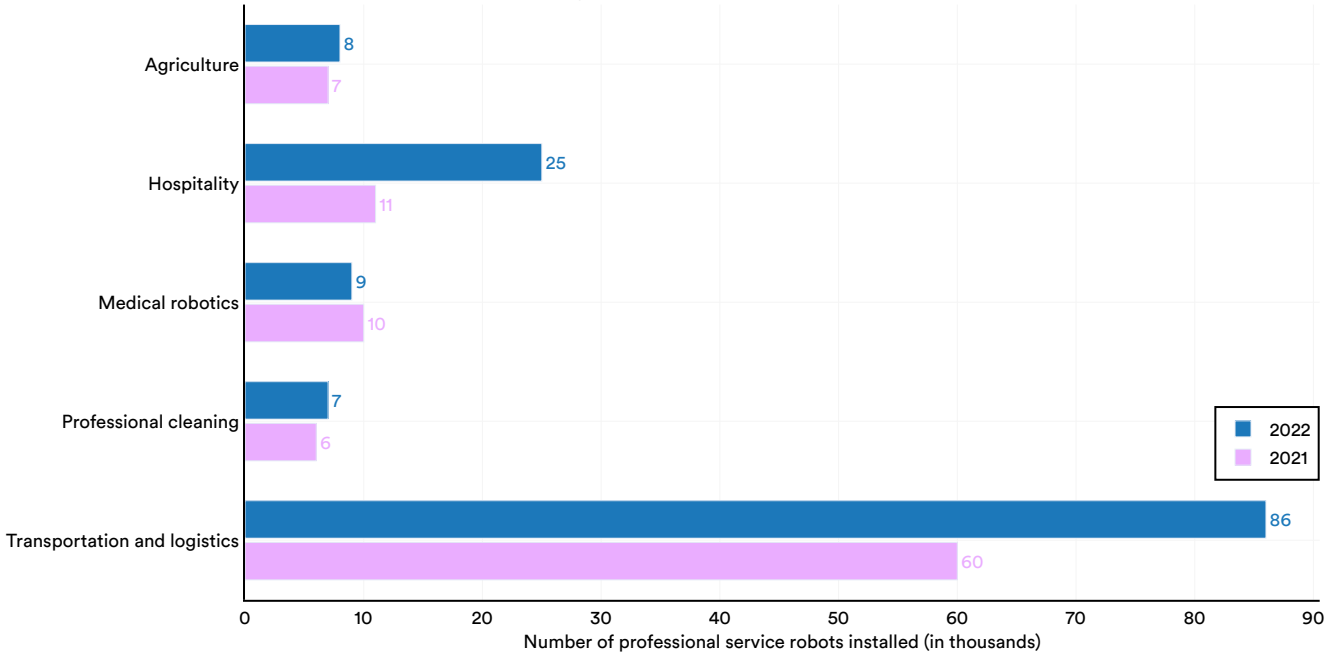


Figure 4.5.8

13 A more detailed definition can be accessed here.

As of 2022, the United States leads in professional service robot manufacturing, with approximately 2.06 times more manufacturers than China, the next leading nation (Figure 4.5.9). Germany, Japan, and France also have significant numbers of robot manufacturers, with 85,000, 72,000, and 53,000, respectively. In most surveyed countries, the majority of these manufacturers are established incumbents.

Number of professional service robot manufacturers in top countries by type of company, 2022
Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

