CHAPTER 3:
The Economy

CHAPTER 3:
Chapter Preview

ACCESS THE PUBLIC DATA

Overview

The rise of artificial intelligence (AI) inevitably raises the question of how much the technologies will impact businesses, labor, and the economy more generally. Considering the recent progress and numerous breakthroughs in AI, the field offers substantial benefits and opportunities for businesses, from increasing productivity gains with automation to tailoring products to consumers using algorithms, analyzing data at scale, and more.

However, the boost in efficiency and productivity promised by AI also presents great challenges: Companies must scramble to find and retain skilled talent to meet their production needs while being mindful about implementing measures to mitigate the risks of using AI. Moreover, the COVID-19 pandemic has caused chaos and continued uncertainty for the global economy. How have private companies relied on and scaled AI technologies to help their business navigate through this most difficult time?

This chapter looks at the increasingly intertwined relationship between AI and the global economy from the perspective of jobs, investment, and corporate activity. It first analyzes the worldwide demand for AI talent using data on hiring rates and skill penetration rates from LinkedIn as well as AI job postings from Burning Glass Technologies. It then looks at trends in private AI investment using statistics from S&P Capital IQ (CapIQ), Crunchbase, and Quid. The third, final section analyzes trends in the adoption of AI capabilities across companies, trends in robot installations across countries, and mentions of AI in corporate earnings, drawing from McKinsey's Global Survey on AI, the International Federation of Robotics (IFR), and Prattle, respectively.

CHAPTER HIGHLIGHTS

- "Drugs, Cancer, Molecular, Drug Discovery" received the greatest amount of private AI investment in 2020, with more than USD 13.8 billion, 4.5 times higher than 2019.

- Brazil, India, Canada, Singapore, and South Africa are the countries with the highest growth in AI hiring from 2016 to 2020. Despite the COVID-19 pandemic, the AI hiring continued to grow across sample countries in 2020.

- More private investment in AI is being funneled into fewer startups. Despite the pandemic, 2020 saw a 9.3% increase in the amount of private AI investment from 2019—a higher percentage increase than in 2019 (5.7%), though the number of newly funded companies decreased for the third year in a row.

- Despite growing calls to address ethical concerns associated with using AI, efforts to address these concerns in the industry are limited, according to a McKinsey survey. For example, issues such as equity and fairness in AI continue to receive comparatively little attention from companies. Moreover, fewer companies in 2020 view personal or individual privacy risks as relevant, compared with in 2019, and there was no change in the percentage of respondents whose companies are taking steps to mitigate these particular risks.

- Despite the economic downturn caused by the pandemic, half the respondents in a McKinsey survey said that the coronavirus had no effect on their investment in AI, while 27% actually reported increasing their investment. Less than a fourth of businesses decreased their investment in AI.

- The United States recorded a decrease in its share of AI job postings from 2019 to 2020—the first drop in six years. The total number of AI jobs posted in the United States also decreased by 8.2%, from 325,724 in 2019 to 300,999 in 2020.

Attracting and retaining skilled AI talent is challenging. This section examines the latest trend in AI hiring, labor demand, and skill penetration, with data from LinkedIn and Burning Glass.

3.1 JOBS

AI HIRING

How rapidly is the growth of AI jobs in different countries? This section first looks at LinkedIn data that gives the AI hiring rate for different countries. The AI hiring rate is calculated as the number of LinkedIn members who include AI skills on their profile or work in AI-related occupations and who added a new employer in the same month their new job began, divided by the total number of LinkedIn members in the country. This rate is then indexed to the average month in 2016; for example, an index of 1.05 in December 2020 points to a hiring rate that is 5% higher than the average month in 2016. LinkedIn makes month-to-month comparisons to account for any potential lags in members updating their profiles. The index for a year is the average index over all months within that year.

This data suggests that the hiring rate has been increasing across all sample countries in 2020. Brazil, India, Canada, Singapore, and South Africa are the countries with the highest growth in AI hiring from 2016 to 2020 (Figure 3.1.1). Across the 14 countries analyzed, the AI hiring rate in 2020 was 2.2 times higher, on average, than that in 2016. For the top country, Brazil, the hiring index grew by more than 3.5 times. Moreover, despite the COVID-19 pandemic, AI hiring continued its growth across the 14 sampled countries in 2020 (Figure 3.1.2).

For more explorations of cross-country comparisons, see the AI Index Global AI Vibrancy Tool.

AI HIRING INDEX by COUNTRY, 2020

Source: LinkedIn, 2020 | Chart: 2021 AI Index Report

Figure 3.1.1

1 Countries included are a sample of eligible countries with at least 40% labor force coverage by LinkedIn and at least 10 AI hires in any given month. China and India were also included in this sample because of their increasing importance in the global economy, but LinkedIn coverage in these countries does not reach 40% of the workforce. Insights for these countries may not provide as full a picture as in other countries, and should be interpreted accordingly.

AI HIRING INDEX by COUNTRY, 2016-20

Source: LinkedIn, 2020 | Chart: 2021 AI Index Report

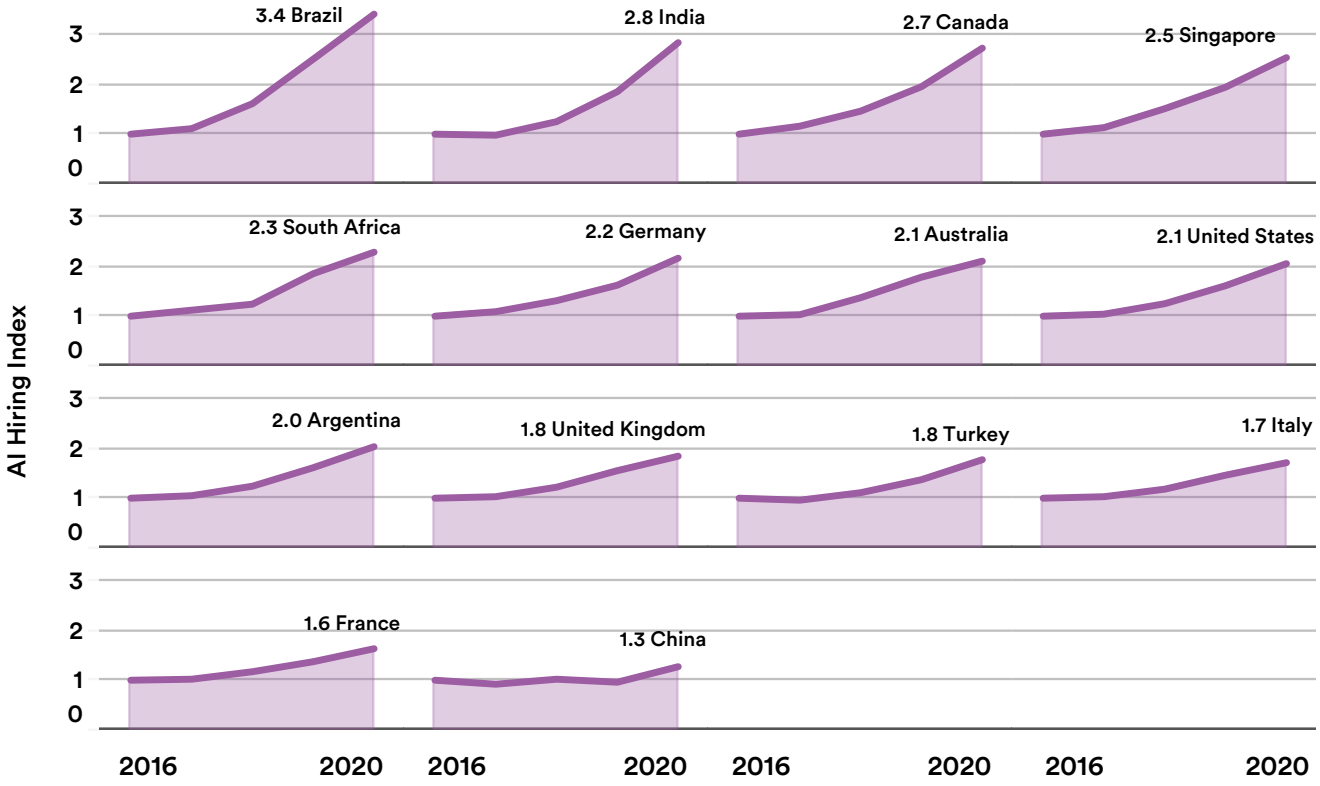

Figure 3.1.2

AI LABOR DEMAND

This section analyzes the AI labor demand based on data from Burning Glass, an analytics firm that collects postings from over 45,000 online job sites. To develop a comprehensive, real-time portrait of labor market demand, Burning Glass aggregated job postings, removed duplicates, and extracted data from job posting text. Note that Burning Glass updated the data coverage in 2020 with more job sites; as a result, the numbers in this report should not be directly compared with data in the 2019 report.

Global AI Labor Demand

Demand for AI labor in six countries covered by Burning Glass data—the United States, the United Kingdom, Canada, Australia, New Zealand, and Singapore—has grown significantly in the last seven years (Figure 3.1.3). On average, the share of AI job postings among all job postings in 2020 is more than five times larger than in 2013. Of the six countries, Singapore exhibits the largest growth, as its percentage of AI job postings across all job roles in 2020 is 13.5 times larger than in 2013.

The United States is the only country among the six that recorded a decrease in its share of AI job postings from 2019 to 2020—the first drop in six years. This may be due to the coronavirus pandemic or the country's relatively more mature AI labor market. The total number of AI jobs posted in the United States also decreased by 8.2%, from 325,724 in 2019 to 300,999 in 2020.

AI JOB POSTINGS (% of ALL JOB POSTINGS) by COUNTRY, 2013-20
Source: Burning Glass, 2020 | Chart: 2021 AI Index Report

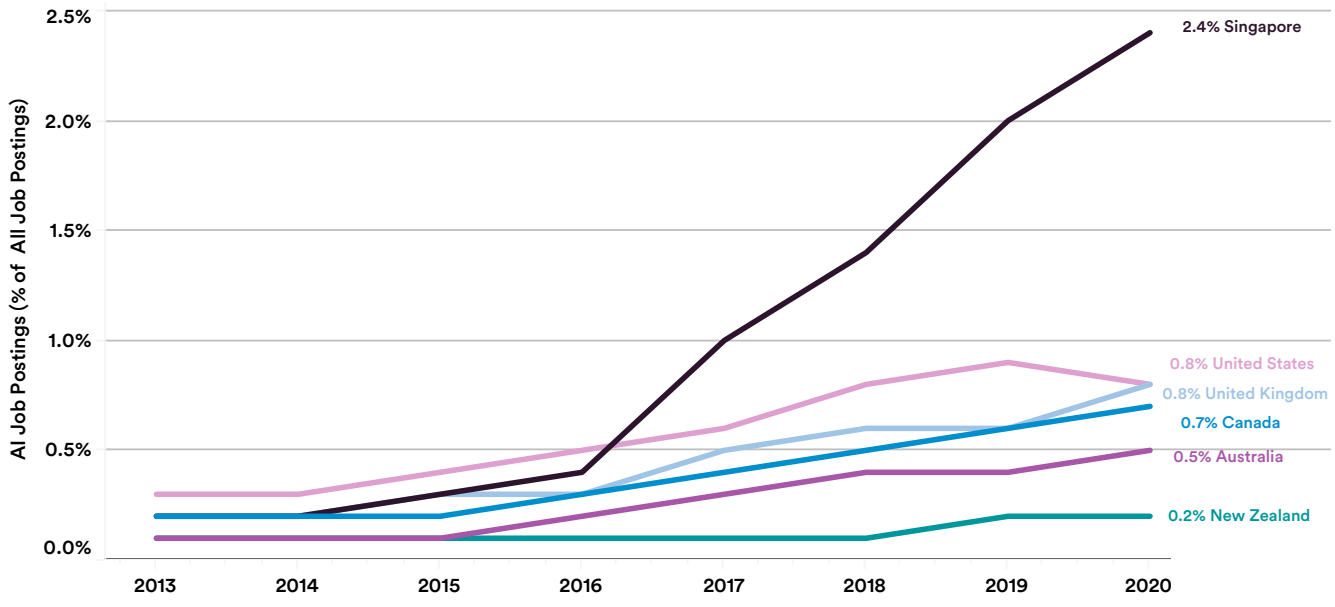

Figure 3.1.3

U.S. AI Labor Demand: By Skill Cluster

Taking a closer look at the AI labor demand in the United States between 2013 and 2020, Figure 3.1.4 breaks down demand during that period year by year according to skill cluster. Each skill cluster consists of a list of AI-related skills; for example, the neural network skill cluster includes skills like deep learning and convolutional neural network. The Economy chapter appendix provides a complete list of AI skills under each skill cluster.

