Diffusion of AI Jobs Across Economic Sectors

Analysis of Job Postings in the U.S. Economy
2018-Q1 through 2024-Q4

UMD-LinkUp AI Maps Project

In Collaboration with Outrigger Group

White Paper #2
January 2025

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About

UMD-LinkUp AI Maps is the world's first attempt to map the creation of AI jobs. To date, the handful of research papers in academia and industry have used keywords to identify which jobs require AI skills and which do not. Our analysis indicates that this is an extremely flawed approach, with up to 70% false positives. In contrast, we use a fine-tuned large language model (LLM), powered by cutting-edge AI technologies, to differentiate jobs requiring AI skills from others. In short, we use AI to do research on AI.

Maryland Smith
The Robert H. Smith School of Business is a global leader in management education and research. One of 12 colleges and schools at the *University of Maryland at College Park*, the school offers undergraduate, MS, MBA, PhD, and executive education programs. Several of the school's departments rank among the top 10 in the world for research in their respective fields.

LinkUp
LinkUp, a subsidiary of *GlobalData PLC*, combines more than 20 years of experience in human capital management and employment data with proprietary technology that indexes millions of job listings daily, directly from employer websites around the world. From this unique jobs dataset, LinkUp provides clients with actionable insights into the global labor market at the macroeconomic to individual company level or across themes, skills, products, and technologies.

Outrigger Group
Outrigger Group provides fractional executives to fast-growing startups and established businesses. Outrigger's team of experienced executives and entrepreneurs helps companies accelerate growth through the most challenging phases of building a business, from inception through liquidity events.

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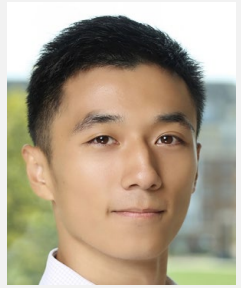

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Methodology

The term “AI Job” refers to a job posting that requires AI skills. We use a fine-tuned large language model (LLM), powered by cutting-edge AI technologies, to differentiate jobs requiring AI skills from others. When compared against manual checks by multiple AI researchers, this LLM approach has an accuracy above 90%. In contrast, a dictionary-based approach has a much less than 50% accuracy-level when compared against manual checks.

As is the case with most data including employment numbers, accounting statements, and GDP figures, keep in mind that our data represent estimates, albeit what we believe to be very good estimates and better than any other data on AI job creation that we have come across.

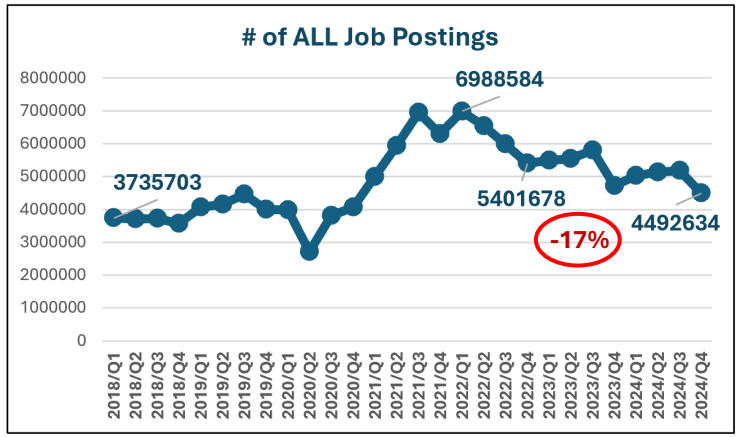
We exclude jobs that would be based outside the United States.

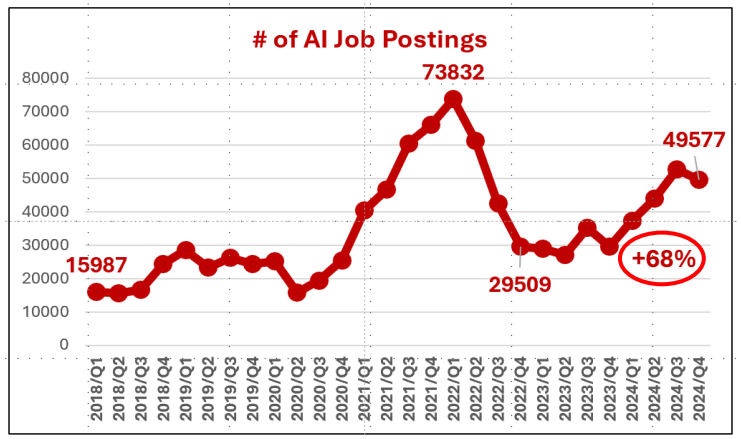
Across the U.S. Economy:
A Very Powerful ChatGPT Effect

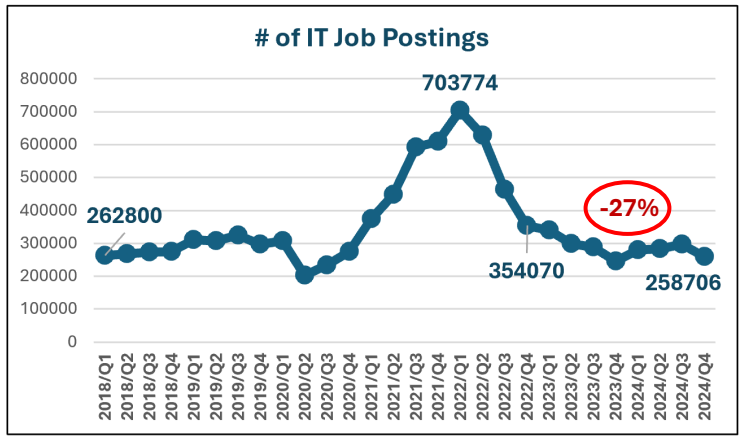
A Very Powerful ChatGPT Effect

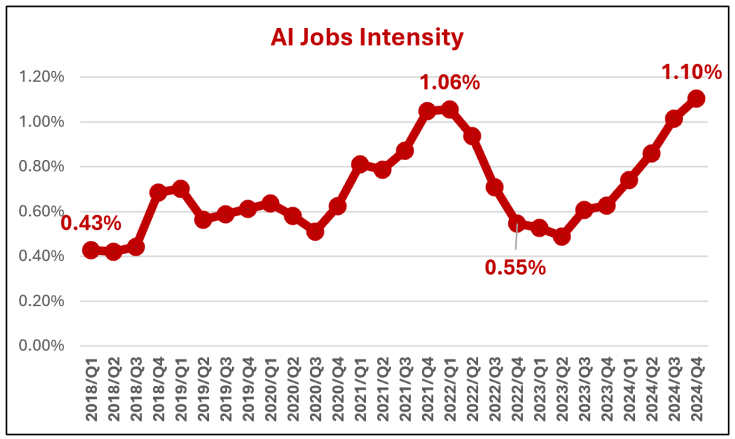
Positive for AI Jobs, But Negative for IT Jobs (in General)

US Total









UMD-LinkUp AI Maps Project

AI Jobs Intensity = Ratio of AI Job Postings-to-ALL Job Postings

- **All jobs: During the two years since the launch of ChatGPT in 2022/Q4, the number of ALL job postings declined by 17%. While this does not suggest that companies are employing fewer people, it does suggest that companies are hiring new staff at a slower pace. Our data are consistent with a broader softening in the labor market. As a recent report from the Minneapolis Fed noted: *"the unemployment rate is unequivocally on the rise, from a historic low of 3.4 percent in 2023 to 4.3 percent in July 2024."***
- **IT Jobs: However, the decline in IT job postings is much starker, from 354,070 in 2022/Q4 to 258,706 in 2024/Q4, a decrease of 27%.**
- **AI Jobs: In contrast, the number of AI job postings has ramped up dramatically, from 29,509 in 2022/Q4 to 49,577 in 2024/Q4, an uptick of 68%.**
- **ChatGPT Effect: There is clear evidence of a strong ChatGPT effect. AI Jobs Intensity grew from 0.55% in 2022/Q4 to 1.10% in 2024/Q4. Similarly, AI-to-IT Jobs Intensity grew from 8.3% in 2022/Q4 to 19.2% in 2024/A4.**

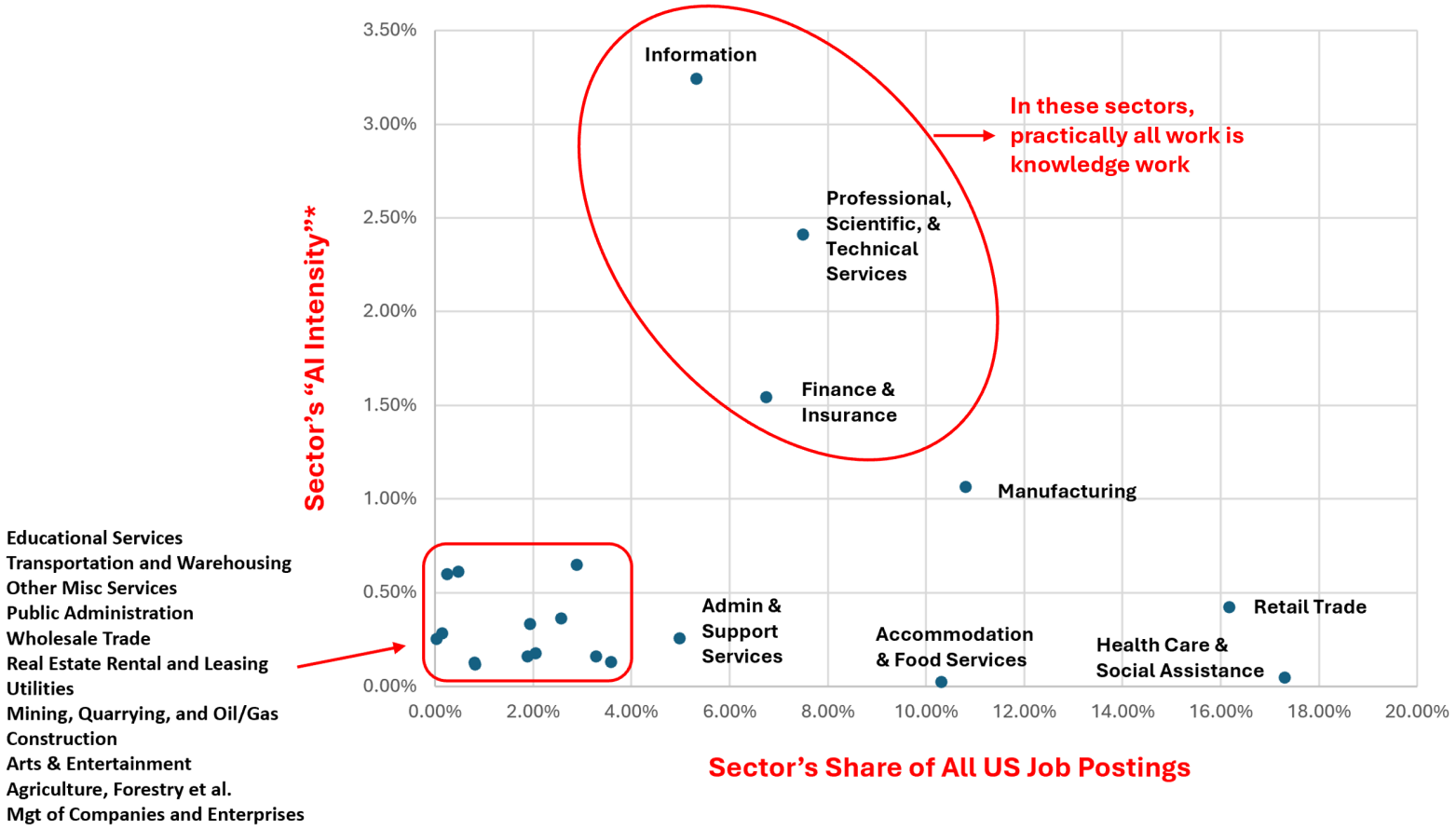
How will the DeepSeek phenomenon affect these trends?