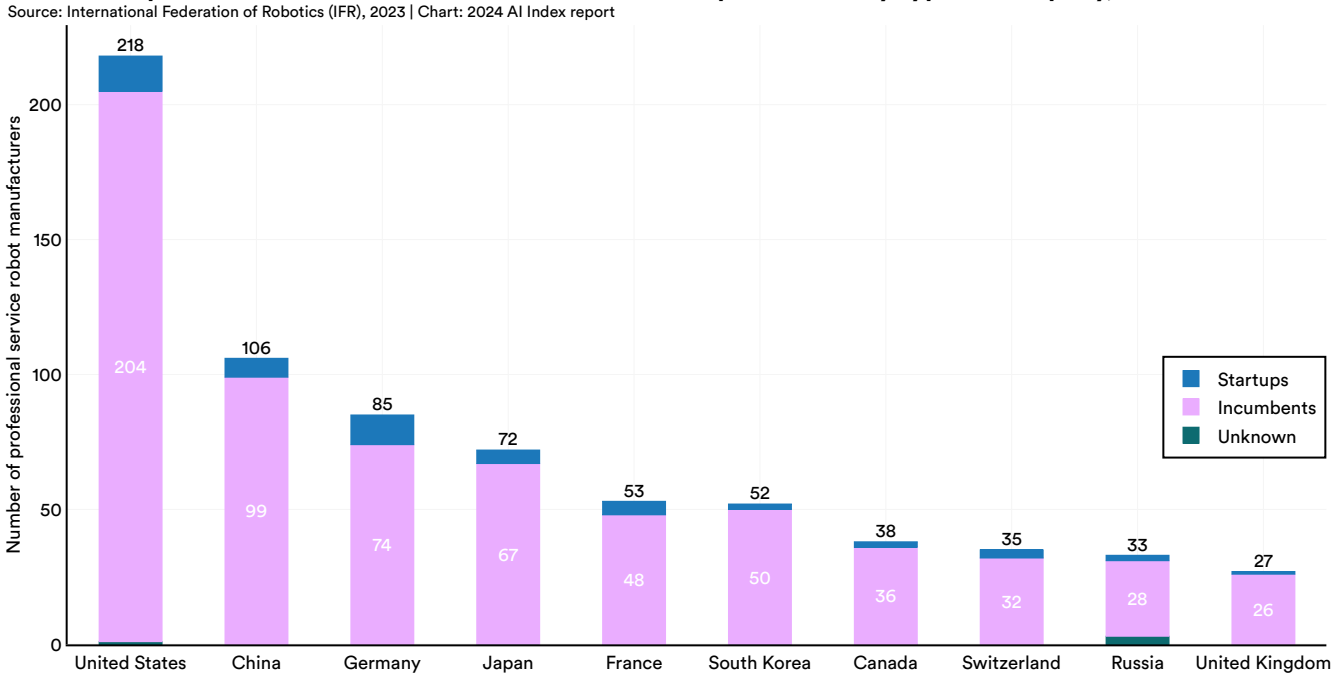


Figure 4.5.9

Sectors and Application Types

Figure 4.5.10 shows the number of industrial robots installed in the world by sector from 2020 to 2022. Globally, the electrical/electronics sector led in robot installations with 157,000 units, closely followed by the automotive sector with 136,000. Both sectors have seen continuous growth in industrial robot installations since 2020.

Number of industrial robots installed in the world by sector, 2020–22
Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

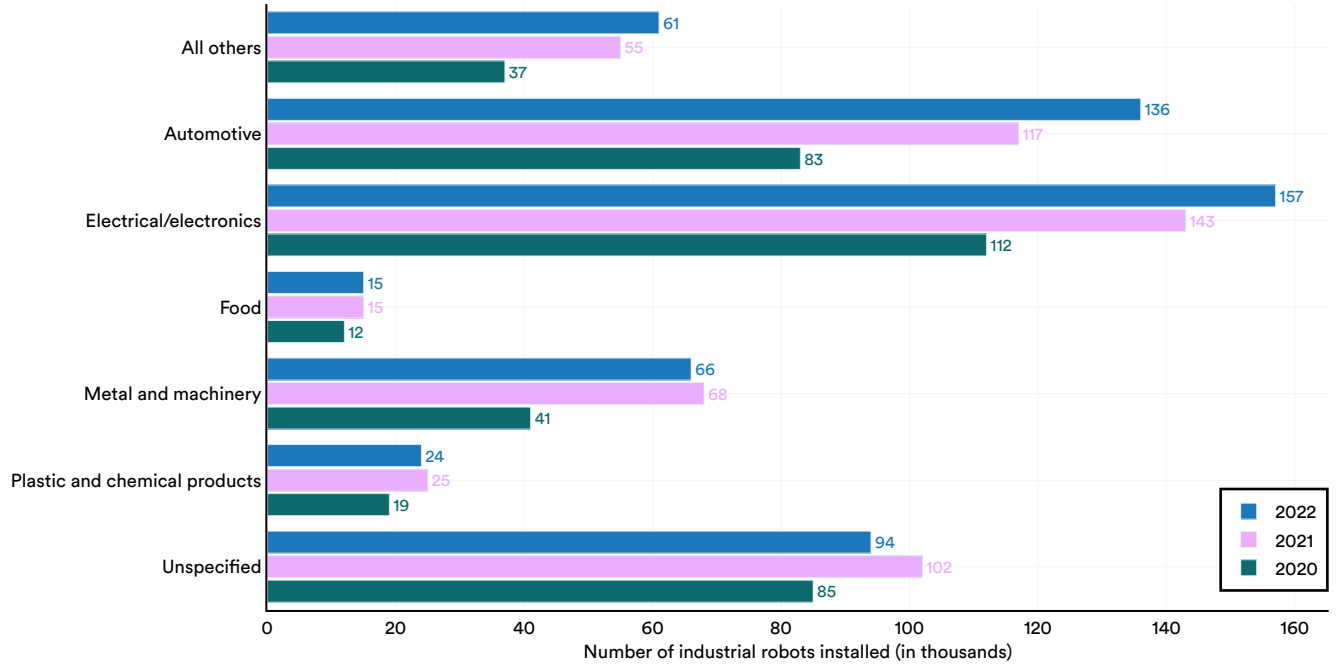


Figure 4.5.10

Figure 4.5.11 shows the number of industrial robots installed in the world by application from 2020 to 2022. Data suggests that handling is the predominant application. In 2022, 266,000 industrial robots were installed for handling tasks, 3.1 times more than for welding (87,000) and 4.4 times more than for assembly (61,000). Except for processing, every application category witnessed an increase in robot installations in 2022 compared to 2020.