Between 2013 and 2020, AI jobs related to machine learning and artificial intelligence experienced the fastest growth in online AI job postings in the United States, increasing from 0.1% of total jobs to 0.5% and 0.03% to 0.3%, respectively. As noted earlier, 2020 shows a decrease in the share of AI jobs among overall job postings across all skill clusters.

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AI JOB POSTINGS (% of ALL JOB POSTINGS) in the UNITED STATES by SKILL CLUSTER, 2013-20
Source: Burning Glass, 2020 | Chart: 2021 AI Index Report

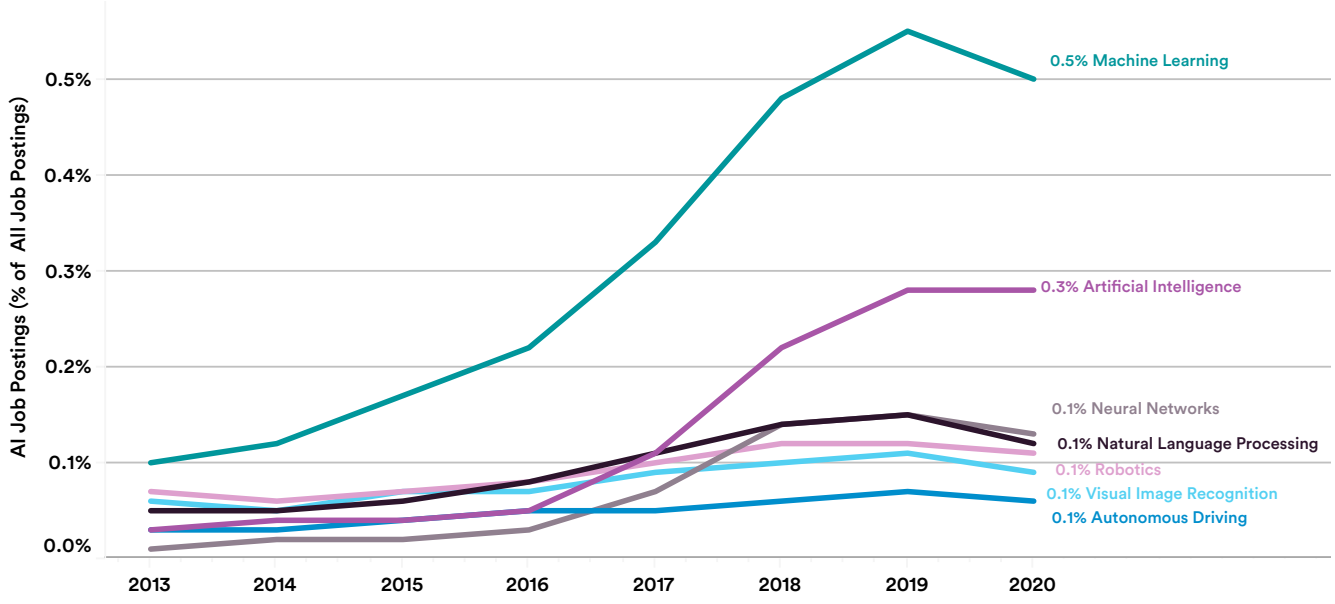

Figure 3.1.4

U.S. Labor Demand: By Industry

To dive deeper into how AI job demand in the U.S. labor market varies across industries, this section looks at the share of AI job postings across all jobs posted in the United States by industry in 2020 (Figure 3.1.5) as well as the trend in the past 10 years (Figure 3.1.6).

In 2020, industries focused on information (2.8%); professional, scientific, and technical services (2.5%); and agriculture, forestry, fishing, and hunting (2.1%) had the highest share of AI job postings among all job postings in the United States. While the first two have always dominated demand for AI jobs, the agriculture, forestry, fishing, and hunting industry saw the biggest jump—by almost 1 percentage point—in the share of AI jobs from 2019 to 2020.

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AI JOB POSTINGS (% of ALL JOB POSTINGS) in the UNITED STATES by INDUSTRY, 2020

Source: Burning Glass, 2020 | Chart: 2021 AI Index Report

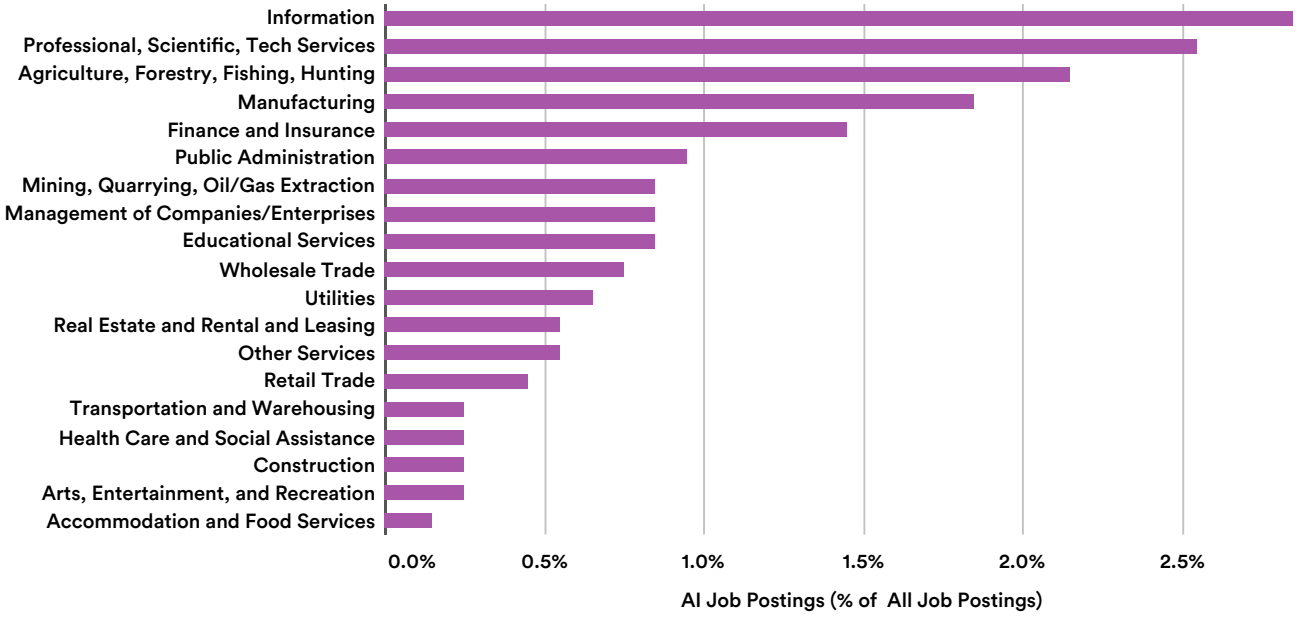

Figure 3.1.5

AI JOB POSTINGS (% of ALL JOB POSTINGS) in the UNITED STATES by INDUSTRY, 2013-20

Source: Burning Glass, 2020 | Chart: 2021 AI Index Report

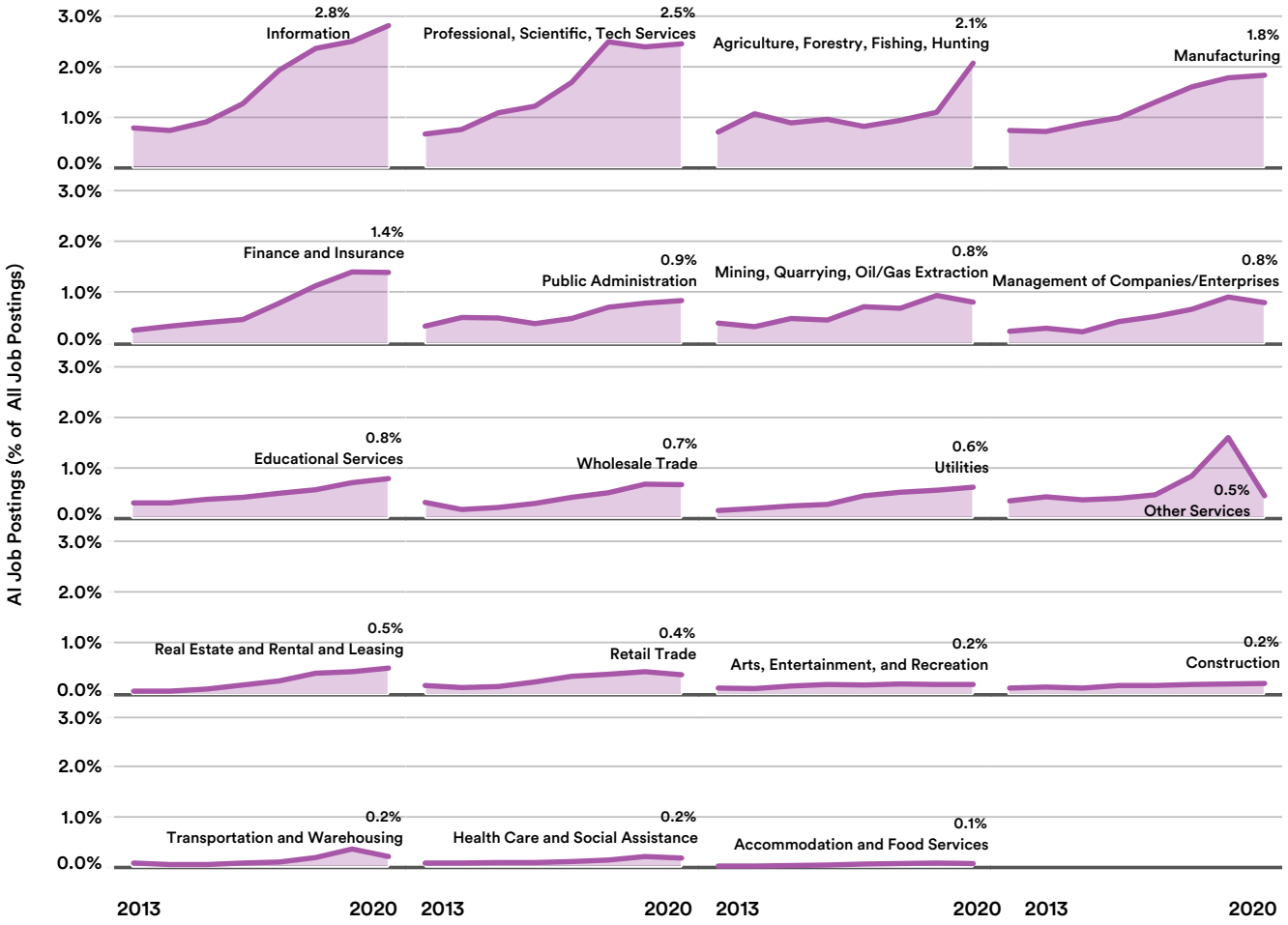

Figure 3.1.6

U.S. Labor Demand: By State

As the competition for AI talent intensifies, where are companies seeking employees with machine learning, data science, and other AI-related skills within the United States?

Figure 3.1.7 examines the labor demand by U.S. state in 2020, plotting the share of AI job postings across all job postings on the y-axis and the total number of AI jobs posted on a log scale on the x-axis. The chart shows that the District of Columbia has the highest share of AI jobs posted (1.88%), overtaking Washington state in 2019; and California remains the state with the highest number of AI job postings (63,433).

In addition to Washington, D.C., six states registered over 1% of AI job postings among all job postings—Washington, Virginia, Massachusetts, California, New York, and Maryland—compared with five last year. California also has more AI job postings than the next three states combined, which are Texas (22,539), New York (18,580), and Virginia (17,718).