- The DeepSeek phenomenon will accelerate these trends.
- **Irrespective of what happens with DeepSeek, its emergence has vindicated with full force Mark Zuckerberg's bet on open-source LLMs. Over the last few days, even Sam Altman has speculated that maybe OpenAI is on the wrong side of history and should start opening up its technology.**
- **As open-source models keep gaining share, the market for foundation models will become commoditized and their costs and prices will decline. This will lead to an even faster deployment of AI technology in every industry, be it software development, technical services, banking, insurance, manufacturing, or agriculture.**
- **While it's a bit early for this effect to show up in job postings data, we anticipate to see these numbers over the next few months.**

How Different Sectors Compare

More Knowledge Work ➔ Greater AI Opportunity

(Based on Aggregated Data Q1-2018 through Q4-2024)



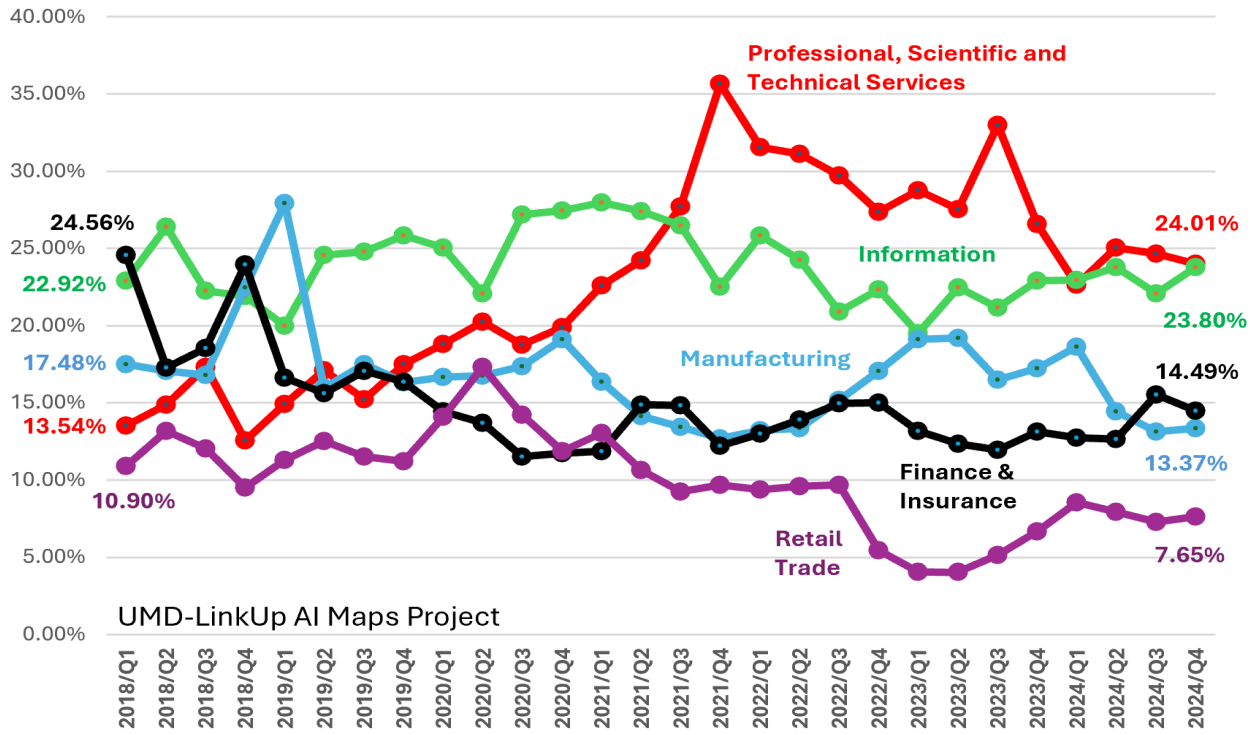
Five Sectors Account for 89% of All AI Job Postings

(Aggregated January 2018 through December 2024)

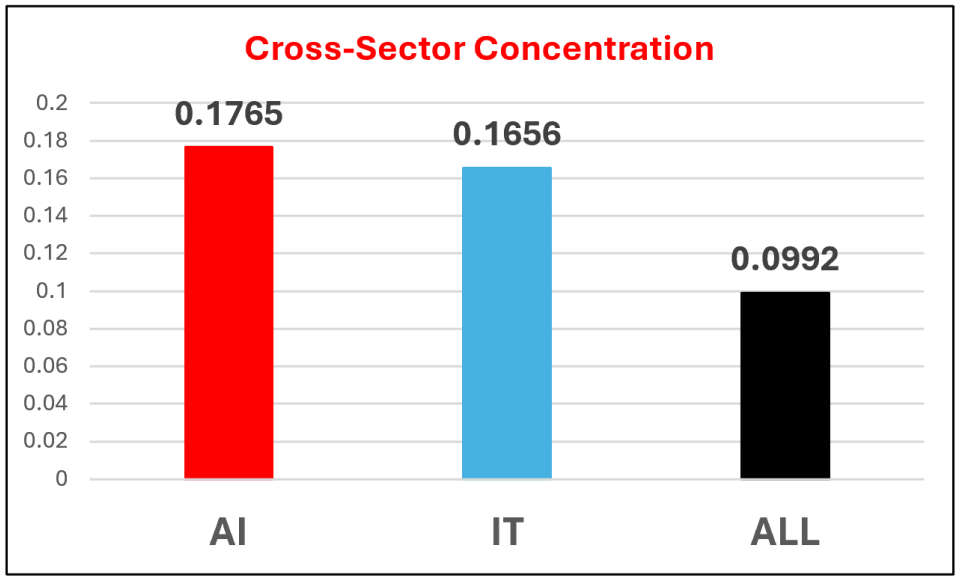
NAICS		Share of AI Jobs	Share of IT Jobs	Share of ALL Jobs	IT Jobs Intensity	AI-to-IT Jobs Intensity	AI Jobs Intensity
54	Professional, Scientific, and Technical Serv	25.05%	28.13%	7.51%	26.91%	8.96%	2.41%
51	Information	23.93%	17.85%	5.34%	24.02%	13.49%	3.24%
31-33	Manufacturing	15.90%	17.14%	10.81%	11.39%	9.33%	1.06%
52	Finance and Insurance	14.41%	13.51%	6.75%	14.36%	10.74%	1.54%
44-45	Retail Trade	9.45%	5.68%	16.18%	2.52%	16.75%	0.42%
61	Educational Services	2.60%	1.96%	2.90%	4.86%	13.34%	0.65%
56	Admin and Support and Waste Mgt etc.	1.77%	3.39%	4.99%	4.88%	5.26%	0.26%
99	Missing	1.29%	1.39%	2.58%	3.88%	9.32%	0.36%
62	Health Care and Social Assistance	1.11%	2.71%	17.31%	1.12%	4.14%	0.05%
48-49	Transportation and Warehousing	0.89%	1.14%	1.94%	4.22%	7.88%	0.33%
81	Other Services (except Public Admin)	0.73%	1.01%	3.28%	2.20%	7.30%	0.16%
92	Public Administration	0.65%	1.98%	3.59%	3.96%	3.32%	0.13%
42	Wholesale Trade	0.50%	1.26%	2.06%	4.38%	4.04%	0.18%
53	Real Estate and Rental and Leasing	0.42%	0.60%	1.90%	2.28%	7.00%	0.16%
22	Utilities	0.41%	0.72%	0.48%	10.84%	5.65%	0.61%
72	Accommodation and Food Services	0.33%	0.47%	10.32%	0.32%	7.02%	0.02%
21	Mining, Quarrying, and Oil and Gas	0.21%	0.26%	0.25%	7.51%	7.97%	0.60%
23	Construction	0.14%	0.35%	0.81%	3.11%	4.05%	0.13%
71	Arts, Entertainment, and Recreation	0.13%	0.30%	0.82%	2.64%	4.40%	0.12%
11	Agriculture, Forestry, Fishing etc.	0.06%	0.07%	0.16%	3.04%	9.30%	0.28%
55	Mgt of Companies and Enterprises	0.01%	0.08%	0.04%	15.88%	1.60%	0.25%
	US Total	100.00%	100.00%	100.00%	7.18%	10.06%	0.72%

- Two sectors (Health Care and Social Assistance, and Accommodation and Food Services) provide an interesting contrast to the Big-5 AI sectors.
- These two sectors account for nearly 28% of all job postings, but less than 1.5% of AI job postings.
- The reasons appear clear. These two sectors require highly complex physical work, not yet amenable to AI or robotics.

Trends in "Big-5" AI Sectors' Shares of AI Job Postings in the U.S. Economy



- There has been a dramatic growth in the AI job postings share of the "Professional, Scientific, and Technical Services" sector.
- The dominant explanation is that, as AI applications have diffused to and been embraced by practically all sectors of the economy, many companies in the historically less digitized sectors have chosen to outsource their AI expertise to consulting firms such as Accenture, Deloitte, EY, PwC, Booz Allen and their peers. These companies belong to the "Professional, Scientific, and Technical Services" sector.
- Since the sum total of all sectors' shares is always 100%, there has been a corresponding drop in the shares of "Finance and Insurance" and "Retail Trade" sectors.