Number of industrial robots installed in the world by application, 2020–22
Source: International Federation of Robotics (IFR), 2023 | Chart: 2024 AI Index report

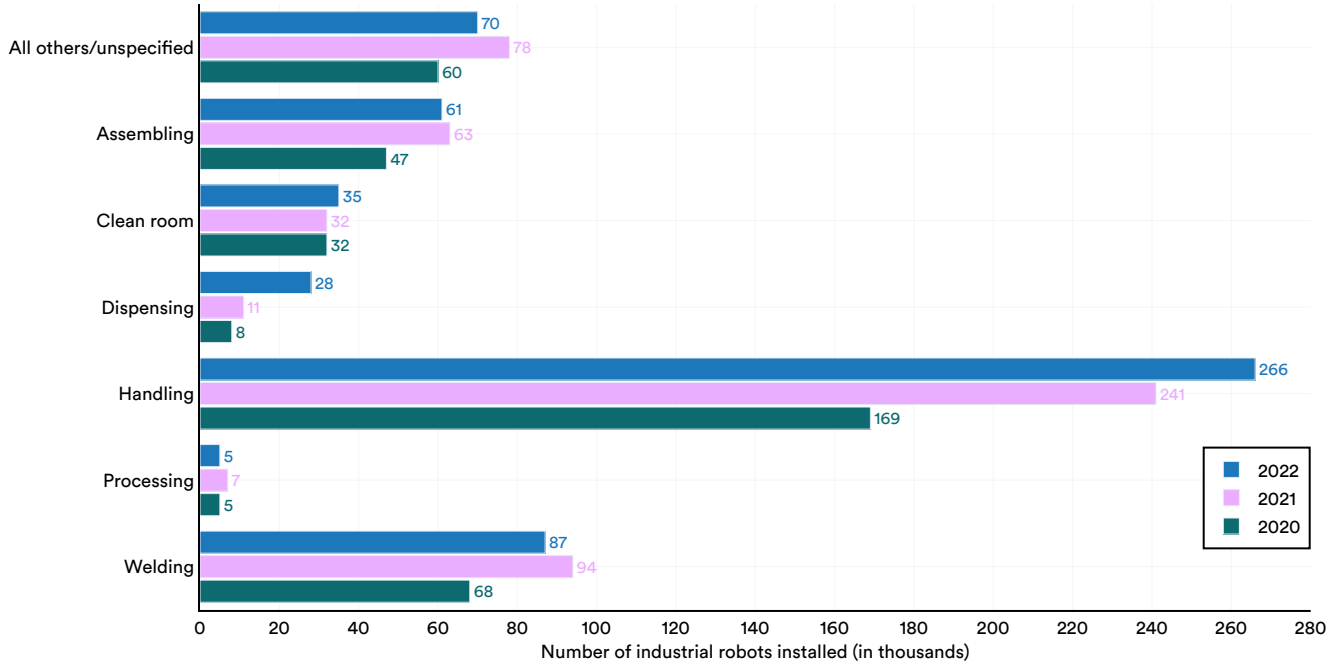


Figure 4.5.11

China vs. United States

Figure 4.5.12 illustrates the number of industrial robots installed across various sectors in China over the past three years. In 2022, the leading sectors for industrial robot installations in China were electrical/electronics (100,000), automotive (73,000), and metal and machinery (31,000).

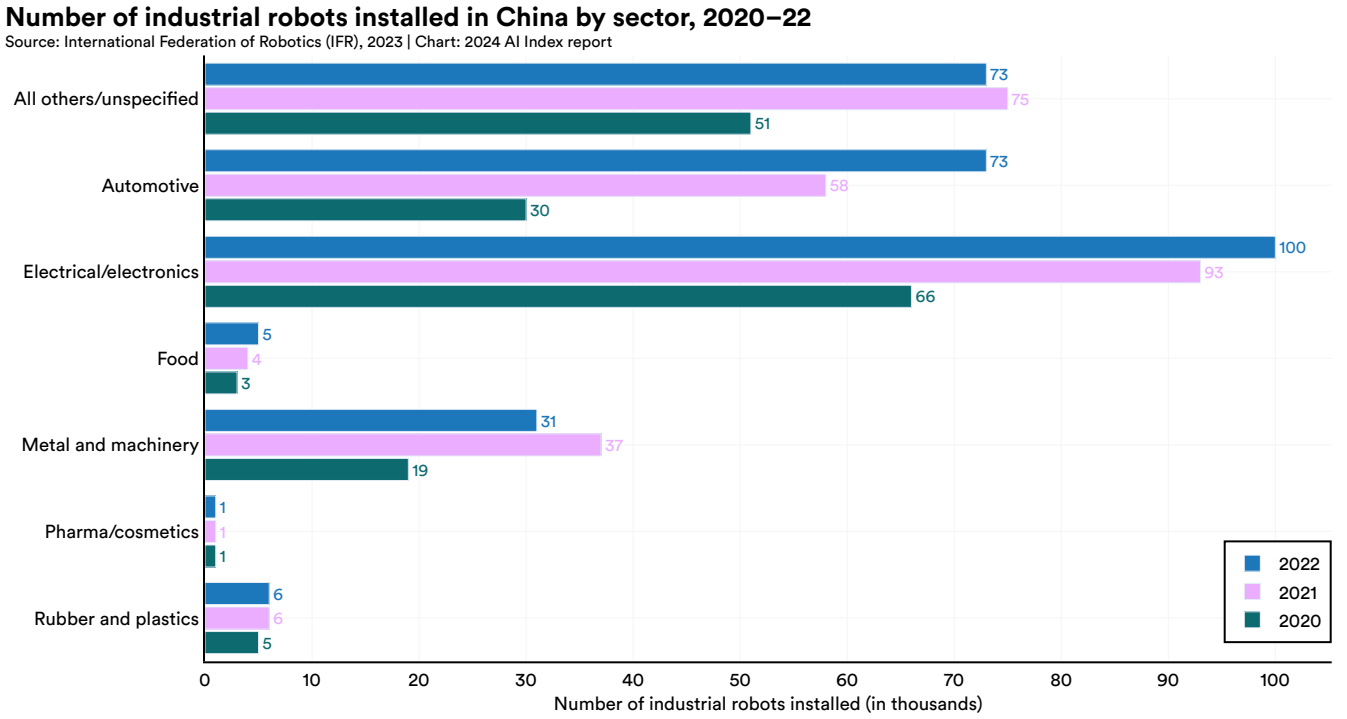


Figure 4.5.12

In 2022, the U.S. automotive industry led in industrial robot installations with 14,500 units, significantly exceeding its 2021 figure (Figure 4.5.13). Except for the electronics sector, every other sector saw fewer robot installations in 2022 than in 2021.