AI JOB POSTINGS (TOTAL and % of ALL JOB POSTINGS) by U.S. STATE and DISTRICT, 2020
Source: Burning Glass, 2020 | Chart: 2021 AI Index Report

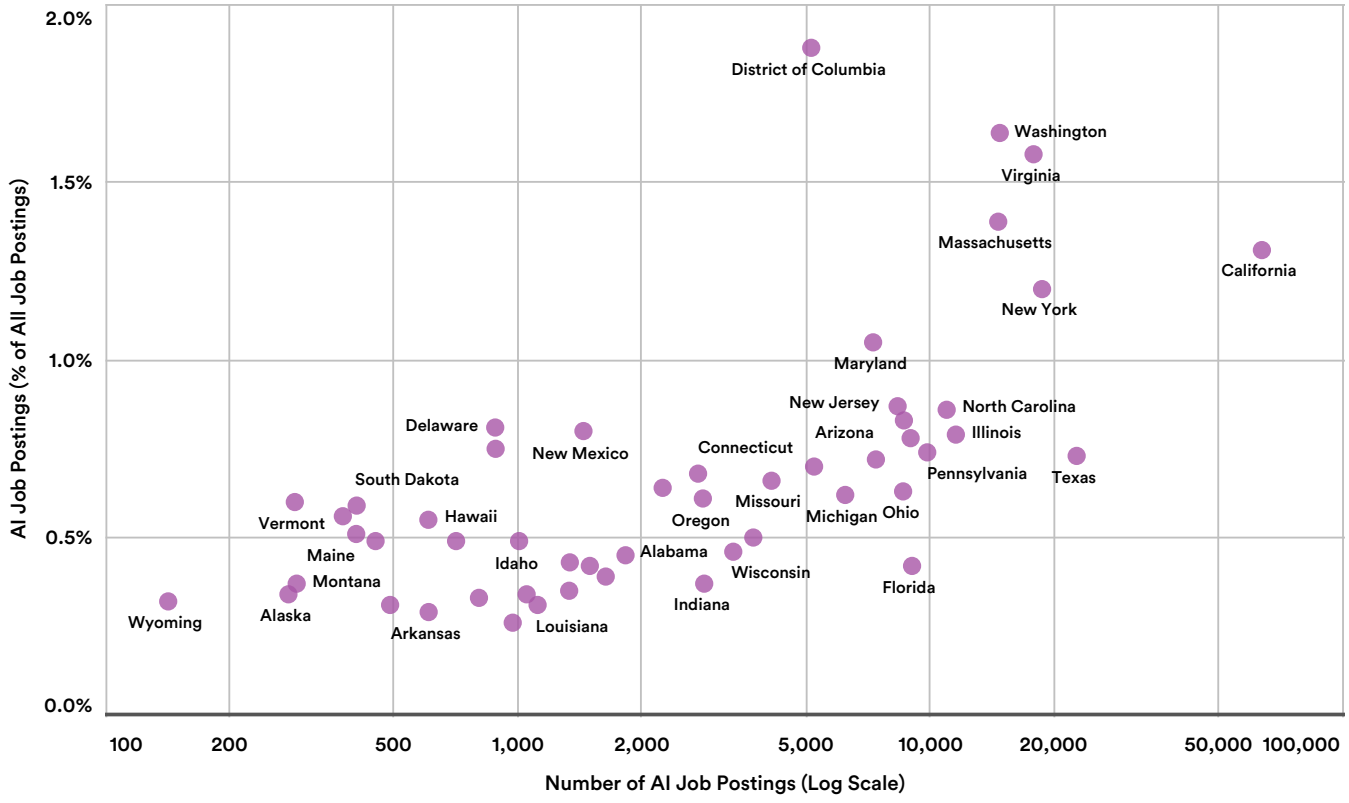

Figure 3.1.7

AI SKILL PENETRATION

How prevalent are AI skills across occupations? The AI skill penetration metric shows the average share of AI skills among the top 50 skills in each occupation, using LinkedIn data that includes skills listed on a member's profile, positions held, and the locations of the positions.

Global Comparison

For cross-country comparison, the relative penetration rate of AI skills is 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 same occupations. For example, a relative penetration rate of 2 means that the average penetration of AI skills in that country is 2 times the global average across the same set of occupations.

Among the sample countries shown in Figure 3.1.8, the aggregated data from 2015 to 2020 shows that India (2.83 times the global average) has the highest relative AI skill penetration rate, followed by the United States (1.99 times the global average), China (1.40 times the global average), Germany (1.27 times the global average), and Canada (1.13 times the global average).[2]

RELATIVE AI SKILL PENETRATION RATE by COUNTRY, 2015-20
Source: LinkedIn, 2020 | Chart: 2021 AI Index Report

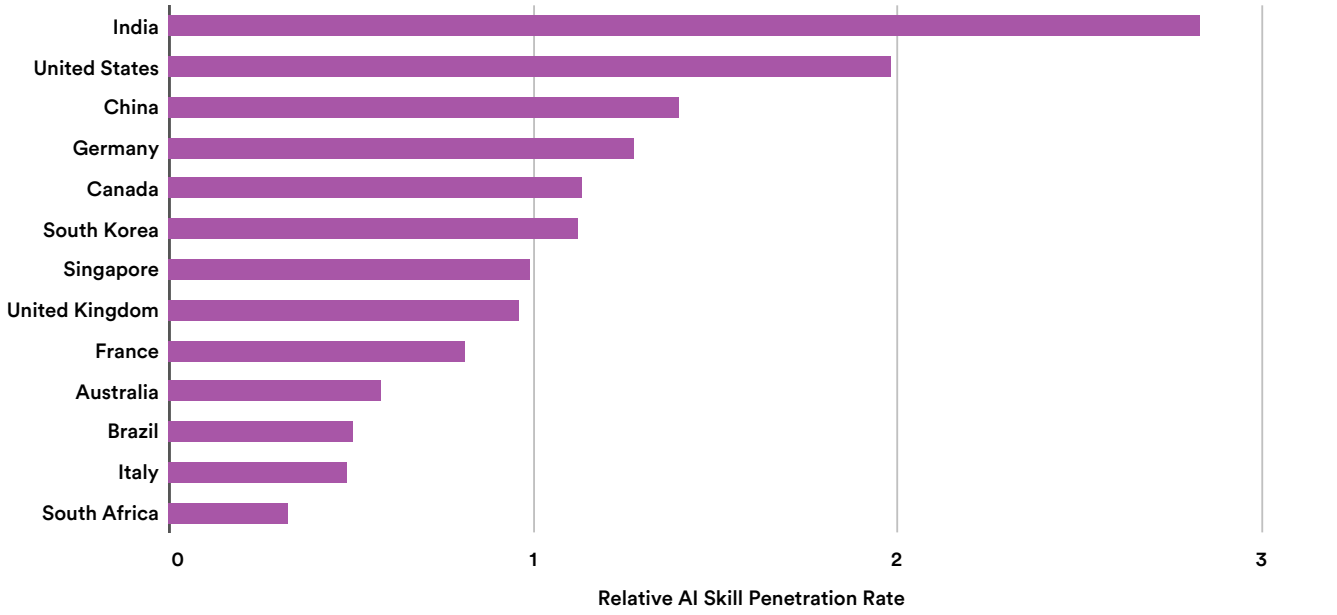

Figure 3.1.8

2 Countries included are 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. China and India were included in this sample because of their increasing importance in the global economy, but LinkedIn coverage in these countries does not reach 40% of the workforce. Insights for these countries may not provide as full a picture as other countries, and should be interpreted accordingly.

Global Comparison: By Industry

To provide an in-depth sectoral decomposition of AI skill penetration across industries and sample countries, Figure 3.1.9 includes the aggregated data of the top five industries with the highest AI skill penetration globally in the last five years: education, finance, hardware and networking, manufacturing, and software and IT.[3] India has the highest relative AI skill penetration across all five industries, while the United States and China frequently appear high up on the list. Other pockets of specialization worth highlighting with relative skill penetration rates of more than 1 include Germany in hardware and networking as well as manufacturing; and Israel in manufacturing and education.

RELATIVE AI SKILL PENETRATION RATE by INDUSTRY, 2015-20
Source: LinkedIn, 2020 | Chart: 2021 AI Index Report

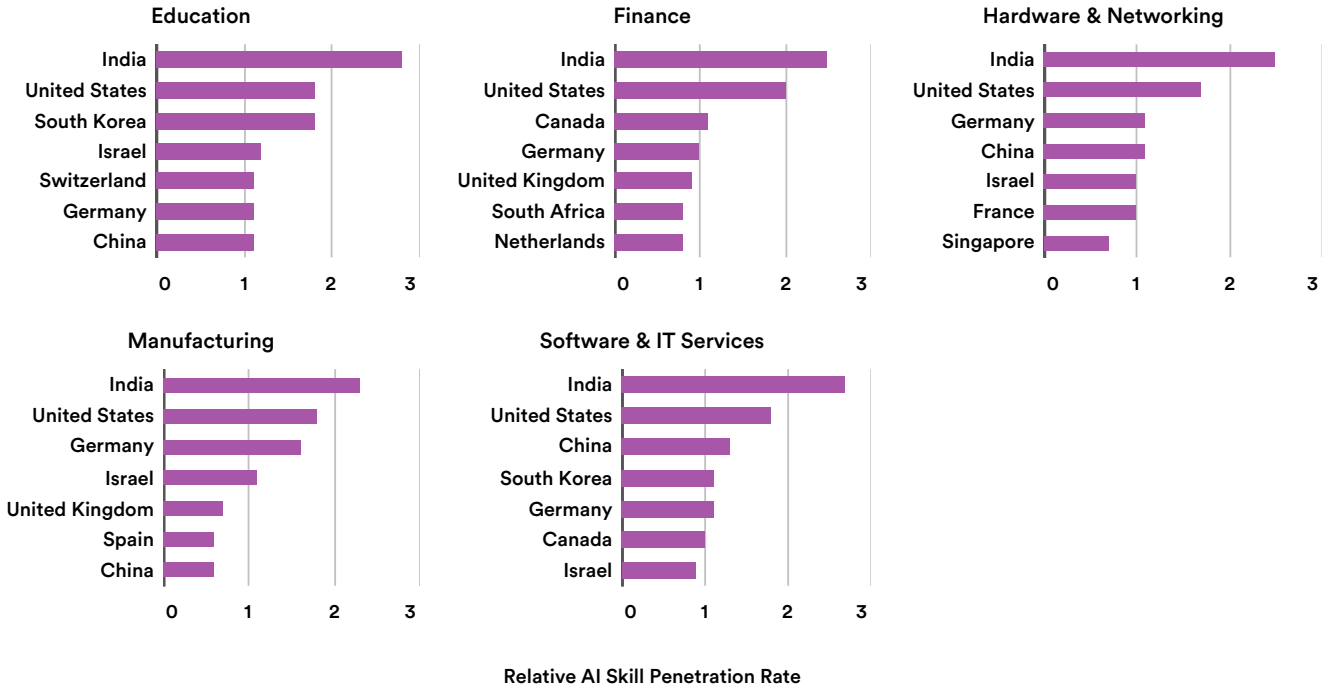

Figure 3.1.9

3 Countries included are 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. China and India were included in this sample because of their increasing importance in the global economy, but LinkedIn coverage in these countries does not reach 40% of the workforce. Insights for these countries may not provide as full a picture as other countries, and should be interpreted accordingly.

This section explores the investment activity of private companies by NetBase Quid based on data from CapIQ and Crunchbase. Specifically, it looks at the latest trends in corporate AI investment, such as private investment, public offerings, mergers and acquisitions (M&A), and minority stakes related to AI. The section then focuses on the private investment in AI, or how much private funding goes into AI startups and which sectors are attracting significant investment and in which countries.

3.2 INVESTMENT

CORPORATE INVESTMENT

The total global investment in AI, including private investment, public offerings, M&A, and minority stakes, increased by 40% in 2020 relative to 2019 for a total of USD 67.9 billion (Figure 3.2.1). Given the pandemic, many small businesses have suffered disproportionately. As a result, industry consolidation and increased M&A activity in 2020 are driving up the total corporate investment in AI. M&A made up the majority of the total investment amount in 2020, increasing by 121.7% relative to 2019. Several high-profile acquisitions related to AI took place in 2020, including NVIDIA's acquisition of Mellanox Technologies and Capgemini's of Altran Technologies.