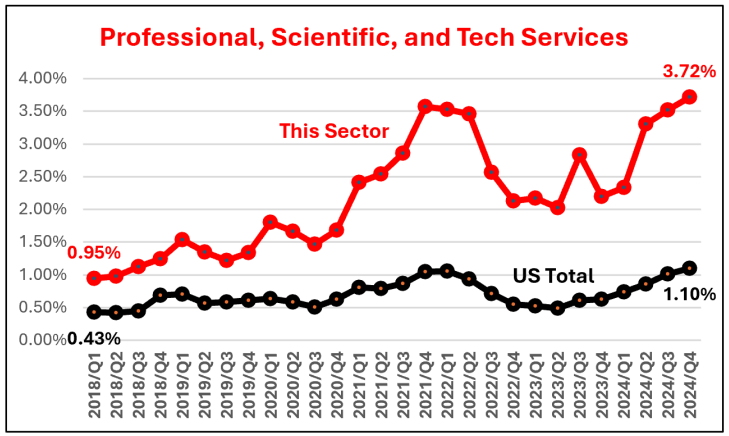
Based on aggregated data from January 2018 through December 2024

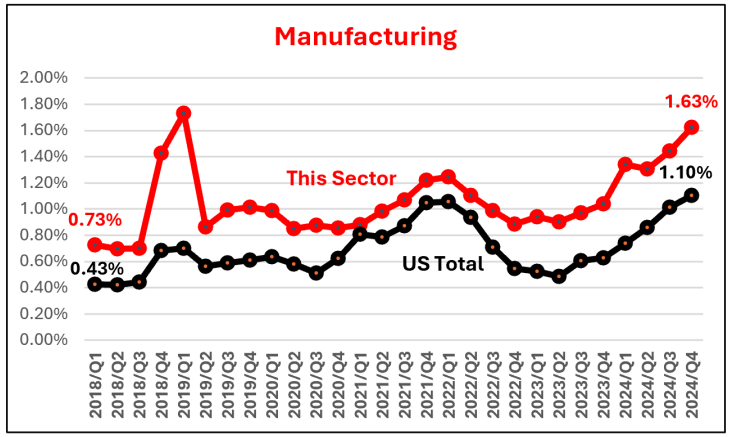
Concentration Index = $\sum (p_i)^2$ where p_i = proportion of a sector's job postings out of the total for the U.S. economy. 0 = lowest possible concentration, 1 = highest possible concentration.

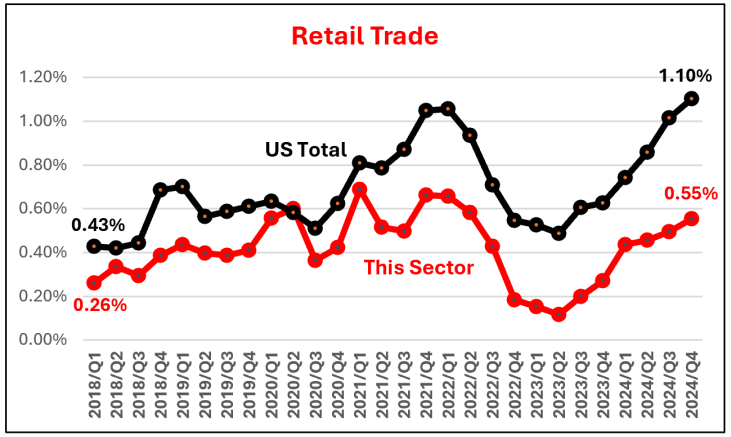
- **On a cross-sector basis, both AI and IT job postings are significantly more concentrated than all job postings.**
- **That said, AI job postings are even more concentrated than IT job postings.**
- **The reason lies in the highly complex and specialized nature of both AI and IT skills (and AI skills relative to IT skills).**
- **It is difficult, if not impossible, for most companies in the historically less-digitized sectors of the economy to hire and retain very expensive AI talent, and be able to deploy such talent productively. As a result, such companies tend to outsource AI expertise to professional consulting firms.**

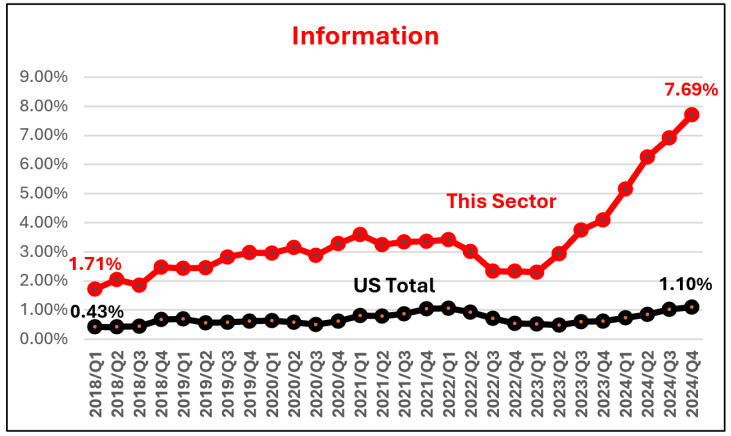
Trends in AI Jobs Intensity

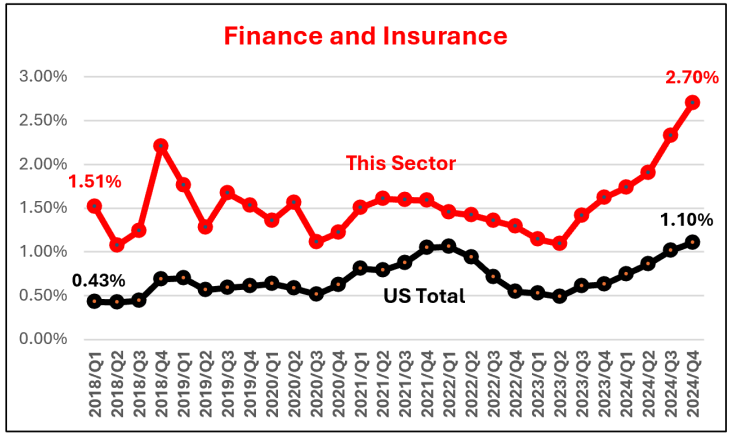
AI Jobs Intensity = Ratio of AI Job Postings-to-ALL Job Postings