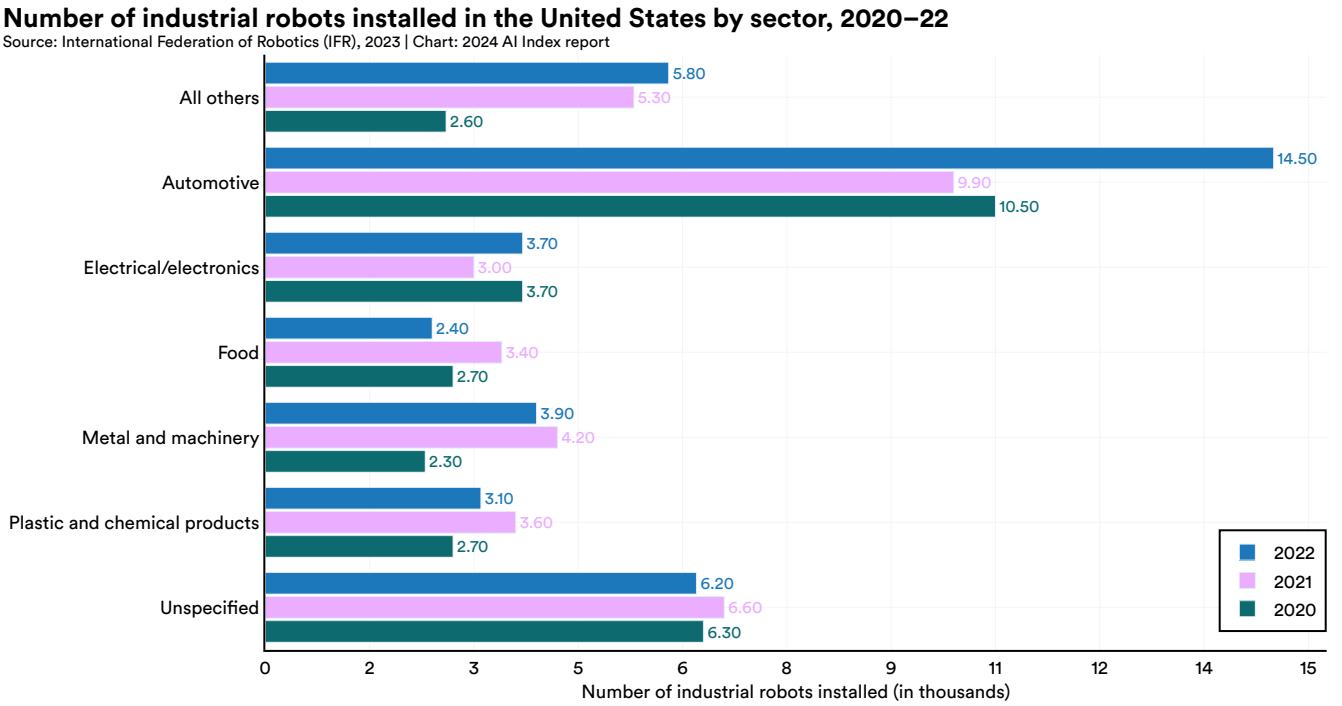


Figure 4.5.13

Appendix

Acknowledgments

The AI Index would like to acknowledge James da Costa for his work collecting information on significant AI-related economic events, and Emma Williamson for her work collecting data from the Stack Overflow survey.

International Federation of Robotics (IFR)

Data presented in the Robot Installations section was sourced from the "World Robotics 2023" report.

Lightcast

Prepared by Cal McKeever, Julia Nitschke, and Layla O'Kane

Lightcast delivers job market analytics that empower employers, workers, and educators to make data-driven decisions. The company's artificial intelligence technology analyzes hundreds of millions of job postings and real-life career transitions to provide insight into labor market patterns. This real-time strategic intelligence offers crucial insights, such as what jobs are most in demand, the specific skills employers need, and the career directions that offer the highest potential for workers. For more information, visit www.lightcast.io.

Job Postings Data

To support these analyses, Lightcast mined its dataset of millions of job postings collected since 2010. Lightcast collects postings from over 51,000 online job sites to develop a comprehensive, real-time portrait of labor market demand. It aggregates job postings, removes duplicates, and extracts data from job postings text. This includes information on job title, employer, industry, and region, as well as required experience, education, and skills.