GLOBAL CORPORATE INVESTMENT in AI by INVESTMENT ACTIVITY, 2015-20

Source: CapIQ, Crunchbase, and NetBase Quid, 2020 | Chart: 2021 AI Index Report

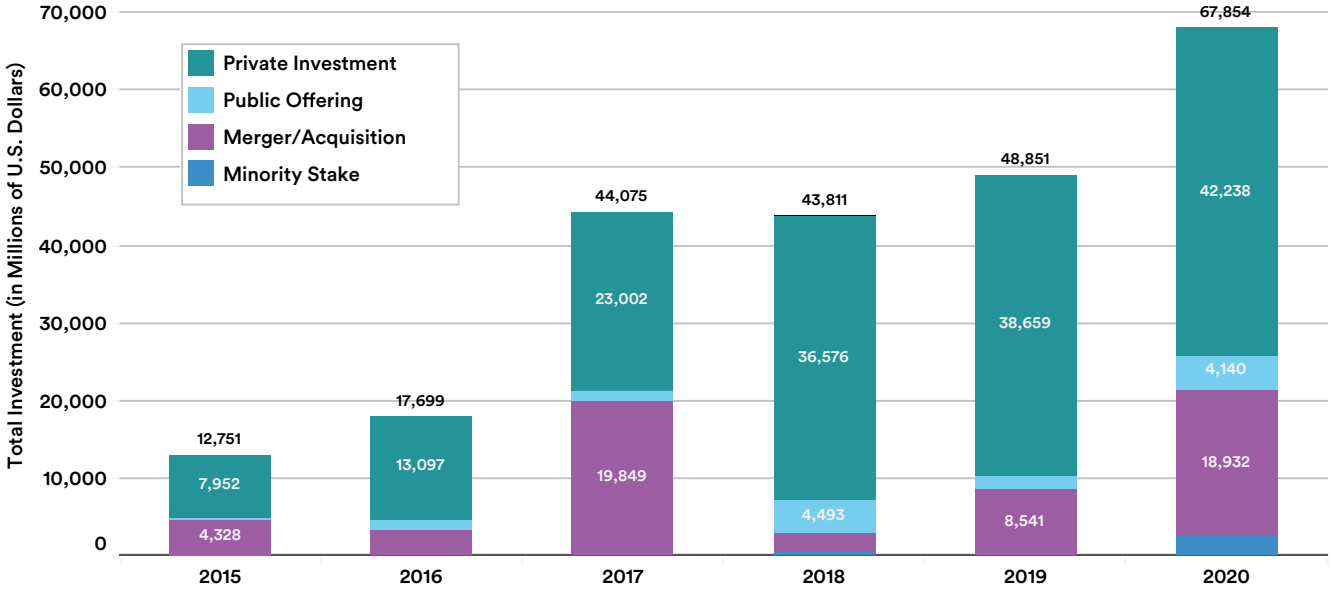

Figure 3.2.1

STARTUP ACTIVITY

The following section analyzed the trend of private investment in AI startups that have received investments of over USD 400,000 in the last 10 years. While the amount of private investment in AI has soared dramatically in recent years, the rate of growth has slowed.

Global Trend

More private investment in AI is being funneled into fewer startups. Despite the pandemic, 2020 saw a 9.3% increase in the amount of private AI investment from 2019—a higher percentage than the 5.7% increase in 2019 (Figure 3.2.2), though the number of companies funded decreased for the third year in a row (Figure 3.2.3). While there was a record high of more than USD 40 billion in private investment in 2020, that represents only a 9.3% increase from 2019—compared with the largest increase of 59.0%, observed between 2017 and 2018. Moreover, the number of funded AI startups continued a sharp decline from its 2017 peak.

PRIVATE INVESTMENT in FUNDED AI COMPANIES, 2015-20
Source: CapIQ, Crunchbase, and NetBase Quid, 2020 | Chart: 2021 AI Index Report

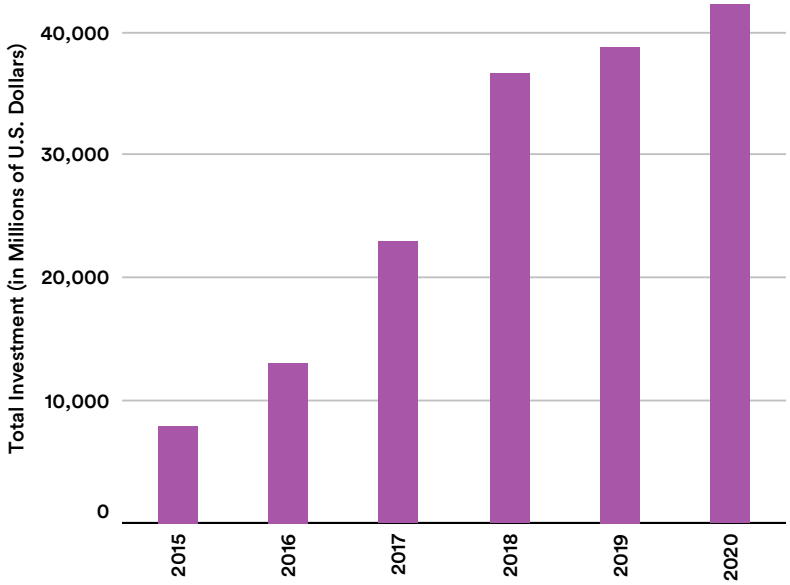

Figure 3.2.2

NUMBER OF NEWLY FUNDED AI COMPANIES in the WORLD, 2015-20
Source: CapIQ, Crunchbase, and NetBase Quid, 2020 | Chart: 2021 AI Index Report

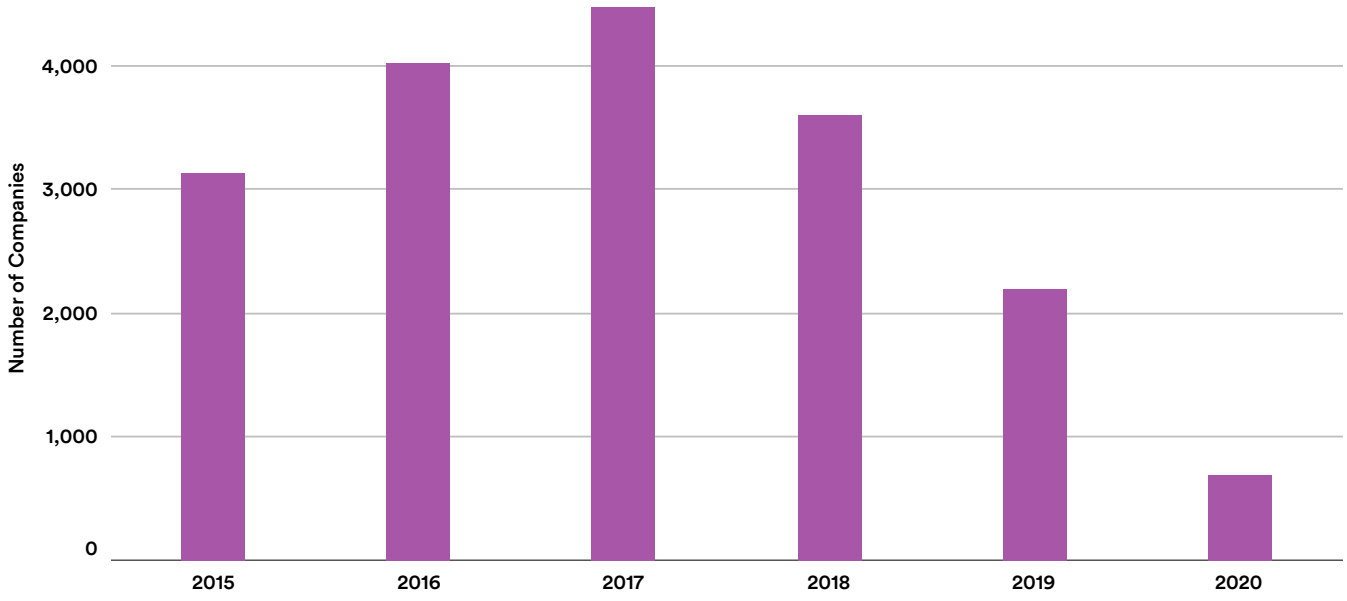

Figure 3.2.3

Regional Comparison

As shown in Figure 3.2.4, the United States remains the leading destination for private investment, with over USD 23.6 billion in funding in 2020, followed by China (USD 9.9 billion) and the United Kingdom (USD 1.9 billion).

PRIVATE INVESTMENT in AI by COUNTRY, 2020
Source: CapIQ, Crunchbase, and NetBase Quid, 2020 | Chart: 2021 AI Index Report

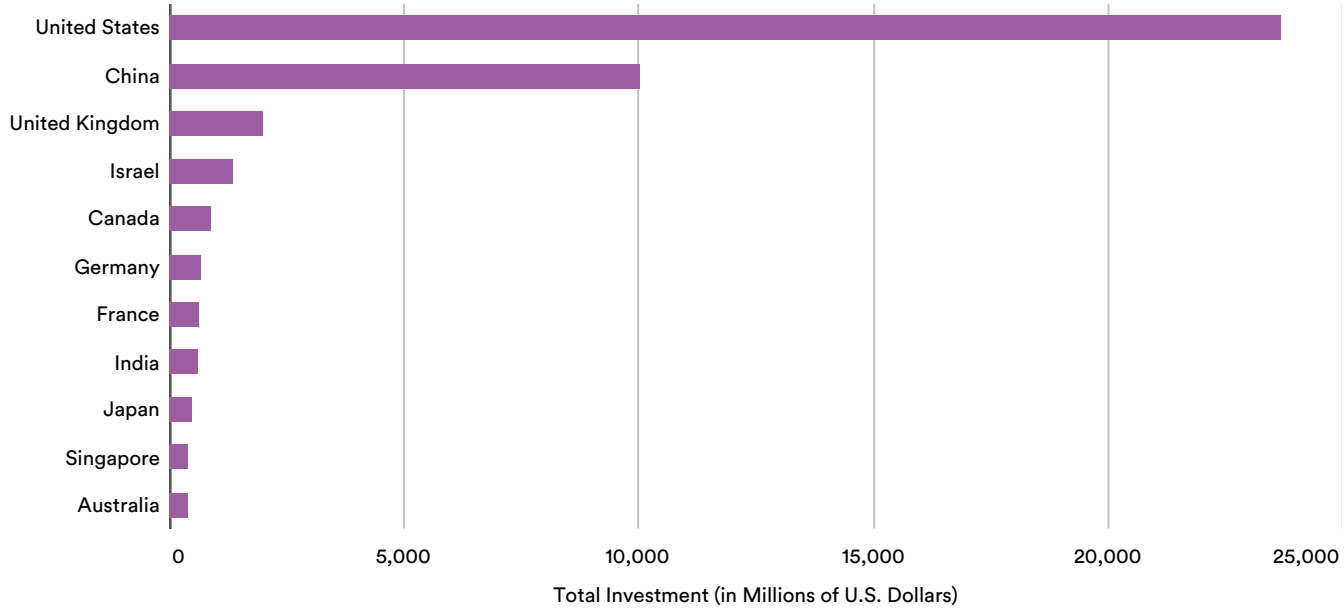

Figure 3.2.4

A closer examination of the three contenders leading the AI race—the United States, China, and the European Union—further validates the United States' dominant position in private AI investment. While China saw an exceptionally high amount of private AI investment in 2018, its investment level in 2020 is less than half that of the United States (Figure 3.2.5). It is important to note, however, that China has strong public investments in AI. Both the central and local governments in China are spending heavily on AI R&D.[4]

4 See "A Brief Examination of Chinese Government Expenditures on Artificial Intelligence R&D" (2020) by the Institute for Defense Analyses for more details.

