Goldman Sachs Research

Economics Research
2 July 2026 | 1:22AM EDT

GLOBAL ECONOMICS ANALYST

Disentangling Tech Hiring Headwinds: Higher Rates, Overhiring, and AI

Joseph Briggs
+1(212)902-2163 |
joseph.briggs@gs.com
Goldman Sachs & Co. LLC

Sarah Dong
+1(212)357-9741 | sarah.dong@gs.com
Goldman Sachs & Co. LLC

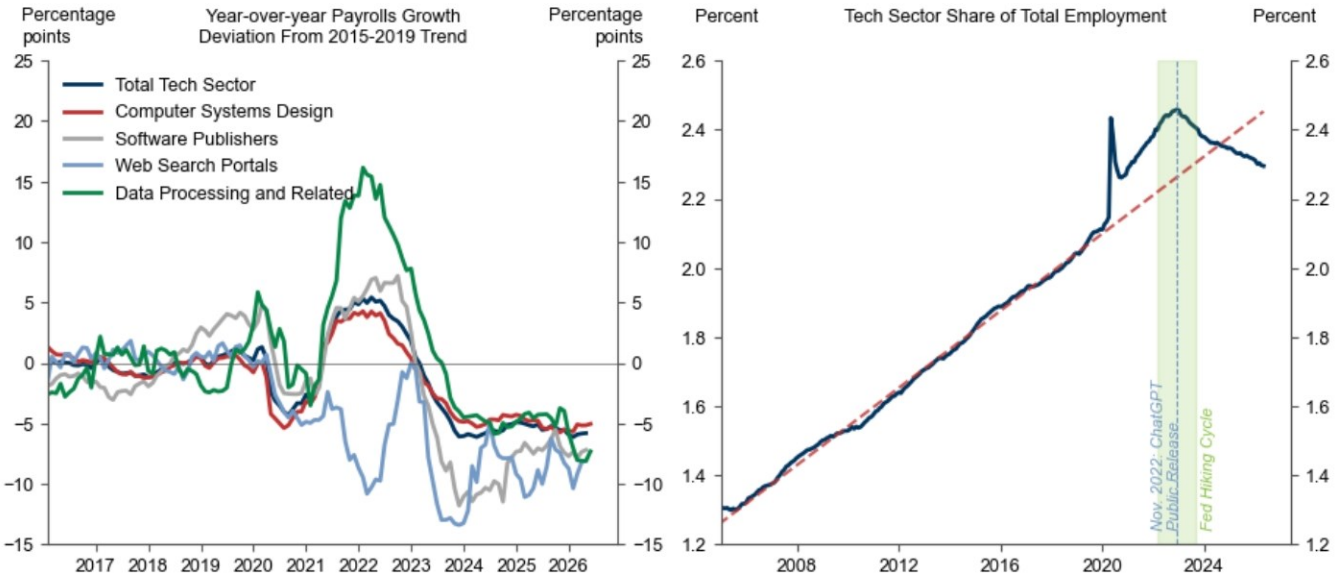
- Three labor market headwinds—a hawkish Fed pivot that slowed growth and raised rates, AI efficiency gains, and a correction for pandemic-era overhiring—have plausibly contributed to a weaker tech labor market since 2022. Disentangling the role of each is complicated, and some commentators have suggested that companies are "AI-washing" layoffs by falsely attributing them to AI efficiencies. In this *Global Economics Analyst,* we leverage detailed company/occupation-level employment data to quantify the contribution of each headwind since 2022.
- First, we find little evidence that higher interest rates have driven the slowdown in tech hiring. Hiring trends are virtually identical across tech companies that were more and less exposed to higher rates.
- Second, we find that AI has slowed hiring, but its impact is small. Differences in occupational AI exposure explain around ½pp of the slowdown in annual tech employment growth since 2022. We also find that AI-layoff announcements appear credible, as companies that announced AI-related layoffs lowered headcount in AI-related occupations more than companies that cited other reasons for layoffs.
- Third, we find stronger evidence that hiring has underperformed among companies that overhired between 2020-2022. Statistical estimates that account for both company and occupational hiring trends suggest that headcount normalization can explain up to 2pp of the slowdown in annual tech employment growth since 2022.
- The main caveat to our results is that they can only explain around half of the 5pp/year slowdown in tech hiring (vs. trend) since 2022. But our results imply that both AI and post-pandemic headcount normalizations have contributed to the recent tech-sector hiring slowdown, with headcount normalization roughly 3-4 times as important. These relative rankings are generally consistent with company commentary on the role of AI in tech sector layoffs, suggesting AI-washing is not a widespread issue.

Investors should consider this report as only a single factor in making their investment decision. For Reg AC certification and other important disclosures, see the Disclosure Appendix, or go to www.gs.com/research/hedge.html.

Disentangling Tech Hiring Headwinds: Higher Rates, Overhiring, and AI

After hiring surged during the pandemic, the tech-sector labor market has weakened significantly since late 2022, with job growth in several subsectors underperforming its long-run trend by around 5pp. As a result, the tech sector's share of overall employment has fallen below its long-run trend (Exhibit 1).