Job postings are useful for understanding trends in the labor market because they allow for a detailed, real-time look at the skills employers seek. To assess the representativeness of job postings data, Lightcast conducts a number of analyses to compare the distribution of job postings to the distribution of official government and other third-party sources in the United States. The primary source of government data on U.S. job postings is the Job Openings and Labor Turnover Survey (JOLTS) program, conducted by the Bureau of Labor Statistics. Based on comparisons between JOLTS and Lightcast, the labor market demand captured by Lightcast data represents over 99% of the total labor demand. Jobs not posted online are usually in small businesses (the classic example being the "Help Wanted" sign in the restaurant window) and union hiring halls.

Measuring Demand for AI

In order to measure the demand by employers of AI skills, Lightcast uses its skills taxonomy of over 30,000 skills. The list of AI skills from Lightcast data are shown below, with associated skill clusters. While some skills are considered to be in the AI cluster specifically, for the purposes of this report, all skills below were considered AI skills. A job posting was considered an AI job if it mentioned any of these skills in the job text.

Artificial Intelligence: AI/ML Inference, AIOps (Artificial Intelligence for IT Operations), Applications of Artificial Intelligence, Artificial General Intelligence, Artificial Intelligence, Artificial Intelligence Development, Artificial Intelligence Markup Language (AIML), Artificial Intelligence Systems, Azure Cognitive Services, Baidu, Cognitive Automation, Cognitive Computing, Computational Intelligence, Cortana, Ethical AI, Expert Systems, Explainable AI (XAI), IPSoft Amelia, Intelligent Control, Intelligent Systems, Interactive Kiosk, Knowledge Engineering, Knowledge-Based Configuration, Knowledge-Based Systems, Multi-agent Systems, Open Neural Network Exchange (ONNX), OpenAI Gym, Operationalizing AI, Reasoning Systems, Watson Conversation, Watson Studio, Weka

Autonomous Driving: Advanced Driver Assistance Systems, Autonomous Cruise Control Systems, Autonomous System, Autonomous Vehicles, Guidance Navigation and Control Systems, Light Detection and Ranging (LiDAR), OpenCV, Path Analysis, Path Finding, Remote Sensing, Unmanned Aerial Systems (UAS)

Generative Artificial Intelligence: ChatGPT, Generative Adversarial Networks, Generative Artificial Intelligence, Large Language Modeling, Prompt Engineering, Variational Autoencoders

Natural Language Processing (NLP): AI Copywriting, ANTLR, Amazon Textract, Apache OpenNLP, BERT (NLP Model), Chatbot, Computational Linguistics, Conversational AI, Dialog Systems, Fuzzy Logic, Handwriting Recognition, Hugging Face (NLP Framework), Hugging Face Transformers, Intelligent Agent, Intelligent Virtual Assistant, Kaldi, Language Model, Latent Dirichlet Allocation, Lexalytics, Machine Translation, Microsoft LUIS, Natural Language Generation, Natural Language Processing, Natural Language Programming, Natural Language Toolkits, Natural Language Understanding, Optical Character Recognition (OCR), Screen Reader, Semantic Analysis, Semantic Parsing, Semantic Search, Sentiment Analysis, Seq2Seq, Speech Recognition, Speech Recognition Software, Speech Synthesis, Statistical Language Acquisition, Text Mining, Text-to-Speech, Tokenization, Voice Assistant Technology, Voice Interaction, Voice User Interface, Word Embedding, Word2Vec Models, fastText

Neural Networks: Apache MXNet, Artificial Neural Networks, Autoencoders, Caffe2, Chainer (Deep Learning Framework), Convolutional Neural Networks, Cudnn, Deep Learning, Deep Learning Methods, Deeplearning4j, Evolutionary Acquisition of Neural Topologies, Fast.ai, Keras (Neural Network Library), Long Short-Term Memory (LSTM), OpenVINO, PaddlePaddle, Recurrent Neural Network (RNN), TensorFlow

Machine Learning: AdaBoost (Adaptive Boosting), Adversarial Machine Learning, Apache MADlib, Apache Mahout, Apache SINGA, Apache Spark, Association Rule Learning, Automated Machine Learning, Autonomic Computing, AWS SageMaker, Azure Machine Learning, Boosting, CHi-Squared Automatic Interaction Detection (CHAID), Classification and Regression Tree (CART), Cluster Analysis, Collaborative Filtering, Confusion Matrix, Cyber-Physical Systems, Dask (Software), Data Classification, Dbscan, Decision Models, Decision Tree Learning, Dimensionality Reduction, Dlib (C++ Library), Ensemble Methods, Feature Engineering, Feature Extraction, Feature Learning, Feature Selection, Gaussian Process, Genetic Algorithm, Google AutoML, Gradient Boosting, H2O.ai, Hidden Markov Model, Hyperparameter Optimization, Inference Engine, K-Means Clustering, Kernel

Methods, Kubeflow, Loss Functions, Machine Learning, Machine Learning Algorithms, Machine Learning Methods, Machine Learning Model Monitoring And Evaluation, Machine Learning Model Training, Markov Chain, Matrix Factorization, Meta Learning, Microsoft Cognitive Toolkit (CNTK), MLflow, MLOps (Machine Learning Operations), mlpack (C++ Library), ModelOps, Naive Bayes Classifier, Perceptron, Predictive Modeling, PyTorch (Machine Learning Library), PyTorch Lightning, Random Forest Algorithm, Recommender Systems, Reinforcement Learning, Scikit-Learn (Python Package), Semi-supervised Learning, Soft Computing, Sorting Algorithm, Supervised Learning, Support Vector Machine, Test Datasets, Theano (Software), Torch (Machine Learning), Training Datasets, Transfer Learning, Transformer (Machine Learning Model), Unsupervised Learning, Vowpal Wabbit, Xgboost