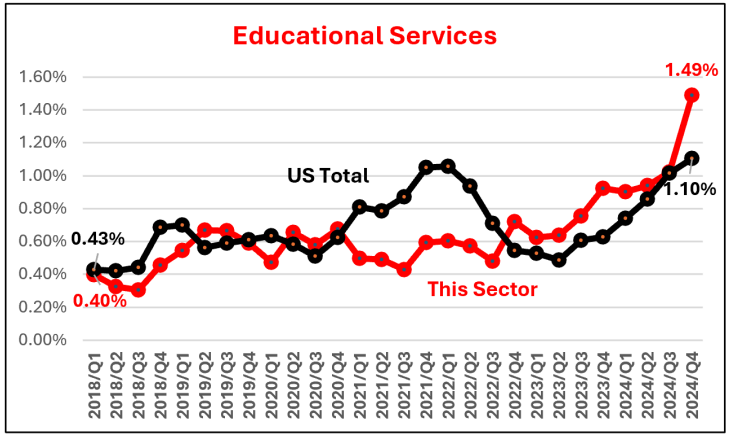






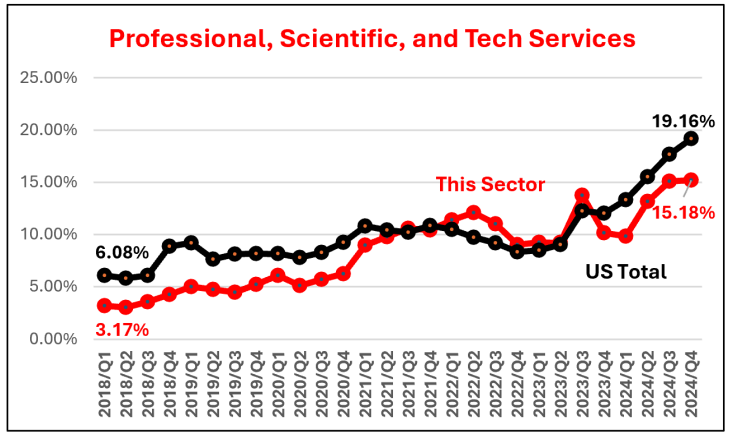


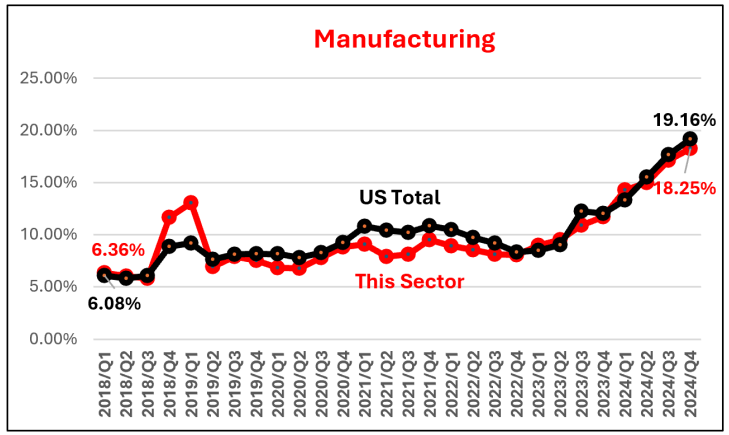


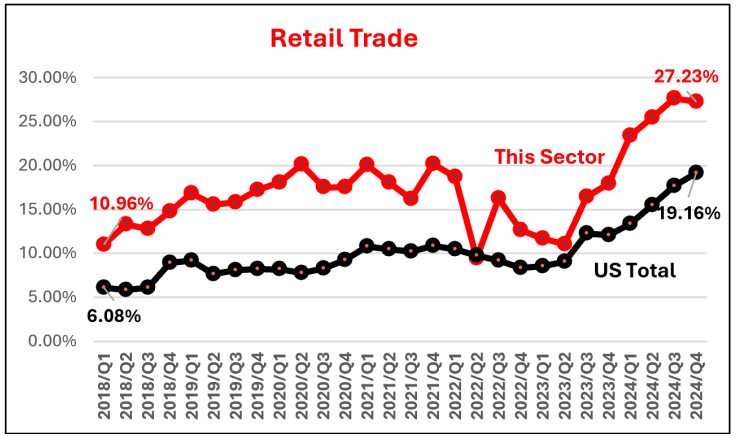


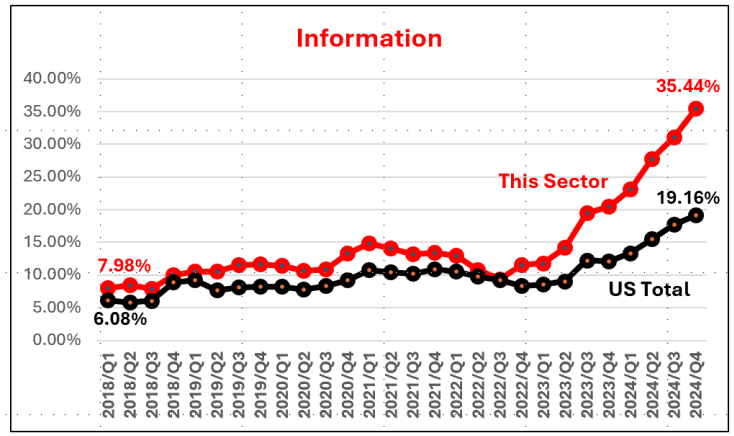
Trends in AI-to-IT Jobs Intensity

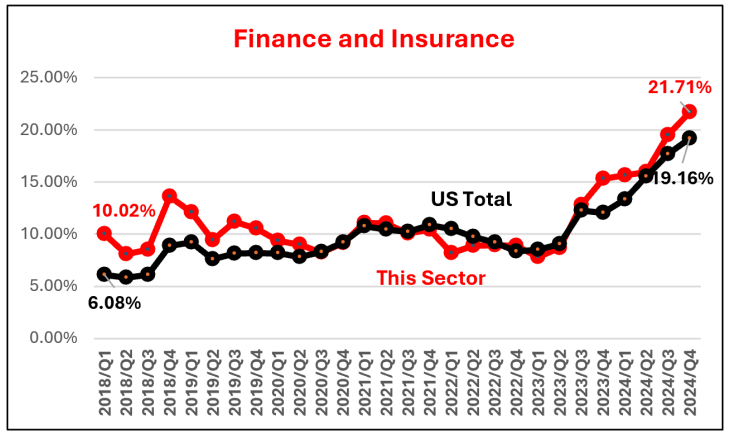
AI-to-IT Jobs Intensity = Ratio of AI Job Postings-to-IT Job Postings

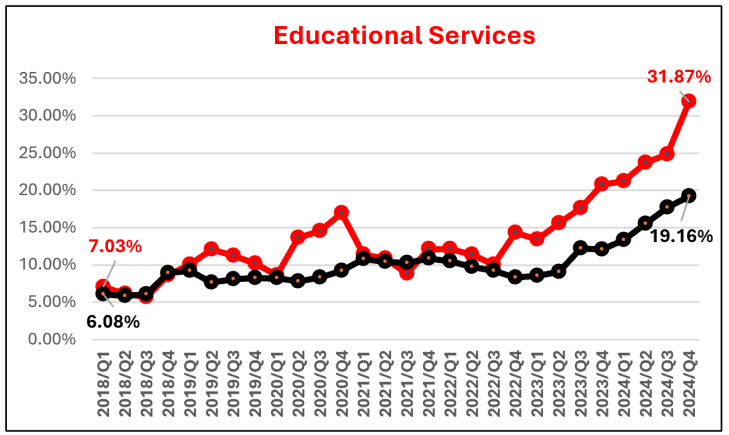








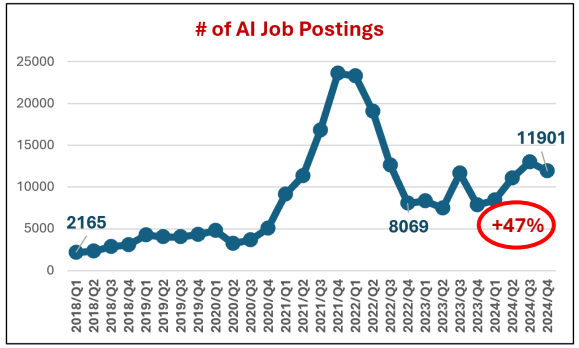


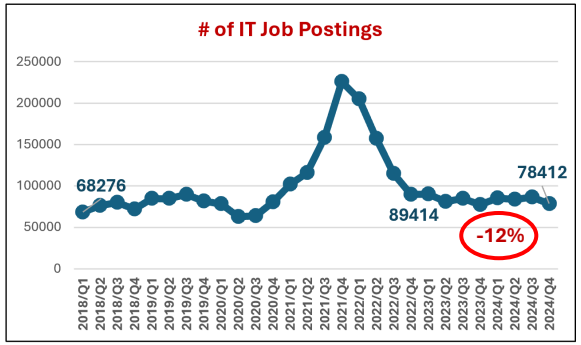


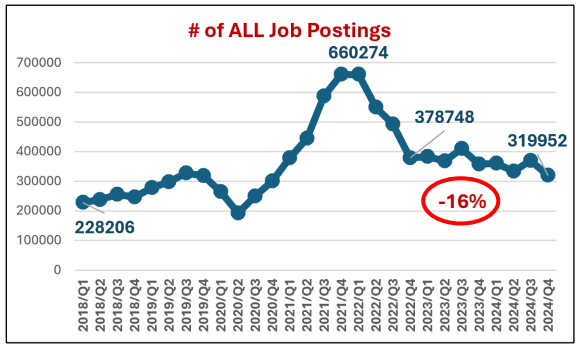
A Deeper Dive

Professional, Scientific, and Technical Services
(NAICS 54)

Professional, Scientific, and Technical Services







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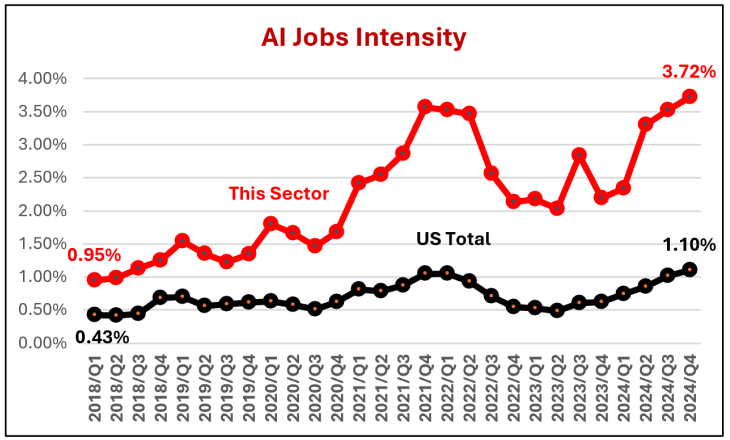
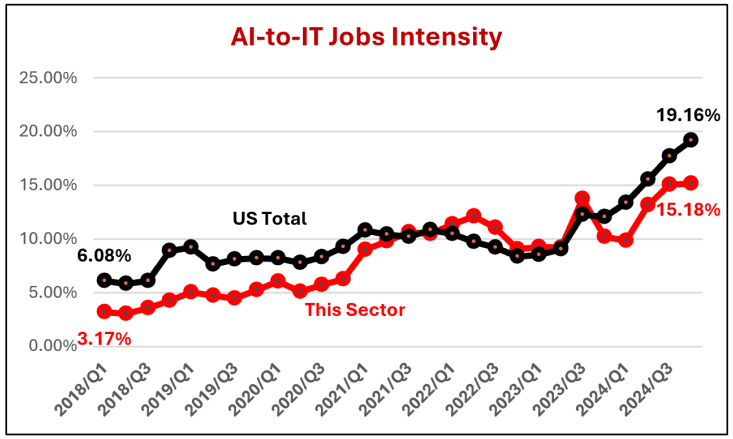




AI Jobs Intensity = Ratio of AI Job Postings-to-ALL Job Postings.
AI-to-IT Jobs Intensity = Ratio of AI Job Postings-to-IT Job Postings.

- **The AI Jobs Intensity in this sector is not only much higher than for the US economy as a whole, but the gap has increased significantly over time. This trend is almost certainly due to the fact that this sector employs mostly professionals with bachelors or graduate degrees. And, the product of this sector is 100% information or knowledge.**
- **In terms of AI-to-IT Jobs Intensity, this sector is not markedly different from the U.S, economy as a whole. Very likely, this is because this sector has always been very IT intensive.**
- **However, in looking at the trends over time, it's clear that AI job postings account for a MUCH larger proportion of IT job postings in 2024/Q4 (15.18%) than in 2018/Q1 (3.17%).**

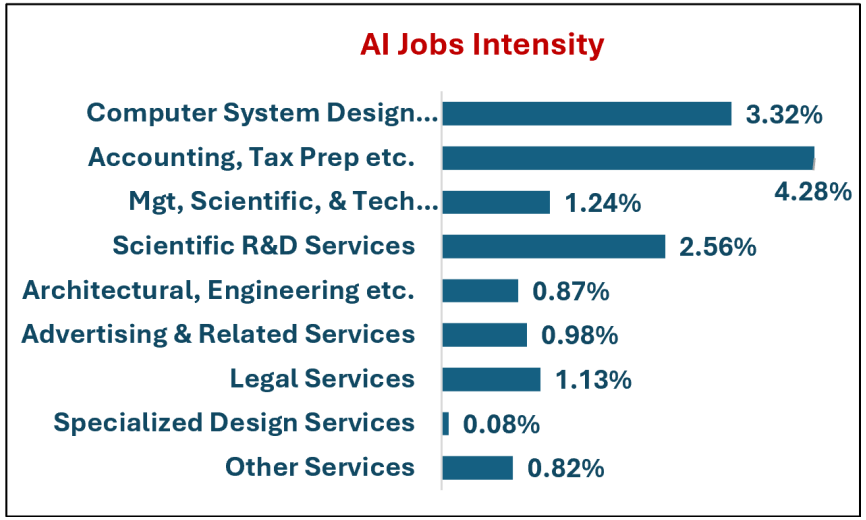
Professional, Scientific, and Technical Services