PRIVATE INVESTMENT in AI by GEOGRAPHIC AREA, 2015-20

Source: CAPIQ, Crunchbase, and NetBase Quid, 2020 | Chart: 2021 AI Index Report

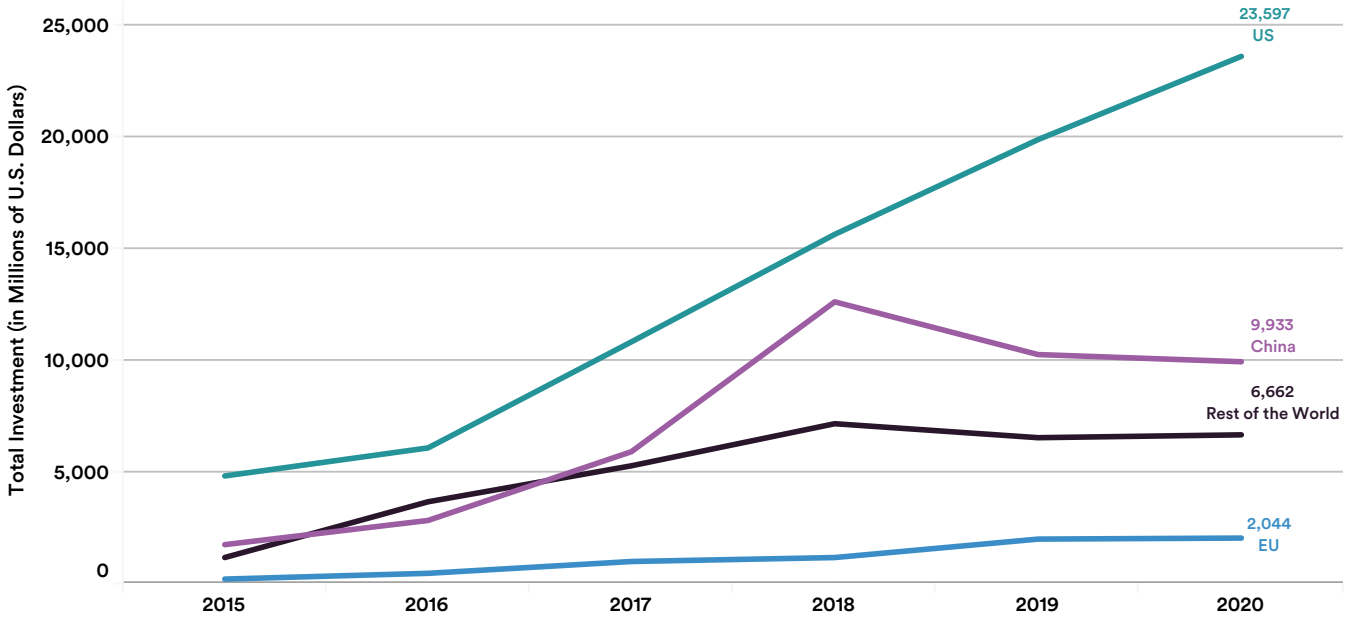

Figure 3.2.5

Focus Area Analysis

Figure 3.2.6 shows the ranking of the top 10 focus areas that receive the greatest amount of private investment in 2020 as well as their respective investment amount in 2019. The "Drugs, Cancer, Molecular, Drug Discovery" area tops the list, with more than USD 13.8 billion in private AI investment—4.5 times higher than 2019—followed by "Autonomous Vehicles, Fleet, Autonomous Driving, Road" (USD 4.5 billion), and "Students, Courses, Edtech, English Language" (USD 4.1 billion).

In addition to Drugs, Cancer, Molecular, Drug Discovery," both "Games, Fans, Gaming, Football" and "Students, Courses, Edtech, English Language" saw a significant increase in the amount of private AI investment from 2019 to 2020. The former is largely driven by several financing rounds to gaming and sports startups in the United States and South Korea, while the latter is boosted by investments in an online education platform in China.

GLOBAL PRIVATE INVESTMENT in AI by FOCUS AREA, 2019 vs 2020

Source: CapIQ, Crunchbase, and NetBase Quid, 2020 | Chart: 2021 AI Index Report

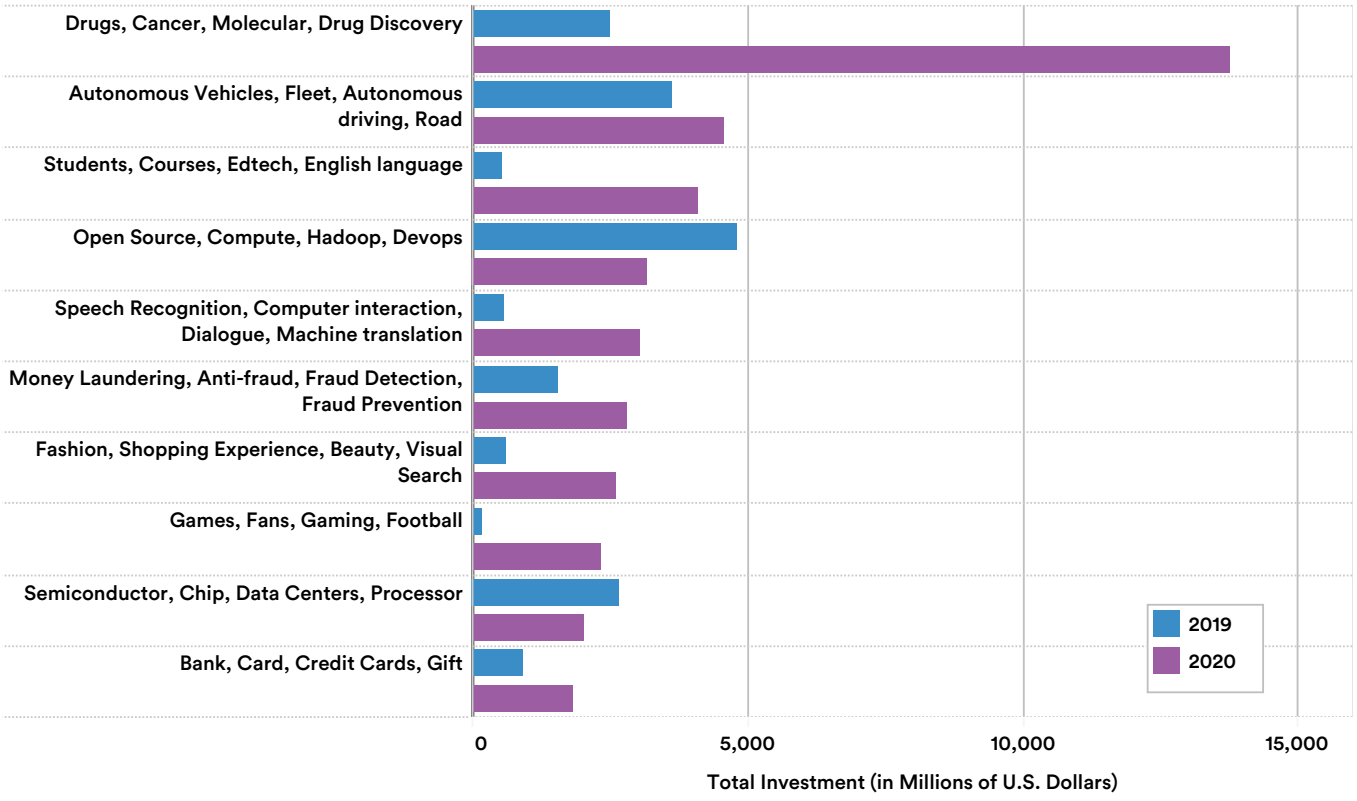

Figure 3.2.6

This section reviews how corporations have capitalized on the advances in AI, using AI and automation to their advantage and generating value at scale. While the number of corporations starting to deploy AI technologies has surged in recent years, the economic turmoil and impact of COVID-19 in 2020 have slowed that rate of adoption. The latest trends in corporate AI activities are examined through data on the adoption of AI capabilities by McKinsey's Global Survey on AI, trends in robot installations across the globe by the International Federation of Robotics (IFR), and mentions of AI in corporate earnings calls by Prattle.

3.3 CORPORATE ACTIVITY

INDUSTRY ADOPTION

This section shares the results of a McKinsey & Company survey of 2,395 respondents: individuals representing companies from a range of regions, industries, sizes, functional specialties, and tenures.

McKinsey & Company's "The State of AI in 2020" report contains the full results of this survey, including insights on how different companies have adopted AI across functions, core best practices shared among the companies that are generating the greatest value from AI, and the impacts of the COVID-19 pandemic on these companies' AI investment plans.

Global Adoption of AI

The 2020 survey results suggest no increase in AI adoption relative to 2019. Over 50% of respondents say that their organizations have adopted AI in at least one business function (Figure 3.3.1). In 2019, 58% of respondents said their companies adopted AI in at least one function, although the 2019 survey asked about companies' AI adoption differently.

In 2020, companies in developed Asia-Pacific countries led in AI adoptions, followed by those in India and North America. While AI adoption was about equal across regions in 2019, this year's respondents working for companies in Latin America and in other developing countries are much less likely to report adopting AI in at least one business function.

AI ADOPTION by ORGANIZATIONS GLOBALLY, 2020

Source: McKinsey & Company, 2020 | Chart: 2021 AI Index Report

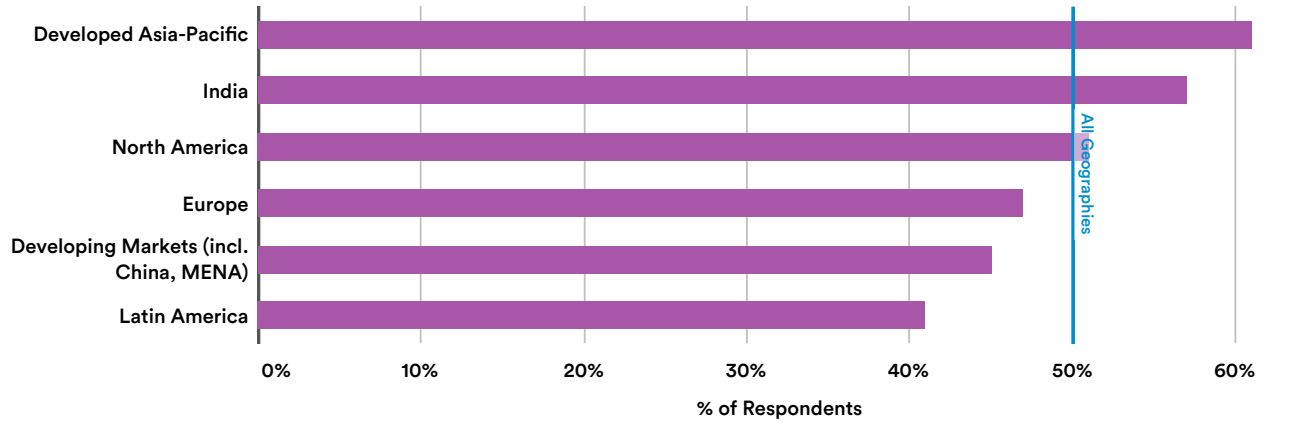

Figure 3.3.1

AI Adoption by Industry and Function

Respondents representing companies in high tech and telecom were most likely to report AI adoption in 2020, similar to the 2019 results, followed in second place by both financial services and automotive and assembly (Figure 3.3.2).

In another repeat from 2019 (and 2018), the 2020 survey suggests that the functions where companies are most likely to adopt AI vary by industry (Figure 3.3.3). For example, respondents in the automotive and assembly industry report greater AI adoption for manufacturing-related tasks than any other; respondents in financial services report greater AI adoption for risk functions; and respondents in high tech and telecom report greater AI adoption for product and service development functions.

Across industries, companies in 2020 are most likely to report using AI for service operations (such as field services, customer care, back office), product and service development, and marketing and sales, similar to the survey results in 2019.

Type of AI Capabilities Adopted

By industry, the type of AI capabilities adopted varies (Figure 3.3.4). Across industries, companies in 2020 were most likely to identify other machine learning techniques, robotic process automation, and computer vision as capabilities adopted in at least one business function.

Industries tend to adopt AI capabilities that best serve their core functions. For example, physical robotics, as well as autonomous vehicles, are most frequently adopted by industries where manufacturing and distribution play a large role—such as automotive and assembly, and consumer goods and retail. Natural language processing capabilities, such as text understanding, speech understanding, and text generation, are frequently adopted by industries with high volumes of customer or operational data in text forms; these include business, legal, and professional services, financial services, healthcare, and high tech and telecom.