Robotics: Advanced Robotics, Bot Framework, Cognitive Robotics, Motion Planning, Nvidia Jetson, Robot Framework, Robot Operating Systems, Robotic Automation Software, Robotic Liquid Handling Systems, Robotic Programming, Robotic Systems, Servomotor, SLAM Algorithms (Simultaneous Localization and Mapping)

Visual Image Recognition: 3D Reconstruction, Activity Recognition, Computer Vision, Contextual Image Classification, Digital Image Processing, Eye Tracking, Face Detection, Facial Recognition, Gesture Recognition, Image Analysis, Image Matching, Image Recognition, Image Segmentation, Image Sensor, Imagenet, Machine Vision, Motion Analysis, Object Recognition, OmniPage, Pose Estimation

LinkedIn

Prepared by Murat Erer, Carl Shan, and Akash Kaura

Country Sample

Included countries represent a select sample of eligible countries with at least 40% labor force coverage by LinkedIn and at least 10 AI hires in any given month. India, despite not reaching 40% coverage, was included in this sample because of its increasing importance in the global economy.

Skills (AI Engineering and AI Literacy skills)

LinkedIn members self-report their skills on their LinkedIn profiles. Currently, more than 41,000 distinct, standardized skills are identified by LinkedIn. These have been coded and classified by taxonomists at LinkedIn into 249 skill groupings, which are the skill groups represented in the dataset.

Skill groupings are derived by expert taxonomists through a similarity-index methodology that measures skill composition at the industry level. LinkedIn's industry taxonomy and their corresponding NAICS codes can be found here.

This year LinkedIn made updates to the AI skills list and categorized them into "AI Engineering" and "AI Literacy" skills. See "AI Skills List Update Compared to Last Year" section for more details.

Skills Genome

For any entity (occupation or job, country, sector, etc.), the skill genome is an ordered list (a vector) of the 50 "most characteristic skills" of that entity. These most characteristic skills are identified using a TF-IDF algorithm to identify the most representative skills of the target entity, while down-ranking ubiquitous skills that add little information about that specific entity (e.g., Microsoft Word).

TF-IDF is a statistical measure that evaluates how representative a word (in this case, a skill) is to a selected entity). This is done by multiplying two metrics:

1. The term frequency of a skill in an entity ("TF").
2. The logarithmic inverse entity frequency of the skill across a set of entities ("IDF"). This indicates how common or rare a word is in the entire entity set. The closer IDF is to 0, the more common a word is.

So, if the skill is very common across LinkedIn entities, and appears in many job or member descriptions, the IDF will approach 0. If, on the other hand, the skill is unique to specific entities, the IDF will approach 1. Details are available at LinkedIn's Skills Genome and LinkedIn–World Bank Methodology note.

AI Skills Penetration

The aim of this indicator is to measure the intensity of AI skills in an entity (in a particular country, industry, gender, etc.) through the following methodology:

- Compute frequencies for all self-added skills by LinkedIn members in a given entity (occupation, industry, etc.) in 2015–2023.
- Re-weight skill frequencies using a TF-IDF model to get the top 50 most representative skills in that entity. These 50 skills compose the "skill genome" of that entity.
- Compute the share of skills that belong to the AI skill group out of the top skills in the selected entity.

Interpretation: The AI skill penetration rate signals the prevalence of AI skills across occupations, or the intensity with which LinkedIn members utilize AI skills in their jobs. For example, the top 50 skills for the occupation of engineer are calculated based on the weighted frequency with which they appear in LinkedIn members' profiles. If four of the skills that engineers possess belong to the AI skill group, this measure indicates that the penetration of AI skills is estimated to be 8% among engineers (e.g., 4/50).

Jobs or Occupations

LinkedIn member titles are standardized and grouped into approximately 15,000 occupations. These are not sector- or country-specific. These occupations are further standardized into approximately 3,600 occupation representatives. Occupation representatives group occupations with a common role and specialty, regardless of seniority.

AI Jobs or Occupations

An **"AI" job** is an occupation representative that requires AI skills to perform the job. Skills penetrations are used as a signal for whether **AI skills** are prevalent in an occupation representative, in any sector where the occupation representative may exist. Examples of such occupations include (but are not limited to): Machine Learning Engineer, Artificial Intelligence Specialist, Data Scientist, and Computer Vision Engineer.

AI Talent

A LinkedIn member is considered **AI talent if they have explicitly added AI skills to their profile and/or they are occupied in an AI occupation representative**. The counts of AI talent are used to calculate talent concentration metrics. For example, to calculate the country-level AI talent concentration, we use the counts of AI talent at the country level vis-a-vis the counts of LinkedIn members in the respective countries. Note that concentration metrics may be influenced by LinkedIn coverage in these countries and should be utilized with caution.

Relative AI Skills Penetration

To allow for skills penetration comparisons across countries, the skills genomes are calculated and a relevant benchmark is selected (e.g., global average). A ratio is then constructed between a country's and the benchmark's AI skills penetrations, controlling for occupations.

Interpretation: A country's relative AI skills penetration of 1.5 indicates that AI skills are 1.5 times as frequent as in the benchmark, for an overlapping set of occupations.