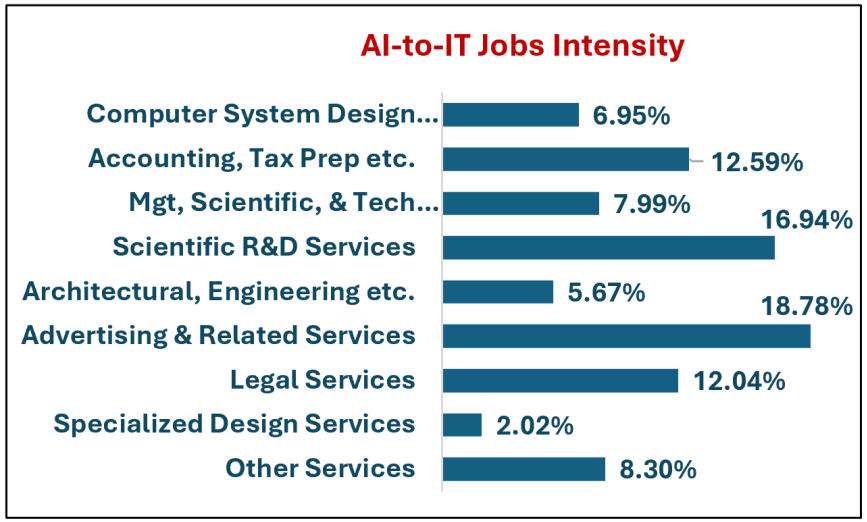
Subsectors' Shares Of Job Postings within the Broader Sector

(Based on Cumulative Data from 2018/Q1 through 2024/Q4)

	All Jobs	IT Jobs	AI Jobs
Computer System Design Services	27.67%	49.19%	38.14%
Accounting, Tax Prep etc.	20.58%	25.99%	36.52%
Mgt, Scientific, & Tech Consulting	14.91%	8.59%	7.66%
Scientific R&D Services	5.87%	3.30%	6.24%
Architectural, Engineering etc.	16.18%	9.27%	5.87%
Advertising & Related Services	9.17%	1.77%	3.71%
Legal Services	1.27%	0.44%	0.60%
Specialized Design Services	0.68%	0.10%	0.02%
Other Services	3.66%	1.34%	1.24%

- "Computer Systems Design Services" and "Accounting, Tax Prep Etc." account for almost 75% of all AI job postings in this sector. This is both because these are the two biggest employing subsectors (see column on "All Jobs") as well as because the AI Jobs Intensity is the highest in these two subsectors.
- In terms of AI-to-IT Jobs Intensity, the two subsectors that stand out are "Scientific R&D Services" and "Advertising & Related Services." The latter is almost certainly due to the heavy use of GenAI applications in copywriting and image generation.

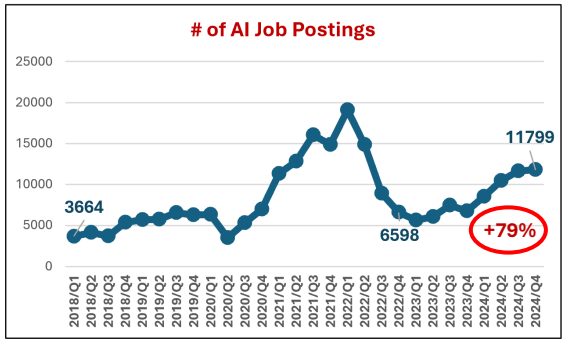


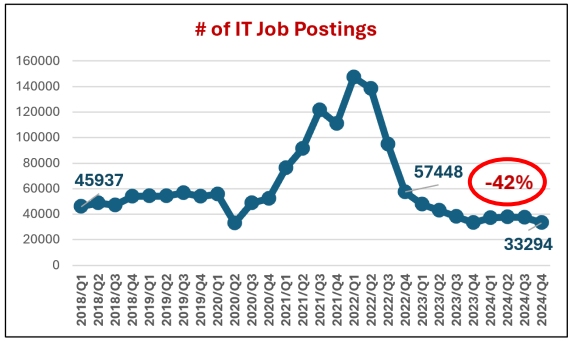


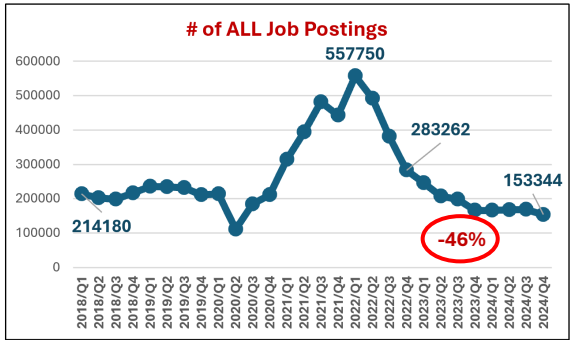
A Deeper Dive

Information
(NAICS 51)

Information







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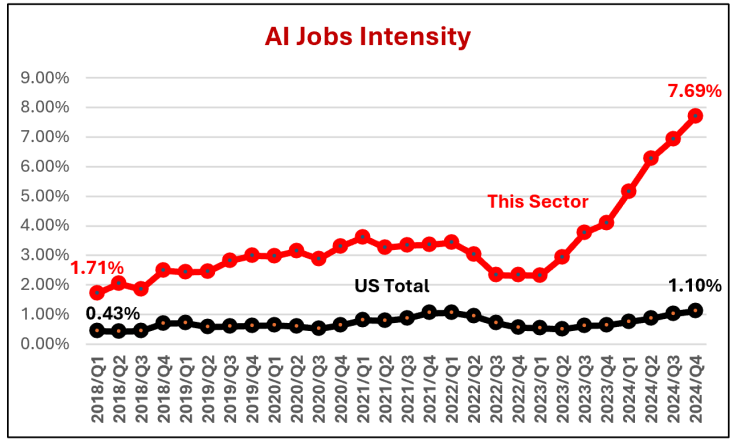
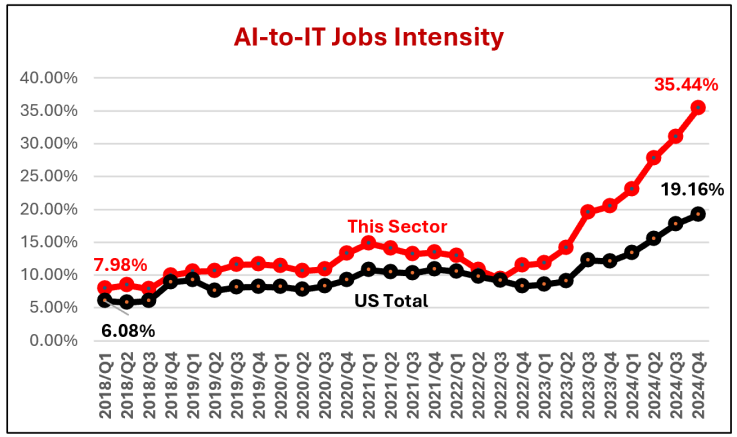




AI Jobs Intensity = Ratio of AI Job Postings-to-ALL Job Postings.
AI-to-IT Jobs Intensity = Ratio of AI Job Postings-to-IT Job Postings.

- **After the heavy layoffs in 2022 (as typified by Meta's "year of efficiency"), this sector has poured the coals on AI since the launch of ChatGPT in late November 2022.**
- **This sector's AI Jobs Intensity ramped up from 2.33% in 2022/Q4 to 7.69% in 2024/Q4. Similarly, the AI-to-IT Jobs Intensity grew rapidly from 11.49% in 2022/Q4 to 35.44% in 2024/Q4.**
- **While "Software Publishers" account for the vast chunk of all job postings in this sector, the ChatGPT effect is evident in all subsectors: software publishers (think Microsoft), social media (think Facebook, Instagram, TikTok, and YouTube), data centers (think AWS and Azure), and web search (think Google).**

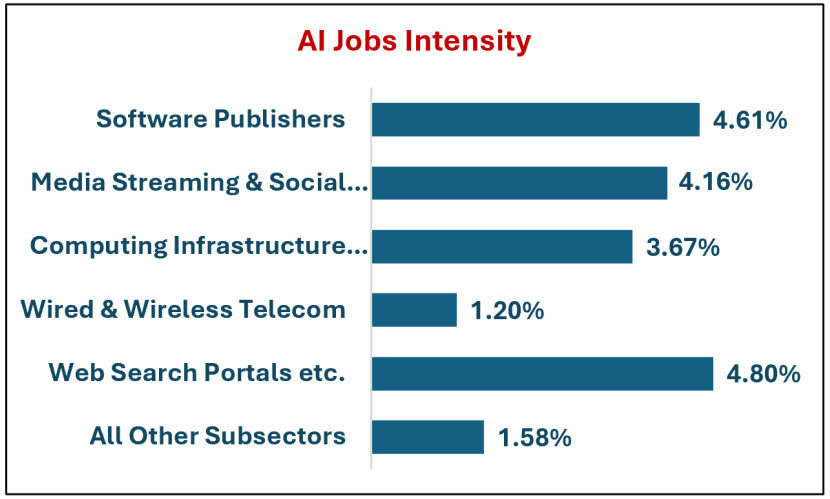
Information

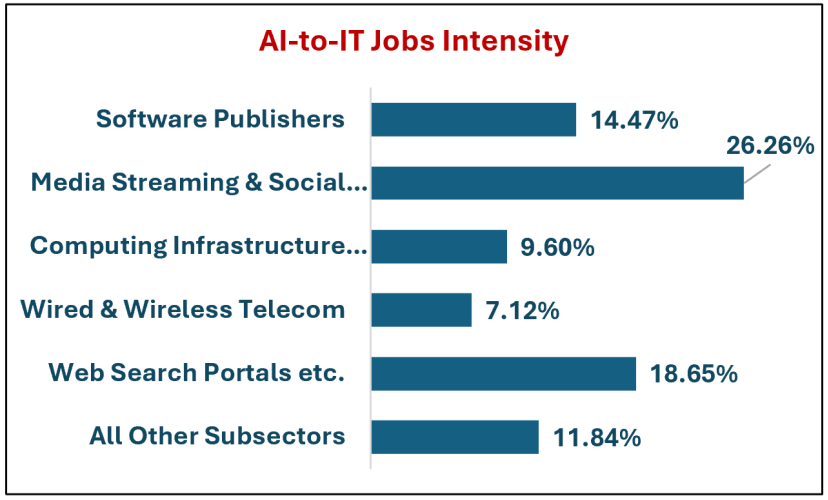
Subsectors' Shares Of Job Postings within the Broader Sector

(Based on Cumulative Data from 2018/Q1 through 2024/Q4)

	All Jobs	IT Jobs	AI Jobs
Software Publishers	43.35%	57.53%	61.72%
Media Streaming, Social Networks etc.	6.25%	4.13%	8.04%
Computing Infrastructure Providers	19.05%	13.35%	7.05%
Wired & Wireless Telecom	4.73%	5.08%	7.02%
Web Search Portals etc.	4.94%	7.87%	5.60%
All Other Subsectors	21.67%	12.05%	10.58%

- **Across the board, every subsector exhibits higher AI Jobs Intensity than the 0.72% figure for the U.S. economy as a whole (see slide 10).**
- **This is because, with the exception of Wired and Wireless Telecom, all of the other subsectors are populated by the major technology players that are leading both the creation as well as the deployment of AI technologies (Apple, Google, Meta, Microsoft, Amazon, Adobe, and many others).**