AI ADOPTION by INDUSTRY, 2020

Source: McKinsey & Company, 2020 | Chart: 2021 AI Index Report

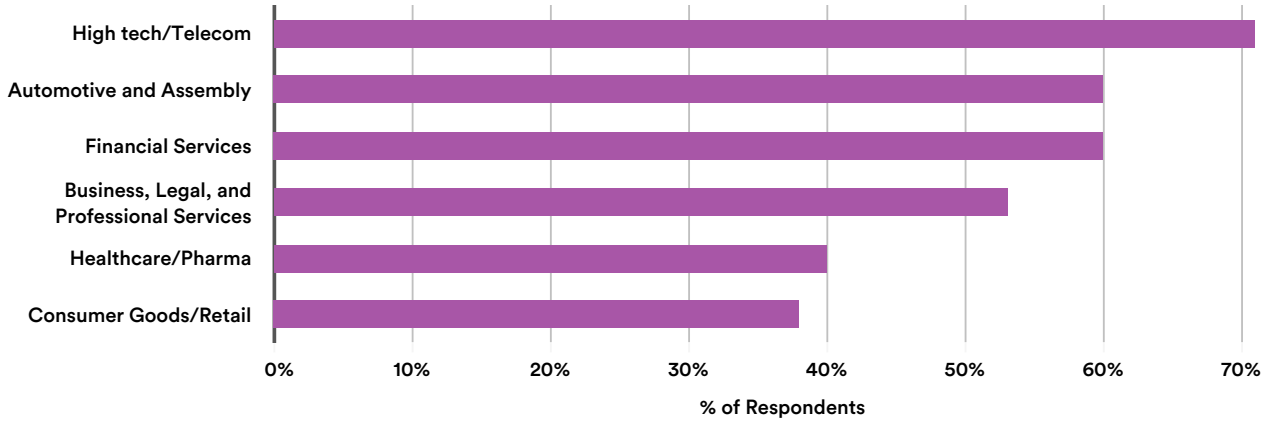

Figure 3.3.2

AI ADOPTION by INDUSTRY & FUNCTION, 2020

Source: McKinsey & Company, 2020 | Chart: 2021 AI Index Report

Industry	Human Resources	Manufacturing	Marketing And Sales	Product and/or Service Development	Risk	Service Operations	Strategy and Corporate Finance	Supply-Chain Management
All Industries	8%	12%	15%	21%	10%	21%	7%	9%
Automotive and Assembly	13%	29%	10%	21%	2%	16%	8%	18%
Business, Legal, and Professional Services	13%	9%	16%	21%	13%	20%	10%	9%
Consumer Goods/Retail	1%	19%	20%	14%	3%	10%	2%	10%
Financial Services	5%	5%	21%	15%	32%	34%	7%	2%
Healthcare/Pharma	3%	12%	16%	15%	4%	11%	2%	6%
High Tech/Telecom	14%	11%	26%	37%	14%	39%	9%	12%

% of Respondents

Figure 3.3.3

AI CAPABILITIES EMBEDDED in STANDARD BUSINESS PROCESSES, 2020

Source: McKinsey & Company, 2020 | Chart: 2021 AI Index Report

Industry	Autonomous Vehicles	Computer Vision	Conversational Interfaces	Deep Learning	NL Generation	NL Speech Understanding	NL Text Understanding	Other Machine Learning Techniques	Physical Robotics	Robotic Process Automation
All Industries	7%	18%	15%	16%	11%	12%	13%	23%	13%	22%
Automotive and Assembly	20%	33%	16%	19%	12%	14%	19%	27%	31%	33%
Business, Legal, and Professional Services	7%	13%	17%	19%	14%	15%	18%	25%	11%	13%
Consumer Goods/Retail	13%	10%	9%	6%	6%	6%	9%	12%	23%	14%
Financial Services	6%	18%	24%	19%	18%	19%	26%	32%	8%	37%
Healthcare/Pharma	1%	15%	10%	14%	12%	11%	15%	19%	10%	18%
High Tech/Telecom	9%	34%	32%	30%	18%	25%	33%	37%	14%	34%

% of Respondents

Figure 3.3.4

Consideration and Mitigation of Risks from Adopting AI

Only a minority of companies acknowledge the risks associated with AI, and even fewer report taking steps to mitigate those risks (Figure 3.3.5 and Figure 3.3.6). Relative to 2019, the share of survey respondents citing each risk as relevant has largely remained flat; that is, most changes were not statistically significant. Cybersecurity remains the only risk a majority of respondents say their organizations consider relevant. A number of less commonly cited risks, such as national security and political stability, were more likely to be seen as relevant by companies in 2020 than in 2019.

Despite growing calls to attend to ethical concerns associated with the use of AI, efforts to address these concerns in the industry are limited. For example, concerns such as equity and fairness in AI use continue to receive comparatively little attention from companies. Moreover, fewer companies in 2020 view personal or individual privacy as a risk from adopting AI compared with in 2019, and there is no change in the percentage of respondents whose companies are taking steps to mitigate this particular risk.

Relative to 2019, the share of survey respondents citing each risk as relevant has largely remained flat; that is, most changes were not statistically significant. Cybersecurity remains the only risk a majority of respondents say their organizations consider relevant.

RISKS from ADOPTING AI THAT ORGANIZATIONS CONSIDER RELEVANT, 2020

Source: McKinsey & Company, 2020 | Chart: 2021 AI Index Report

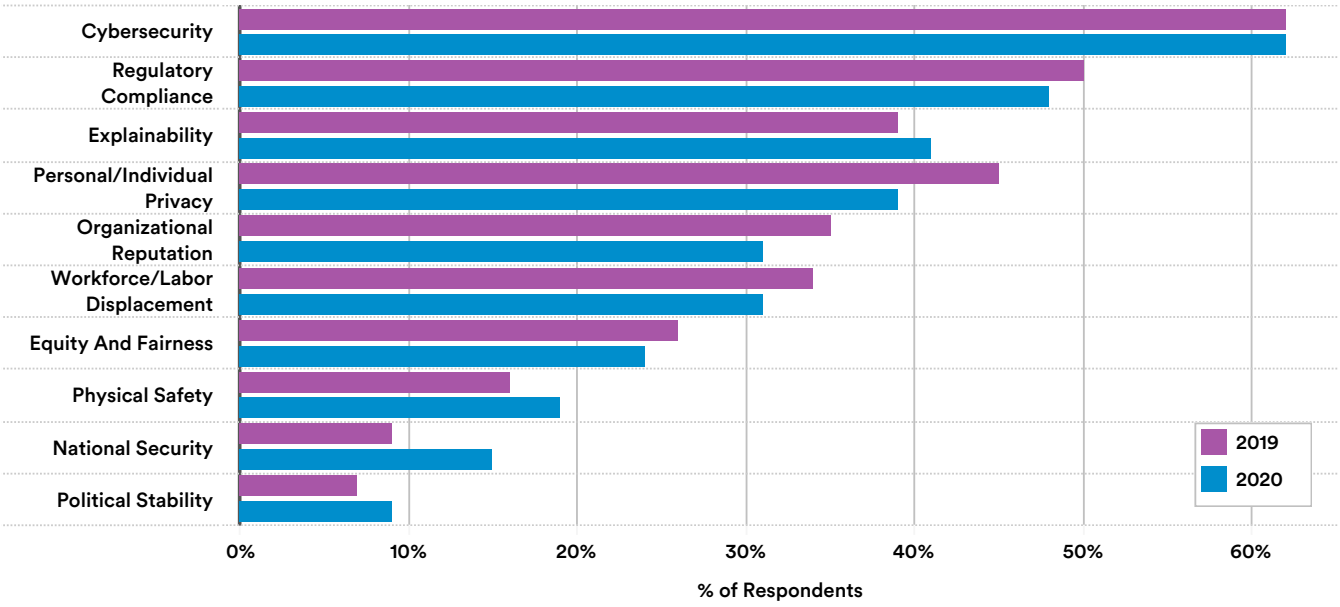

Figure 3.3.5

RISKS from ADOPTING AI THAT ORGANIZATIONS TAKE STEPS to MITGATE, 2020

Source: McKinsey & Company, 2020 | Chart: 2021 AI Index Report

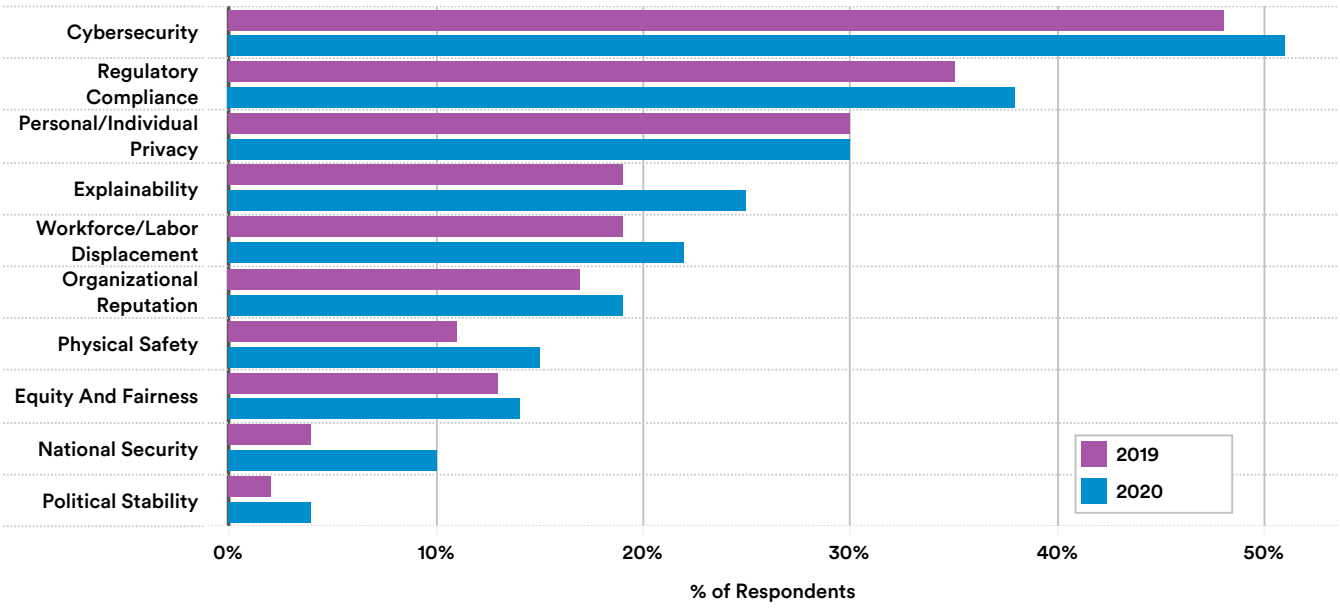

Figure 3.3.6

The Effect of COVID-19

Despite the economic downturn caused by the pandemic, half of respondents said the pandemic had no effect on their investment in AI, while 27% actually reported increasing their investment. Less than a fourth of businesses decreased their investment in AI (Figure 3.3.7).[5] By industry, respondents in healthcare and pharma as well as automotive and assembly were the most likely to report that their companies had increased investment in AI.

Despite the economic downturn caused by the pandemic, half of respondents said the pandemic had no effect on their investment in AI, while 27% actually reported increasing their investment.