Global Comparison

For cross-country comparison, we present the relative penetration rate of AI skills, measured as the sum of the penetration of each AI skill across occupations in a given country, divided by the average global penetration of AI skills across the overlapping occupations in a sample of countries.

Interpretation: A relative penetration rate of 2 means that the average penetration of AI skills in that country is two times the global average across the same set of occupations.

Global Comparison: By Industry

The relative AI skills penetration by country for industry provides an in-depth sectoral decomposition of AI skill penetration across industries and sample countries.

Interpretation: A country's relative AI skill penetration rate of 2 in the education sector means that the average penetration of AI skills in that country is two times the global average across the same set of occupations in that sector.

Global Comparison: By Gender

The "Relative AI Skills Penetration by Gender" metric provides a cross-country comparison of AI skill penetrations within each gender, comparing countries' male/female AI skill penetrations to the global average of the same gender. Since the global averages are distinct for each gender, this metric should only be used to compare country rankings within each gender, and not for cross-gender comparisons within countries.

Interpretation: A country's AI skills penetration for women of 1.5 means that female members in that country are 1.5 times more likely to list AI skills than the average female member in all countries pooled together across the same set of occupations that exist in the country/gender combination.

Global Comparison: Across Genders

The "Relative AI Skills Penetration Across Genders" metric allows for cross-gender comparisons within and across countries globally, since we compare the countries' male/female AI skill penetrations to the same global average regardless of gender.

Relative AI Talent Hiring Rate YoY Ratio

- **LinkedIn Hiring Rate or Overall Hiring Rate** is a measure of hires normalized by LinkedIn membership. It is computed as the percentage of LinkedIn members who added a new employer in the same period the job began, divided by the total number of LinkedIn members in the corresponding location.
- **AI Hiring Rate** is computed following the overall hiring rate methodology, but only considering members classified as AI talent.
- **Relative AI Talent Hiring Rate YoY Ratio** is the year-over-year change in AI Hiring Rate relative to Overall Hiring Rate in the same country. For each month, we first calculate AI Hiring rate in the country, then divide AI Hiring Rate by Overall Hiring Rate in that country,

then calculate YoY change of this ratio, and then take the 12-month moving average using the last 12 months.

Interpretation: In 2023 in India, the ratio of AI talent hiring relative to overall hiring has grown 16.8% year over year.

AI Talent Migration

Data on migration comes from the World Bank Group–LinkedIn "Digital Data for Development" partnership (please see Zhu et al. [2018]).

LinkedIn migration rates are derived from the self-identified locations of LinkedIn member profiles. For example, when a LinkedIn member updates his or her location from Paris to London, this is counted as a migration. Migration data is available from 2019 onward. LinkedIn data provides insights into countries on the AI Talent gained or lost due to migration trends. AI Talent migration is considered for all members with AI Skills/holding AI jobs at time t for country A as the country of interest and country B as the source of inflows and destination for outflows. Thus, net AI Talent migration between country A and country B—for country A—is calculated as follows:

$$Net\ AI\ Talent\ Migration_{a,b,t} = \frac{Net\ AI\ Talent\ flows_{a,b,t}}{Member\ count_{a,t}}$$

Net flows are defined as total arrivals minus departures within the given time period. LinkedIn membership varies considerably between countries, which makes interpreting absolute movements of members from one country to another difficult. To compare migration flows between countries fairly, migration flows are normalized for the country of interest. For example, if country A is the country of interest, all absolute net flows into and out of country A, regardless of origin and destination countries, are normalized based on LinkedIn membership in country A at the end of each year and multiplied by 10,000. Hence, this metric indicates relative talent migration from all countries to and from country A.

AI Skills List Update Compared to Last Year

1. LinkedIn introduced "AI Literacy" skills.
    a. The following skills were added to the list and categorized as "AI Literacy" skills: ChatGPT, DALL-E, GPT-3, GPT-4, Generative Art, Github Copilot, Google Bard, Midjourney, Prompt Engineering, and Stable Diffusion.

2. LinkedIn updated the former AI skills list and categorized them as "AI Engineering" skills:
    a. The following skills were excluded from the list: Alexa, Common Lisp, Data Structures, Gaussian 03, Graph Theory, IBM Watson, Information Retrieval, Jena, Julia (Programming Language), Linked Data, Lisp, Pandas (Software), Parallel Algorithms, Perl Automation, Resource Description Framework, Smalltalk, and dSPACE.

    b. The following skills were added to the list: Apache Spark ML, Applied Machine Learning, Audio Synthesis, Autoencoders, Automated Clustering, Automated Feature Engineering, Automated Machine Learning (AutoML), Autoregressive Models, Chatbot Development, Chatbots, Concept Drift Adaptation, Conditional Generation, Conditional Image Generation, Decision Trees, Deep Convolutional Generative Adversarial Networks (DCGAN), Deep Neural Networks (DNN), Generative AI, Generative Adversarial Imitation Learning, Generative Adversarial Networks (GANs), Generative

Design Optimization, Generative Flow Models, Generative Modeling, Generative Neural Networks, Generative Optimization, Generative Pre-training, Generative Query Networks (GQNs), Generative Replay Memory, Generative Synthesis, Google Cloud AutoML, Graph Embeddings, Graph Networks, Hyperparameter Optimization, Hyperparameter Tuning, Image Generation, Image Inpainting, Image Synthesis, Image-to-Image Translation, Large Language Models (LLM), MLOps, Machine Learning Algorithms, Machine Translation, Meta-learning, Model Compression, Model Interpretation, Model Training, Music Generation, Neural Network Architecture Design, Predictive Modeling, Probabilistic Generative Models, Probabilistic Programming, Random Forest, Recurrent Neural Networks (RNN), Responsible AI, Style Transfer, StyleGAN, Synthetic Data Generation, Text Generation, Text-to-Image Generation, Time Series Forecasting, Transformer Models, Variational Autoencoders, Variational Autoencoders (VAEs), Video Generation, and k-means clustering.