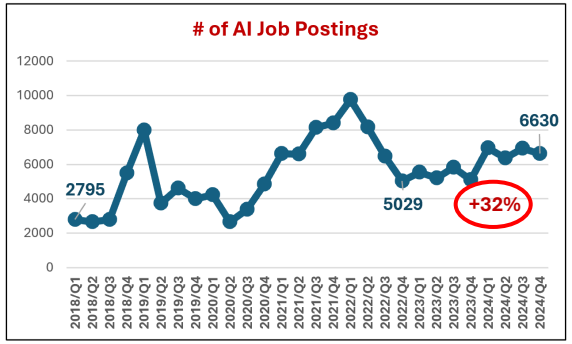


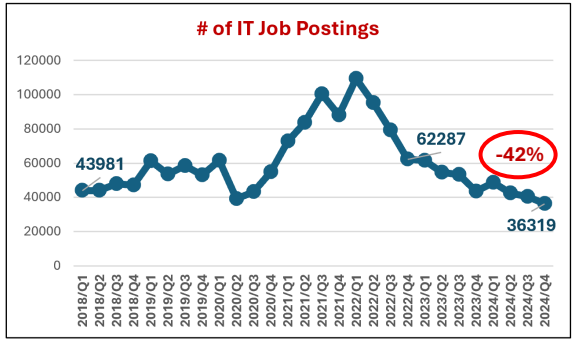


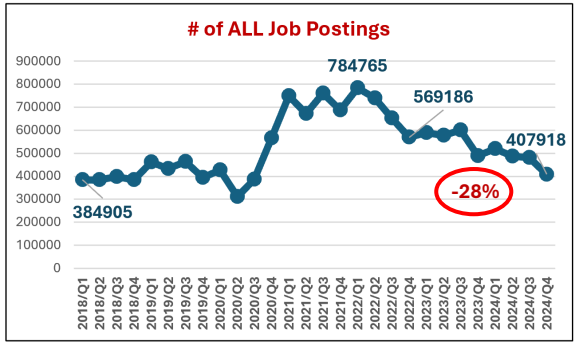
A Deeper Dive

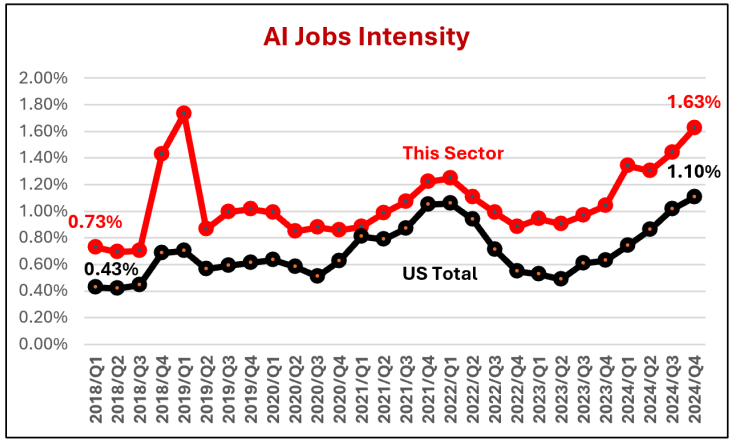
Manufacturing
(NAICS 31-33)

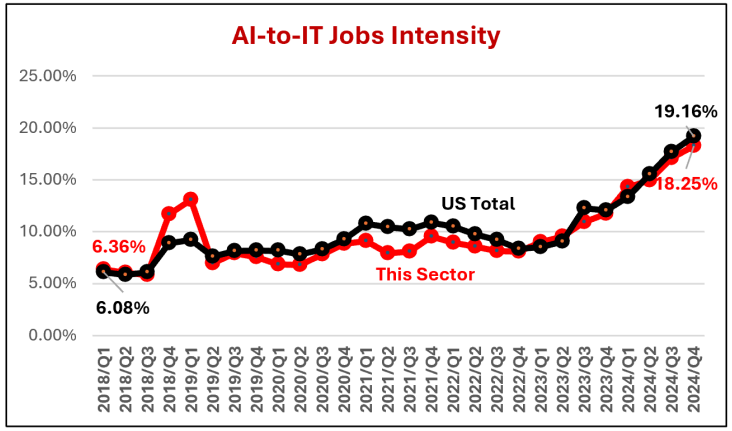
Manufacturing











AI Jobs Intensity = Ratio of AI Job Postings-to-ALL Job Postings.
AI-to-IT Jobs Intensity = Ratio of AI Job Postings-to-IT Job Postings.

- **In comparing 2024/Q4 with 2022/Q4, this sector has witnessed a significant decline of 28% in all job postings, and an even sharper 42% drop in IT job postings.**
- **In contrast, during this period, the # of AI job postings grew by 32%.**
- **Overall, the Manufacturing sector exhibits higher AI Jobs Intensity than the U.S. economy as a whole.**
- **On the other hand, the AI-to-IT Jobs Intensity for this sector closely tracks that for the U.S. economy over the entire 7 year period.**

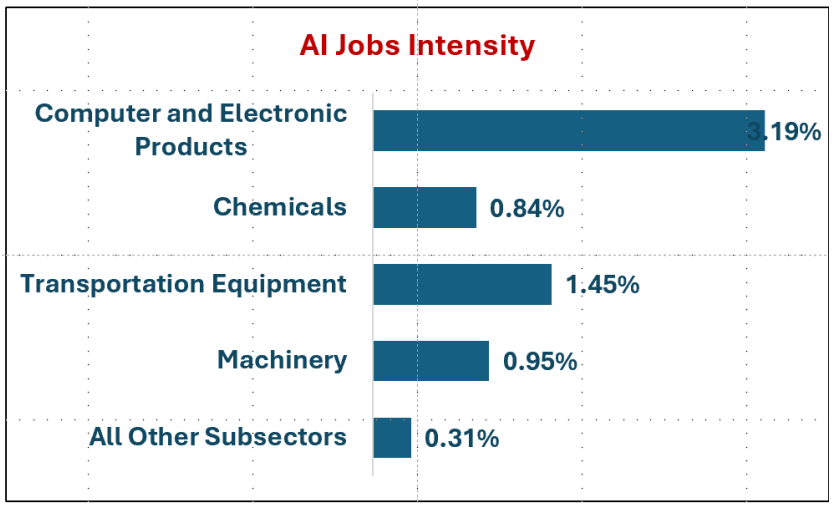
Manufacturing

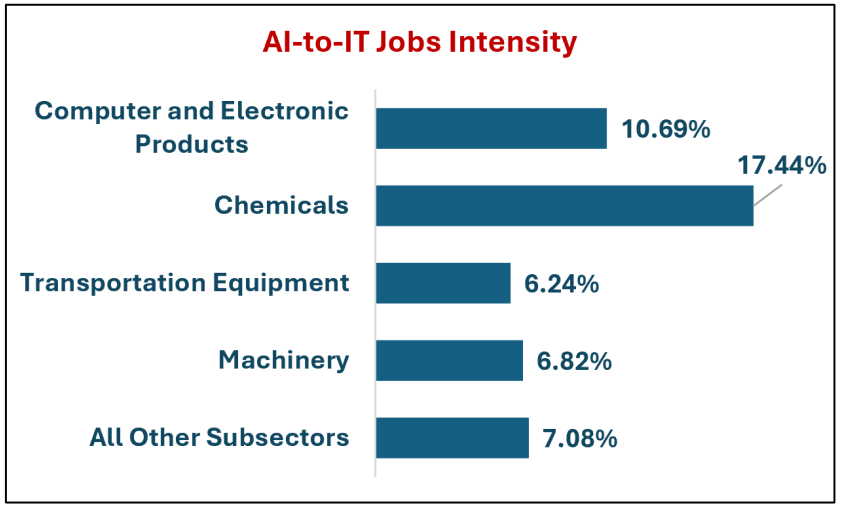
Subsectors' Shares Of Job Postings within the Broader Sector

(Based on Cumulative Data from 2018/Q1 through 2024/Q4)

	All Jobs	IT Jobs	AI Jobs
Computer and Electronic Products	15.48%	40.52%	46.42%
Chemicals	23.09%	9.77%	18.25%
Transportation Equipment	11.42%	23.30%	15.59%
Machinery	8.63%	10.51%	7.68%
All Other Subsectors	41.38%	15.90%	12.06%

- **Not surprisingly, the "Computer and Electronic Products" subsector vastly outshines the other manufacturing subsectors in terms of AI Jobs Intensity. This subsector accounts for 46% of AI job postings, even though its share of all job postings is only 15%.**
- **The "Chemicals" subsector – characterized by extremely process intensive manufacturing – also exhibits a very high AI-to-IT Jobs Intensity (17.44%). However, the AI Jobs Intensity of this subsector (0.84%) is not very high, apparently because the IT Jobs Intensity of this subsector is relatively low.**

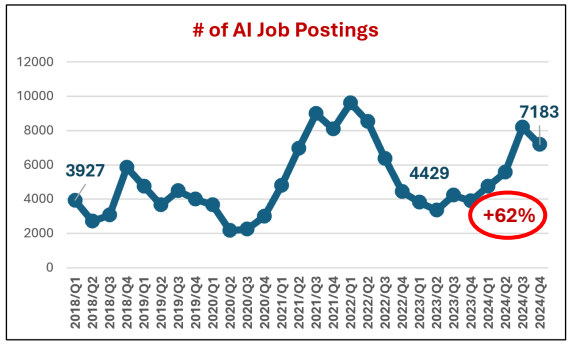


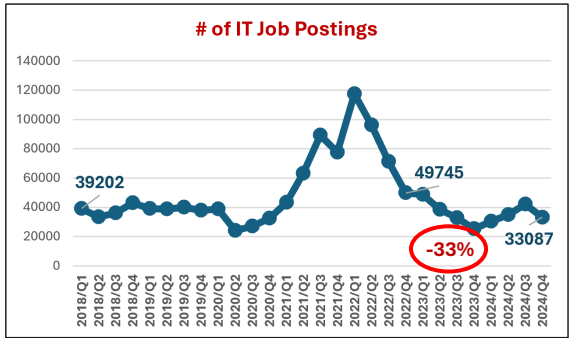


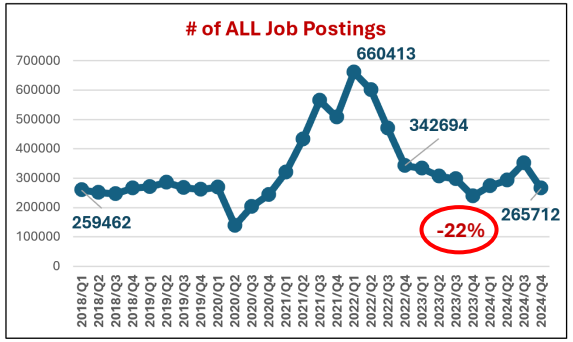
A Deeper Dive

Finance and Insurance
(NAICS 52)