CHANGES in AI INVESTMENTS AMID the COVID-19 PANDEMIC
Source: McKinsey & Company, 2020 | Chart: 2021 AI Index Report

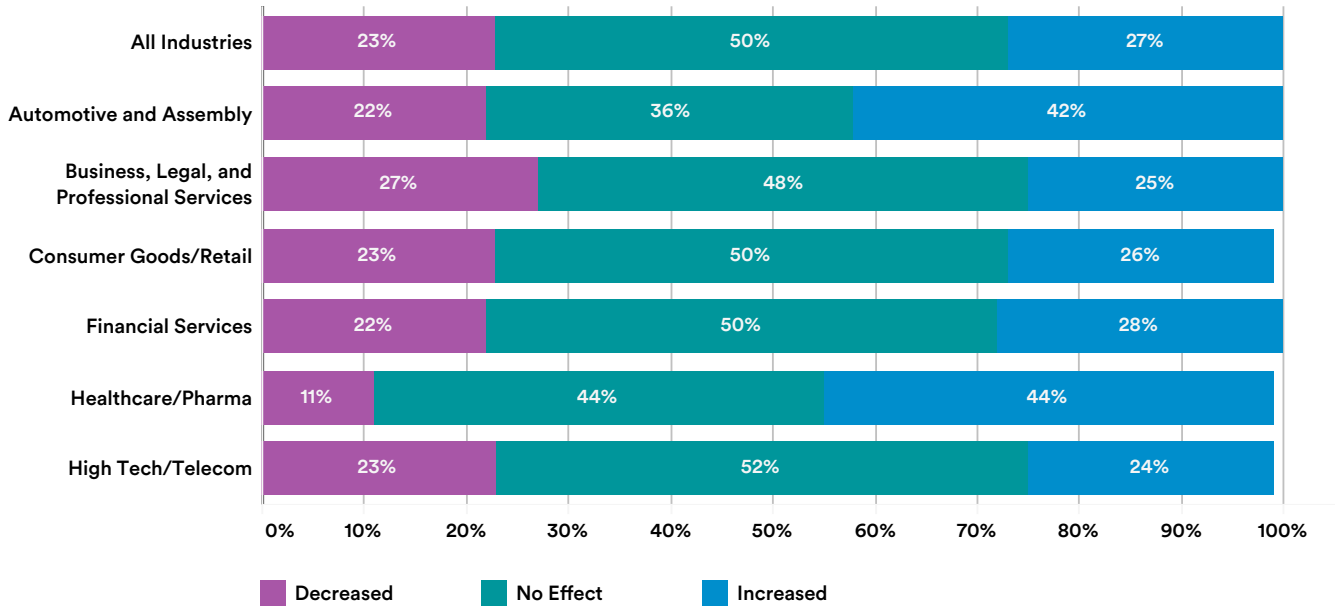

Figure 3.3.7

5 Figures may not sum to 100% because of rounding.

INDUSTRIAL ROBOT INSTALLATIONS

Right now, AI is being deployed widely onto consumer devices like smartphones and personal vehicles (e.g., self-driving technology). But relatively little AI is deployed on actual robots.[6] That may change as researchers develop software to integrate AI-based approaches with contemporary robots. For now, it is possible to measure global sales of industrial robots to draw conclusions about the amount of AI-ready infrastructure being bought worldwide. While the COVID-19-induced economic crisis will lead to a decline in robot sales in the short term, the International Federation of Robotics (IFR) expects the pandemic to generate global growth opportunities for the robotics industry in the medium term.

Global Trend

After six years of growth, the number of new industrial robots installed worldwide decreased by 12%, from 422,271 units in 2018 to 373,240 units in 2019 (Figure 3.3.8). The decline is a product of trade tensions between the United States and China as well as challenges faced by the two primary customer industries: automotive and electrical/electronics.

With the automotive industry taking the lead (28% of total installations), followed by electrical/electronics (24%), metal and machinery (12%), plastics and chemical products (5%), and food and beverages (3%).[7] It is important to note that these metrics are a measurement of installed infrastructure that is susceptible to adopting new AI technologies and does not indicate whether every new robot used a significant amount of AI.

GLOBAL INDUSTRIAL ROBOT INSTALLATIONS, 2012-19
Source: International Federation of Robotics, 2020 | Chart: 2021 AI Index Report

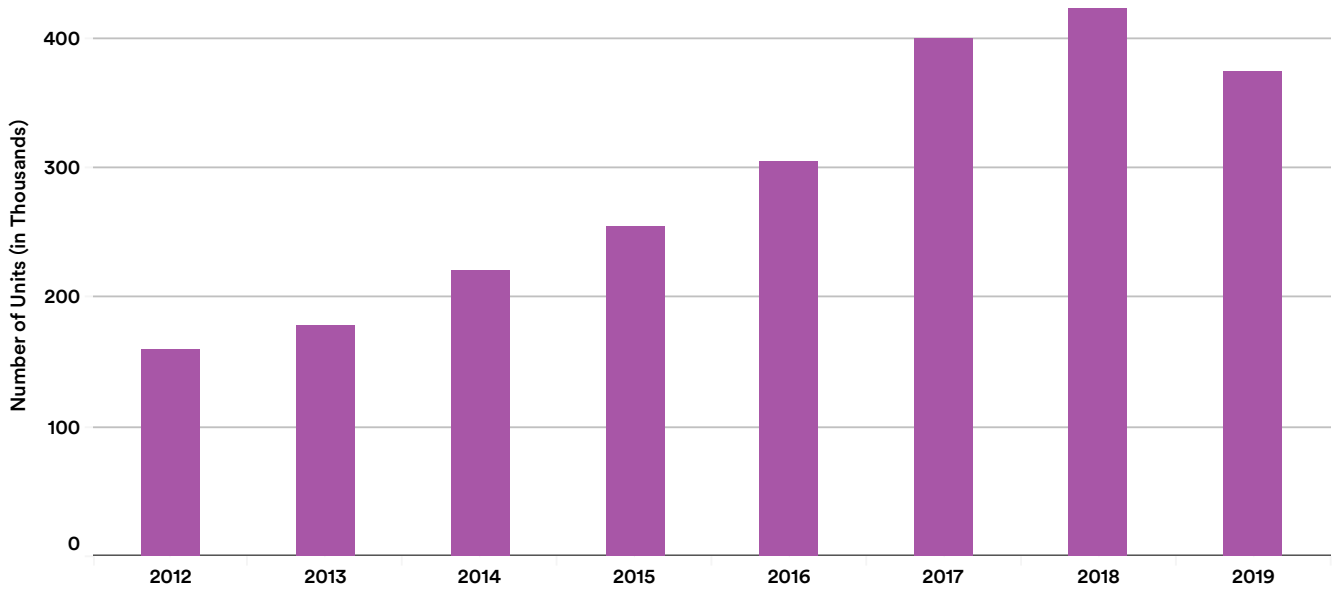

Figure 3.3.8

6 For more insights on the adoption of AI and robots by the industry, read the National Bureau of Economic Research working paper based on the 2018 Annual Business Survey by the U.S. Census Bureau, "Advancing Technologies Adoption and Use by U.S. Firms: Evidence From the Annual Business Survey" (2020).
7 Note that there is no information on the customer industry for approximately 20% of robots installed.

Regional Comparison

Asia, Europe, and North America—three of the largest industrial robot markets—all witnessed the end of a six-year growth period in robot installations (Figure 3.3.9). North America experienced the sharpest decline, of 16%, in 2019, compared with 5% in Europe and 13% in Asia.

Figure 3.3.10 shows the number of installations in the five major markets for industrial robot markets. All five—accounting for 73% of global robot installations—saw roughly the same decline, except for Germany, which saw a slight bump in installations between 2018 and 2019. Despite the downward trend in China, it is worth noting that the country had more industrial robots in 2019 than the other four countries combined.

Asia, Europe, and North America—three of the largest industrial robot markets—all witnessed the end of a six-year growth period in robot installations. North America experienced the sharpest decline, of 16%, in 2019, compared with 5% in Europe and 13% in Asia.

NEW INDUSTRIAL ROBOT INSTALLATIONS by REGION, 2017-19

Source: International Federation of Robotics, 2020 | Chart: 2021 AI Index Report

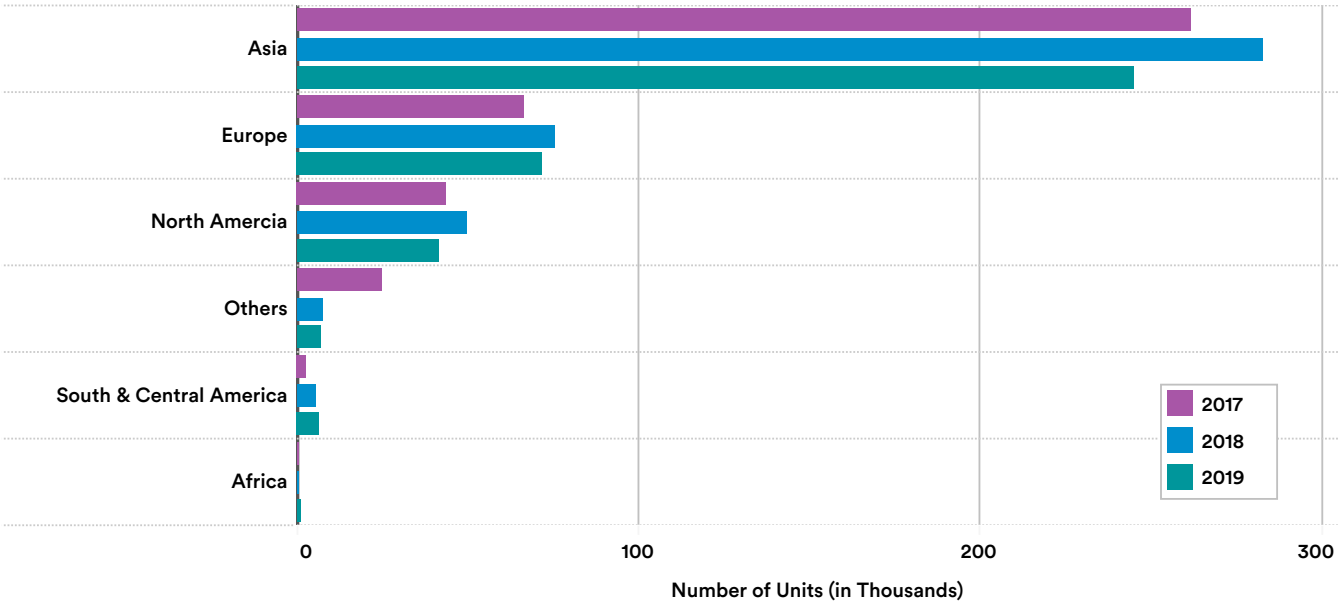

Figure 3.3.9

NEW INDUSTRIAL ROBOT INSTALLATIONS in FIVE MAJOR MARKETS, 2017-19
Source: International Federation of Robotics, 2020 | Chart: 2021 AI Index Report

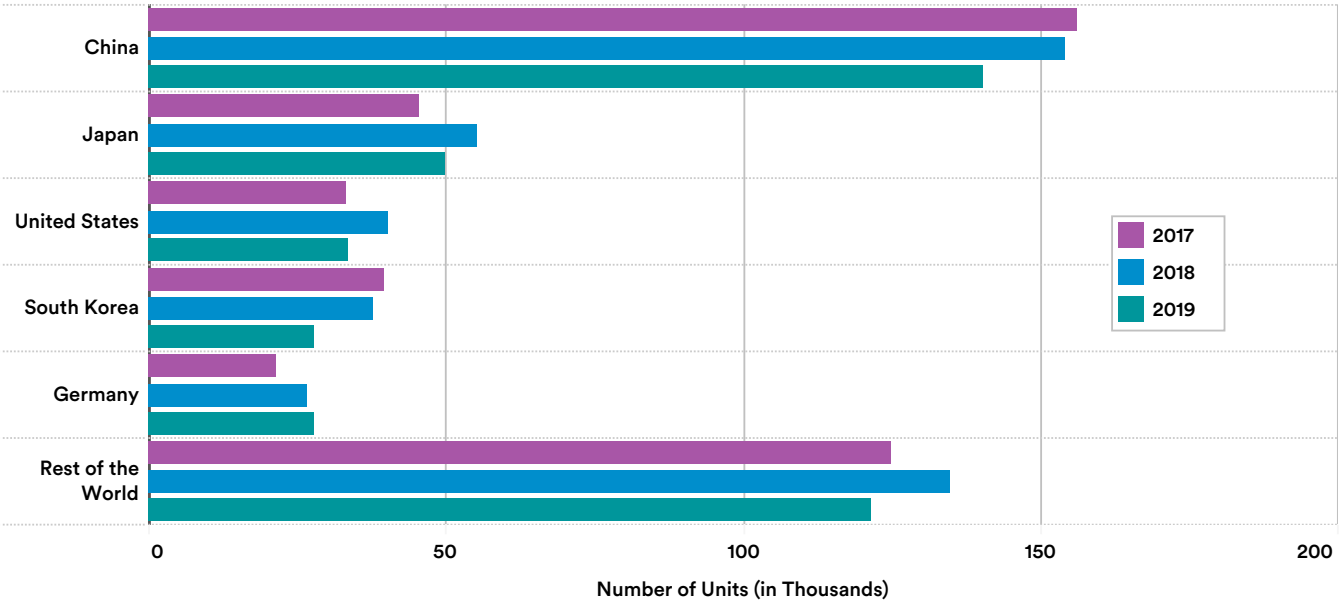

Figure 3.3.10

EARNINGS CALLS

Mentions of AI in corporate earnings calls have increased substantially since 2013, as Figure 3.3.11 shows. In 2020, the number of mentions of AI in earning calls was two times higher than mentions of big data, cloud, and machine learning combined, though that figure declined by 8.5% from 2019. The mentions of big data peaked in 2017 and have since declined by 57%.