Quid

Quid Insights prepared by Bill Valle and Heather English

Quid uses its own in-house LLM and other smart search features, as well as traditional Boolean query, to search for focus areas, topics, and keywords within many datasets: social media, news, forums and blogs, companies, patents, as well as other custom feeds of data (e.g., survey data). Quid has many visualization options and data delivery endpoints, including network graphs based on semantic similarity, in-platform dashboarding capabilities, as well as programmatic PostgreSQL database delivery, and so on. Quid applies best-in-class AI and NLP to reveal hidden patterns in large datasets, enabling users to make data-driven decisions accurately, quickly, and efficiently.

Search, Data Sources, and Scope

Over 8 million global public and private company profiles from multiple data sources are indexed to search across company descriptions, while filtering and including metadata ranging from investment information to firmographic information, such as founded year, HQ location, and more. Company information is updated on a weekly basis. The Quid algorithm reads a large amount of text data from each document to make links between different documents based on their similar language. This process is repeated at an immense scale, which produces a network with different clusters identifying distinct topics or focus areas. Trends are identified based on keywords, phrases, people, companies, and institutions that Quid identifies, and the other metadata that is put into the software.

Data

Companies

Organization data is embedded from Capital IQ and Crunchbase. These companies include all types of organizations (private, public, operating, operating as a subsidiary, out of business) throughout the world. The investment data includes private investments, M&A, public offerings, minority stakes made by PE/VCs, corporate venture arms, governments, and institutions both within and outside the United States. Some data is simply unreachable—for instance, when investors' names or funding amounts are undisclosed.

Quid embeds Capital IQ data as a default and adds in data from Crunchbase for the data points

that are not captured in Capital IQ. This not only yields comprehensive and accurate data on all global organizations, but it also captures early-stage startups and funding events data. Company information is updated on a weekly basis.

Earnings Calls

Quid leverages earnings call transcript data embedded from Seeking Alpha. For this report, Quid has analyzed mentions of AI-related keywords across all earnings call transcripts from Fortune 500 companies from January 2018 through December 2023. New earnings call transcript data is updated in Quid on the 1st and 15th of every month.

Search Parameters

Boolean query is used to search for focus areas, topics, and keywords within the archived company database, within their business descriptions and websites. We can filter out the search results by HQ regions, investment amount, operating status, organization type (private/public), and founding year. Quid then visualizes these companies by semantic similarity. If there are more than 7,000 companies from the search result, Quid selects the 7,000 most relevant companies for visualization based on the language algorithm.

Boolean search: "artificial intelligence" or "AI" or "machine learning" or "deep learning"

Companies

- Global AI and ML companies that have received investments (private, IPO, M&A) from January 1, 2013, to December 31, 2023.
- Global AI and ML companies that have received over $1.5M for the last 10 years (January 1, 2013, to December 31, 2023).
- Global data was also pulled for a Generative AI query (Boolean search: "generative AI" OR "gen AI" OR "generative artificial intelligence") for companies that have received over $1.5M for the last 10 years (January 1, 2013, to December 31, 2023).

Target Event Definitions

- Private investments: A private placement is a private sale of newly issued securities (equity or debt) by a company to a selected investor or a selected group of investors. The stakes that buyers take in private placements are often minority stakes (under 50%), although it is possible to take control of a company through a private placement as well, in which case the private placement would be a majority stake investment.
- Minority investment: These refer to minority stake acquisitions in Quid, which take place when the buyer acquires less than 50% of the existing ownership stake in entities, asset products, and business divisions.
- M&A: This refers to a buyer acquiring more than 50% of the existing ownership stake in entities, asset products, and business divisions.

McKinsey & Company

Data used in the Corporate Activity–Industry Adoption section was sourced from the McKinsey Global Survey "The State of AI in 2023: Generative AI's Breakout Year."

The online survey was in the field April 11, 2023, to April 21, 2023, and garnered responses from 1,684 participants representing the full range of regions, industries, company sizes, functional specialties, and tenures. Of those respondents, 913 said their organizations had adopted AI in at least one function

and were asked questions about their organization's AI use. To adjust for differences in response rates, the data is weighted by the contribution of each respondent's nation to global GDP.

The AI Index also considered data from previous iterations of the survey. More specifically, the AI index made use of data from:

The State of AI in 2022—and a Half Decade in Review

The State of AI in 2021

The State of AI in 2020

AI Proves Its Worth, But Few Scale Impact (2019)

AI Adoption Advances, But Foundational Barriers Remain (2018)

Stack Overflow

Data on the use of AI by developers was sourced from the 2023 Developer Survey. The survey was conducted from May 8, 2023, to May 19, 2023, and incorporates the insights of 89,184 software developers from 185 countries around the world.

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