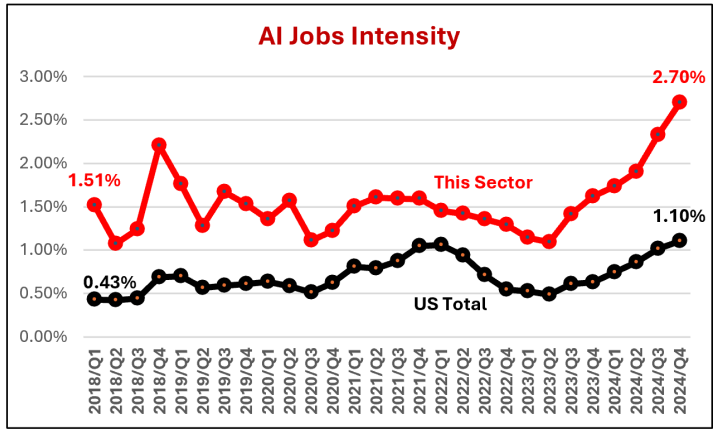
Finance and Insurance

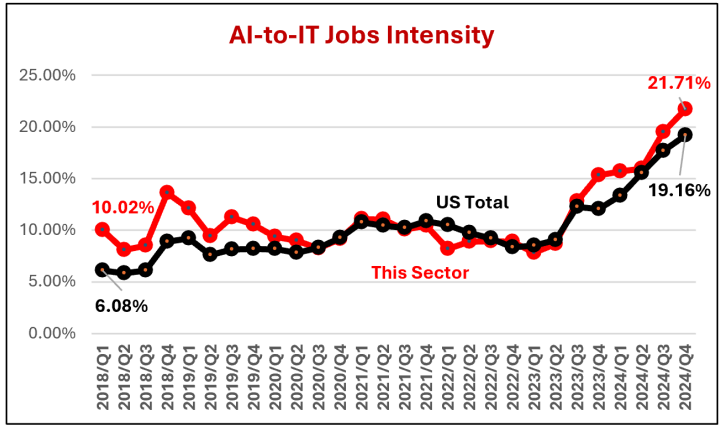






UMD-LinkUp AI Maps Project





AI Jobs Intensity = Ratio of AI Job Postings-to-ALL Job Postings.
AI-to-IT Jobs Intensity = Ratio of AI Job Postings-to-IT Job Postings.

- **Paralleling other sectors, during the 2-year period after the launch of ChatGPT in 2022/Q4, the Finance and Insurance sector also exhibits a decline in All job postings (-22%) as well as IT job postings (-33%) - but a sharp increase in AI job postings (+62%).**
- **Given that bulk of the employee base of this sector comprises college-educated professionals and the output is pure information, the AI Jobs Intensity of this sector is significantly higher than for the U.S. economy as a whole.**
- **In contrast, the AI-to-IT Jobs Intensity closely tracks the broader U.S. economy.**

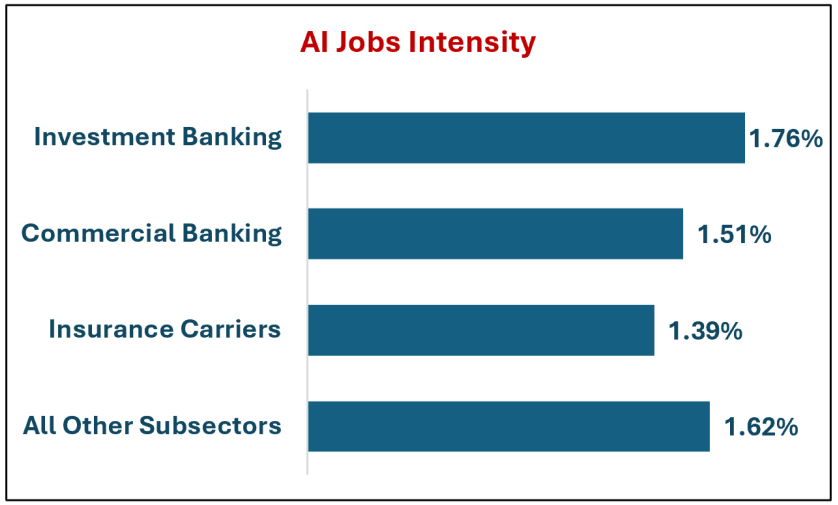
Finance and Insurance

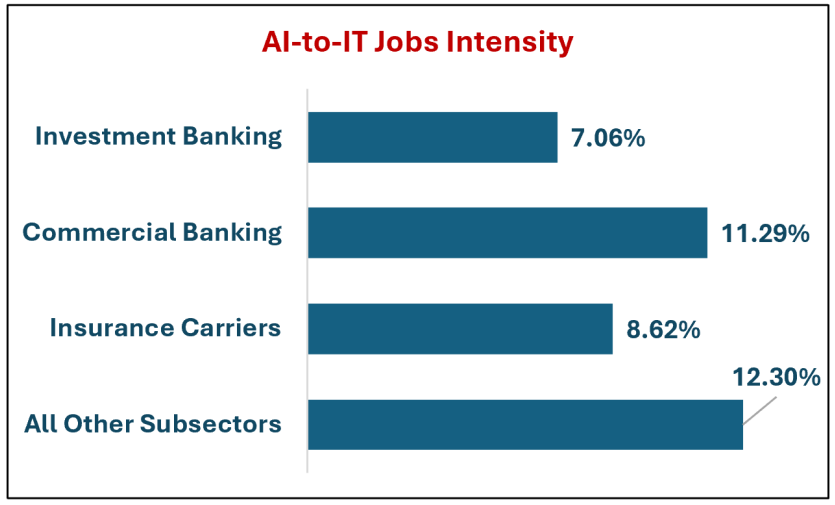
Subsectors' Shares Of Job Postings within the Broader Sector

(Based on Cumulative Data from 2018/Q1 through 2024/Q4)

	All Jobs	IT Jobs	AI Jobs
Investment Banking	4.85%	8.41%	5.53%
Commercial Banking	37.81%	35.22%	37.02%
Insurance Carriers	18.50%	20.83%	16.72%
All Other Subsectors	38.84%	35.55%	40.73%

- There are significant differences in the size of different subsectors. Commercial Banking posts significantly more jobs than Insurance Carriers (or even more dramatically than Investment Banking).
- However, other than size, there are no major differences among the various subsectors in either AI Jobs Intensity or AI-to-IT Jobs Intensity.

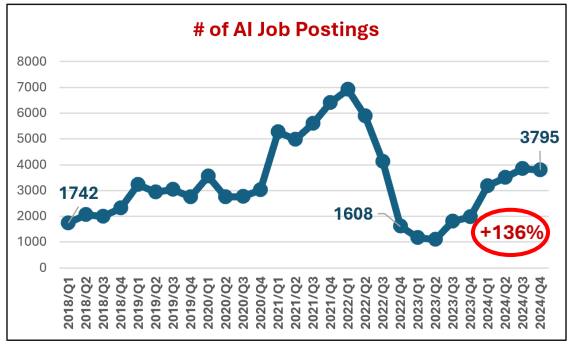


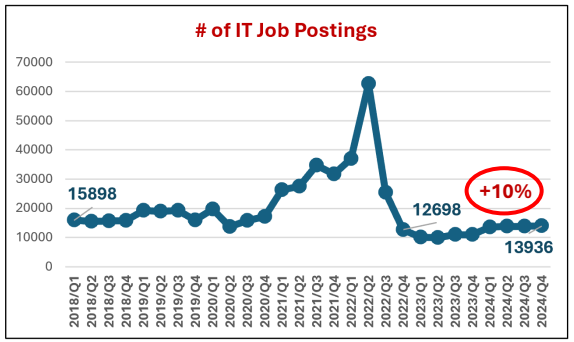


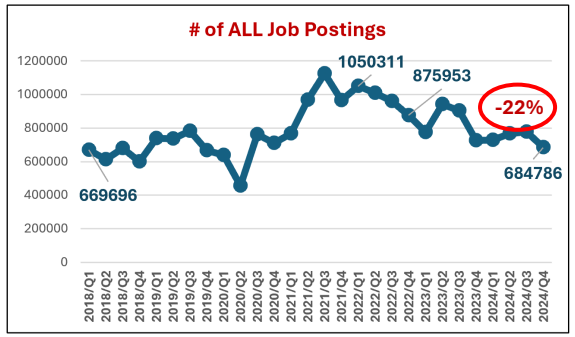
A Deeper Dive

Retail Trade
(NAICS 44-45)

Retail Trade







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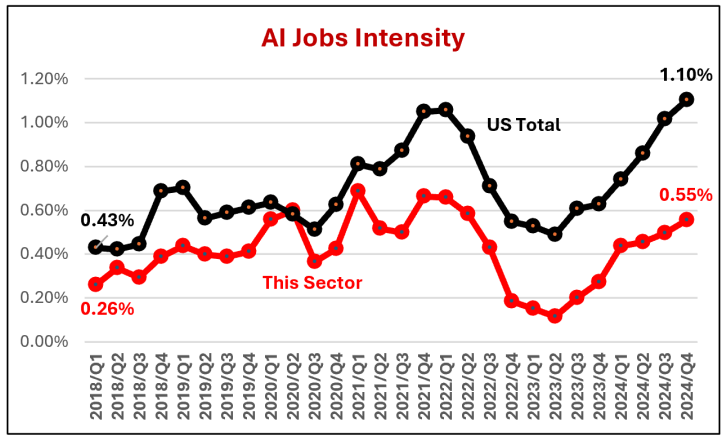
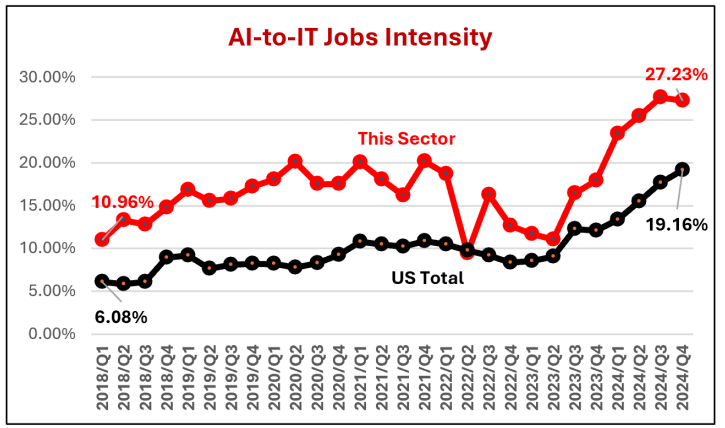




AI Jobs Intensity = Ratio of AI Job Postings-to-ALL Job Postings.
AI-to-IT Jobs Intensity = Ratio of AI Job Postings-to-IT Job Postings.