MENTIONS of AI in CORPORATE EARNINGS CALLS, 2011-20
Source: Prattle & Liquidnet, 2020 | Chart: 2021 AI Index Report

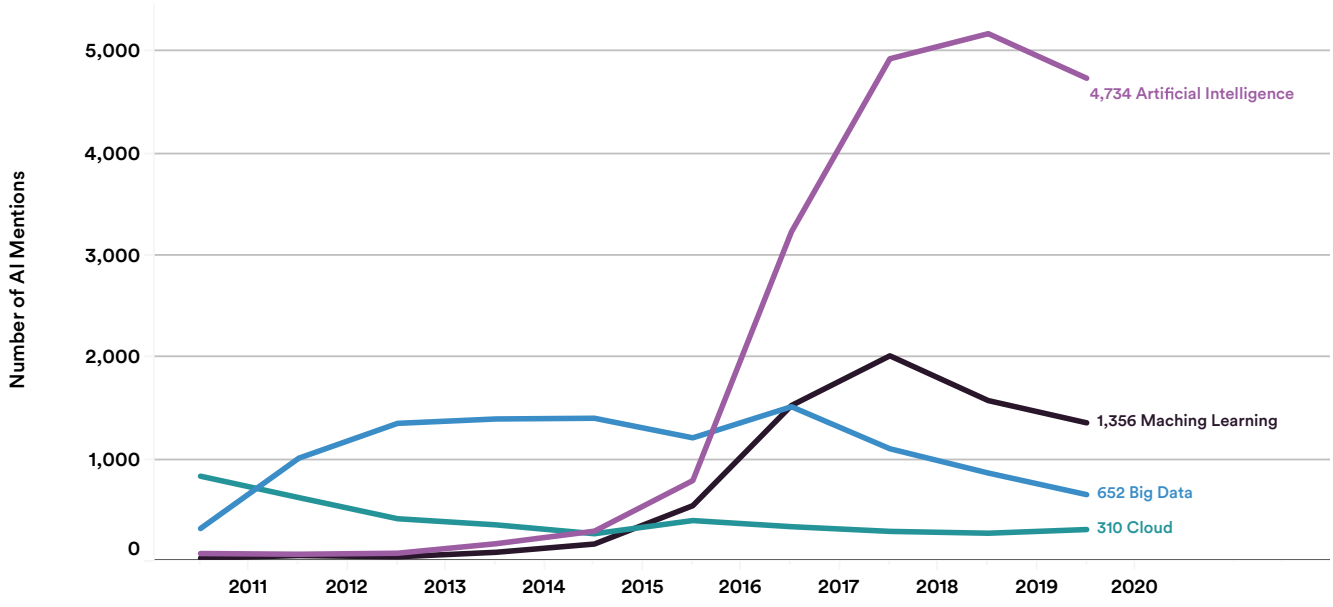

Figure 3.3.11

APPENDIX

LINKEDIN

Prepared by Mar Carpanelli, Ramanujam MV, and Nathan Williams

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. China and India were included in this sample because of their increasing importance in the global economy, but LinkedIn coverage in these countries does not reach 40% of the workforce. Insights for these countries may not provide as full a picture as other countries, and should be interpreted accordingly.

Skills

LinkedIn members self-report their skills on their LinkedIn profiles. Currently, more than 35,000 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. The top skills that make up the AI skill grouping are machine learning, natural language processing, data structures, artificial intelligence, computer vision, image processing, deep learning, TensorFlow, Pandas (software), and OpenCV, among others.

Skill groupings are derived by expert taxonomists through a similarity-index methodology that measures skill composition at the industry level. Industries are classified according to the ISIC 4 industry classification (Zhu et al., 2018).

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 2015–2020.
- 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).

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.

LinkedIn AI Hiring Index

The LinkedIn AI hiring rate is calculated as the total number of LinkedIn members who are identified as AI talent and added a new employer in the same month the new job began, divided by the total number of LinkedIn members in the country. By analyzing only the timeliest data, it is possible to make month-to-month comparisons and account for any potential lags in members updating their profiles.

The baseline time period is typically a year, and it is indexed to the average month/period of interest during that year. The AI hiring rate is indexed against the average annual hiring in 2016; for example, an index of 3.5 for Brazil in 2020 indicates that the AI hiring rate is 3.5 times higher in 2020 than the average in 2016.

Interpretation: The hiring index means the rate of hiring in the AI field, specifically how fast each country is experiencing growth in AI hiring.

Top AI Skills

AI skills most frequently added by members during 2015–2020 period.

BURNING GLASS TECHNOLOGIES

Prepared by Bledi Taska, Layla O'Kane, and Zhou Zhou

Burning Glass Technologies 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 burning-glass.com.

Job Posting Data

To support these analyses, Burning Glass mined its dataset of millions of job postings collected since 2010. Burning Glass collects postings from over 45,000 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, Burning Glass 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.

To understand the share of job openings captured by Burning Glass data, it is important to first note that Burning Glass and JOLTS collect data on job postings differently. Burning Glass data captures new postings: A posting appears in the data only on the first month

it is found and is considered a duplicate and removed in subsequent months. JOLTS data captures active postings: A posting appears in the data for every month that it is still actively posted, meaning the same posting can be counted in two or more consecutive months if it has not been filled. To allow for apples-to-apples volume comparison in postings, the Burning Glass data needs to be inflated to account for active postings, not only new postings. The number of postings from Burning Glass can be inflated using the ratio of new jobs to active jobs in Help Wanted OnLine™ (HWOL), a method used in Carnevale, Jayasundera and Repnikov (2014). Based on this calculation, the share of jobs online as captured by Burning Glass is roughly 85% of the jobs captured in JOLTS in 2016.

The labor market demand captured by Burning Glass data represents over 85% 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, Burning Glass uses its skills taxonomy of over 17,000 skills. The list of AI skills from Burning Glass 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 requested one or more of these skills.

Artificial Intelligence: Expert System, IBM Watson, IPSoft Amelia, Ithink, Virtual Agents, Autonomous Systems, Lidar, OpenCV, Path Planning, Remote Sensing

Natural Language Processing (NLP): ANTLR, Automatic Speech Recognition (ASR), Chatbot, Computational Linguistics, Distinguo, Latent Dirichlet Allocation, Latent Semantic Analysis, Lexalytics, Lexical Acquisition, Lexical Semantics, Machine Translation (MT), Modular Audio Recognition Framework (MARF), MoSes, Natural Language Processing, Natural Language Toolkit (NLTK), Nearest Neighbor Algorithm, OpenNLP, Sentiment Analysis/Opinion Mining, Speech Recognition, Text Mining, Text to Speech (TTS), Tokenization, Word2Vec

Neural Networks: Caffe Deep Learning Framework, Convolutional Neural Network (CNN), Deep Learning, Deeplearning4j, Keras, Long Short-Term Memory (LSTM), MXNet, Neural Networks, Pybrain, Recurrent Neural Network (RNN), TensorFlow

Machine Learning: AdaBoost algorithm, Boosting (Machine Learning), Chi Square Automatic Interaction Detection (CHAID), Classification Algorithms, Clustering Algorithms, Decision Trees, Dimensionality Reduction, Google Cloud Machine Learning Platform, Gradient boosting, H2O (software), Libsvm, Machine Learning, Madlib, Mahout, Microsoft Cognitive Toolkit, MLPACK (C++ library), Mlpy, Random Forests, Recommender Systems, Scikit-learn, Semi-Supervised Learning, Supervised Learning (Machine Learning), Support Vector Machines (SVM), Semantic Driven Subtractive Clustering Method (SDSCM), Torch (Machine Learning), Unsupervised Learning, Vowpal, Xgboost

Robotics: Blue Prism, Electromechanical Systems, Motion Planning, Motoman Robot Programming, Robot Framework, Robotic Systems, Robot Operating System (ROS), Robot Programming, Servo Drives / Motors, Simultaneous Localization and Mapping (SLAM)

Visual Image Recognition: Computer Vision, Image Processing, Image Recognition, Machine Vision, Object Recognition

NETBASE QUID

Prepared by Julie Kim

NetBase Quid is a big data analytics platform that inspires full-picture thinking by drawing connections across massive amounts of unstructured data. The software applies advanced natural language processing technology, semantic analysis, and artificial intelligence algorithms to reveal patterns in large, unstructured datasets and to generate visualizations that allow users to gain actionable insights. NetBase Quid uses Boolean query to search for focus areas, topics, and keywords within the archived news and blogs, companies, and patents database, as well as any custom uploaded datasets. This can filter out the search by published date time frame, source regions, source categories, or industry categories on the news—and by regions, investment amount, operating status, organization type (private/public), and founding year within the companies database. NetBase Quid then visualizes these data points based on the semantic similarity.

Search, Data Sources, and Scope

Here 3.6 million public and private company profiles from multiple data sources are indexed in order 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. Quid algorithm reads a big amount of text data from each document (news article, company descriptions, etc.) 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, institutions that Quid identifies, and the other metadata that is put into the software.

Data

Organization data is embedded from CapIQ and Crunchbase. These companies include all types of companies (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 the investors are undisclosed or the funding amounts by investors are undisclosed. Quid also embeds firmographic information such as founded year and HQ location.

NetBase Quid embeds CapIQ data as a default and adds in data from Crunchbase for the ones that are not captured in CapIQ. This yields not only comprehensive and accurate data on all global organizations, but it also captures early-stage startups and funding events data. Company information is uploaded on a weekly basis.

Methodology

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. 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:

- Chart 3.2.1: Global AI & ML companies that have been invested (private, IPO, M&A) from 01/01/2011 to 12/31/2020.
- Chart 3.2.2–3.2.6: Global AI & ML companies that have invested over USD 400,000 for the last 10 years (January 1, 2011 to December 31, 2020)—7,000 companies out of 7,500 companies have been selected through Quid’s relevance algorithm.

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 product, and business divisions.
- M&A: This refers to a buyer acquiring more than 50% of the existing ownership stake in entities, asset product, and business divisions.

MCKINSEY & COMPANY

SOURCE

This survey was written, filled, and analyzed by McKinsey & Company. You can find additional results from the Global AI Survey here.

Methodology

The survey was conducted online and was in the field from June 9, 2020, to June 19, 2020, and garnered responses from 2,395 participants representing the full range of regions, industries, company sizes, functional specialties, and tenures. Of those respondents, 1,151 said their organizations had adopted AI in at least one function and were asked questions about their organizations' AI use. To adjust for differences in response rates, the data are weighted by the contribution of each respondent's nation to global GDP. McKinsey also conducted interviews with executives between May and August 2020 about their companies' use of AI. All quotations from executives were gathered during those interviews.

Note

Survey respondents are limited by their perception of their organization's AI adoption.

INTERNATIONAL FEDERATION OF ROBOTICS

Source

Data was received directly from the International Federation of Robotics' (IFR) 2020 World Robotics Report. Learn more about IFR.

Methodology

The data displayed is the number of industrial robots installed by country. Industrial robots are defined by the ISO 8373:2012 standard. See more information on IFR's methodology.

Nuance

- It is unclear how to identify what percentage of robot units run software that would be classified as "AI," and it is unclear to what extent AI development contributes to industrial robot usage.
- This metric was called "robot imports" in the 2017 AI Index Report.

PRATTLE (EARNING CALLS ONLY)

Prepared by Jeffrey Banner and Steven Nichols

Source

Liquidnet provides sentiment data that predicts the market impact of central bank and corporate communications. Learn more about Liquidnet here.