- **Unlike say the Information sector, the Retail sector employs vast numbers of people doing mostly physical work. While this is starkly so for brick-and-mortar retailers, in many ways, it is true also of purely online retailers such as Amazon.com with its network of fulfillment centers.**
- **Reflecting the nature of work in this sector, its AI Jobs Intensity trails that for the U.S. economy as a whole.**
- **That said, the AI-to-IT Jobs Intensity of this sector is significantly higher than for the U.S. economy.**

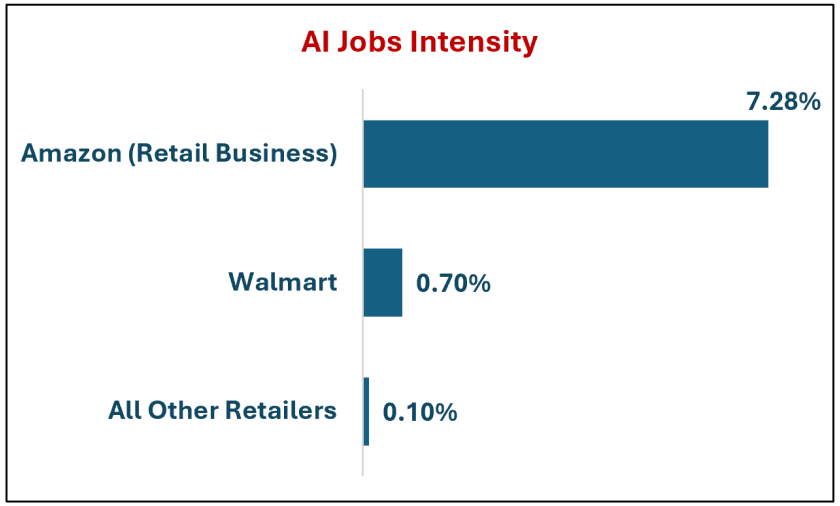
Retail Trade

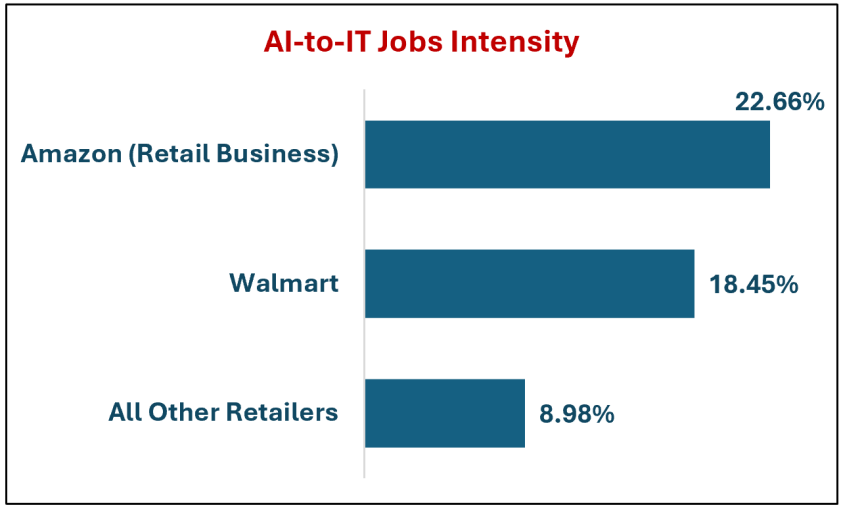
Subsectors' Shares Of Job Postings within the Broader Sector

(Based on Cumulative Data from 2018/Q1 through 2024/Q4)

	All Jobs	IT Jobs	AI Jobs
Amazon (Retail Business)	4.10%	52.26%	70.70%
Walmart	4.32%	6.54%	7.20%
All Other Retailers	91.58%	41.20%	22.10%

- As the largest online retailer in the U.S. economy (and as one of the world's biggest technology companies), Amazon Retail dominates AI job postings in this sector (70.70%).
- Given its massive brick-and-mortar footprint, Walmart is well behind Amazon Retail in terms of AI Jobs Intensity (0.70% versus 7.28%). However, Walmart's AI-to-IT Jobs Intensity is fairly close to that of Amazon Retail (18.45% versus 22.66%) and way ahead of all other retailers (at 8.98%). These data reflect Walmart's very aggressive investments in AI, including at its technology hubs in Silicon Valley and India.

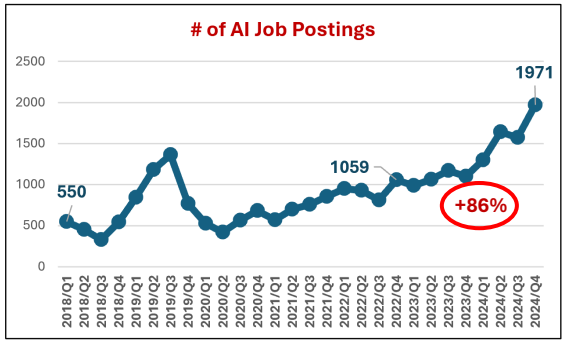


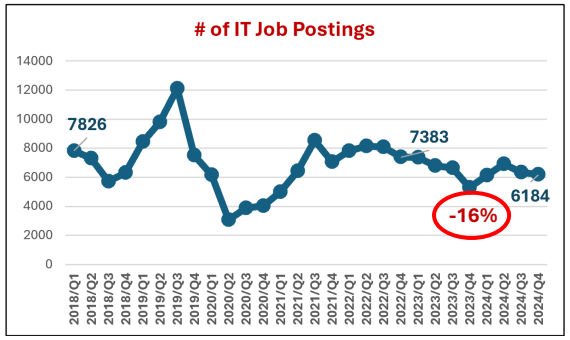


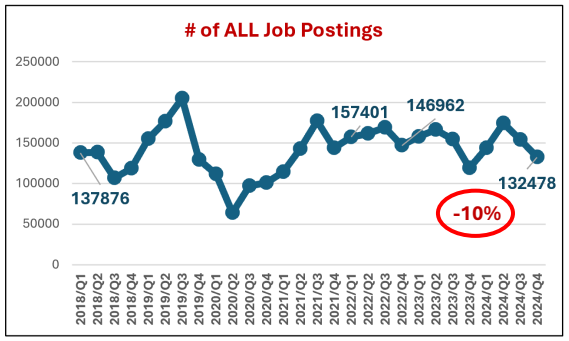
A Deeper Dive

Educational Services
(NAICS 61)

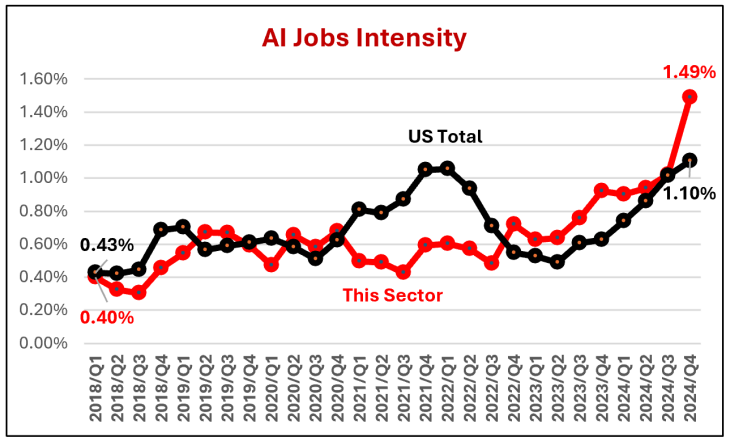
Educational Services

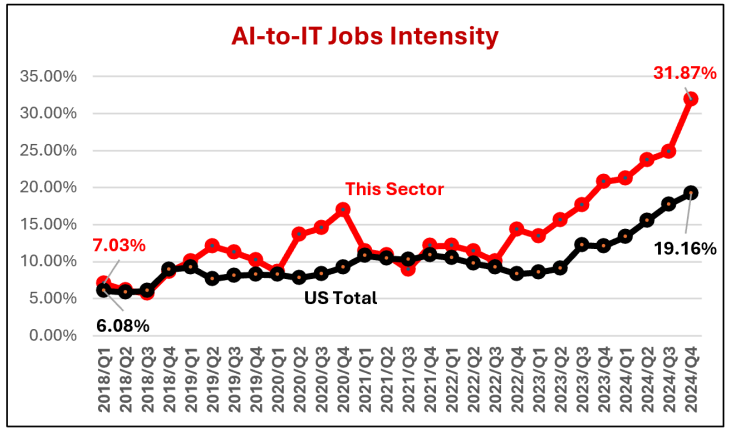






UMD-LinkUp AI Maps Project





AI Jobs Intensity = Ratio of AI Job Postings-to-ALL Job Postings.
AI-to-IT Jobs Intensity = Ratio of AI Job Postings-to-IT Job Postings.

- **Until 2022/Q4, this sector largely tracked the AI Jobs Intensity and AI-to-IT Jobs Intensity for the U.S. economy as a whole.**
- **However, since then, this sector has posted for AI jobs far more aggressively than the broader U.S. economy.**
- **In 2024/Q4, the AI Jobs Intensity for this sector was 1.49% (versus 1.10% for the U.S. economy), while the AI-to-IT Jobs Intensity was 31.87% (versus 19.16% for the U.S. economy).**
- **These developments are driven almost entirely by the "Colleges and Universities" subsector (see next slide).**

Educational Services

Subsectors' Shares Of Job Postings within the Broader Sector

(Based on Cumulative Data from 2018/Q1 through 2024/Q4)

	All Jobs	IT Jobs	AI Jobs
Colleges and Universities	81.11%	84.95%	95.25%
All Other Educational Services	18.89%	15.05%	4.75%

- The AI Jobs Intensity of the "Colleges and Universities" subsector far exceed that of other Educational Services subsectors (0.76% versus 0.16%) and is slightly larger than the 0.72% figure for the U.S. economy as a whole (see slide 10).
- This is true also for AI-to-IT Jobs Intensity (14.96% versus 4.21%). As per slide 10, the figure for the U.S. economy as a whole is 10.06%.