Exhibit 1: Tech Sector Employment Has Underperformed Since 2022



Source: US Bureau of Labor Statistics, Haver Analytics, Goldman Sachs Global Investment Research

Three labor market dynamics—a hawkish Fed pivot that slowed growth and raised rates, AI efficiency gains, and a correction for pandemic overhiring—have plausibly contributed to the tech sector's labor market pullback since late 2022. But disentangling the role of each is difficult since all three headwinds emerged at the same time. Most notably, the hawkish Fed pivot that raised financing costs and led to a downgrade in growth expectations (thereby possibly kicking off a headcount normalization) arrived at the same time as the release of ChatGPT. And while recent studies and company anecdotes strongly point to significant AI-related uplifts to tech worker productivity, some commentators have suggested that companies are "AI-washing" layoffs by overstating the role of AI.

In this *Global Economics Analyst,* we leverage detailed company/occupation-level employment data from Revelio Labs to quantify the impact of each of these three headwinds has had on tech sector employment.

The Overall Tech Sector Hiring Slowdown and Identification Challenge

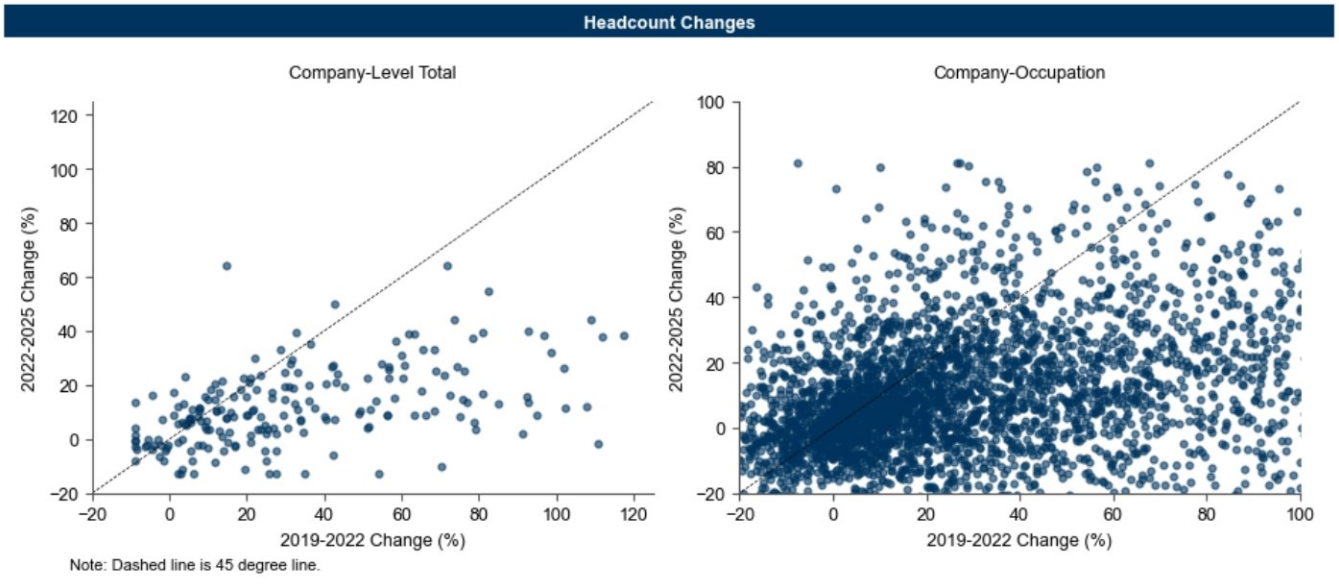
Before examining the three potential drivers of the slowdown in tech hiring, we first consider overall tech labor market trends and what questions our new data might be able (and not be able) to answer.

Exhibit 2 illustrates the variation we exploit by scatter plotting 2019-2022 hiring vs. 2022-2025 hiring at both the company- and company/occupation-levels. These scatter plots illustrate several key points.

First, tech hiring slowed broadly across most companies and occupations from 2022-2025, suggesting that aggregate factors and a broad sectoral slowdown in hiring explains a large share of the labor market underperformance in recent years. Our new analysis—which leverages cross-sectional differences in company- and occupation-level hiring patterns—will not be able to conclusively identify the shock that drove this overall slowdown.

Second, both scatters illustrate that hiring patterns differed significantly across companies and particularly across occupations. Leveraging the distribution of hiring shifts across companies that were differentially exposed to higher rates and overhiring and across occupations that are differentially exposed to AI should provide useful insights into the relative importance of the different tech-sector labor market headwinds.

Exhibit 2: Company- and Company/Occupation-Level Headcount Changes Imply a Sharp Slowdown for the Sector Overall, but Substantial Variation



Source: Revelio Labs, Goldman Sachs Global Investment Research

Against this backdrop, we analyze the role of each hiring headwind separately.

Interest Rate Effects Appear Minimal

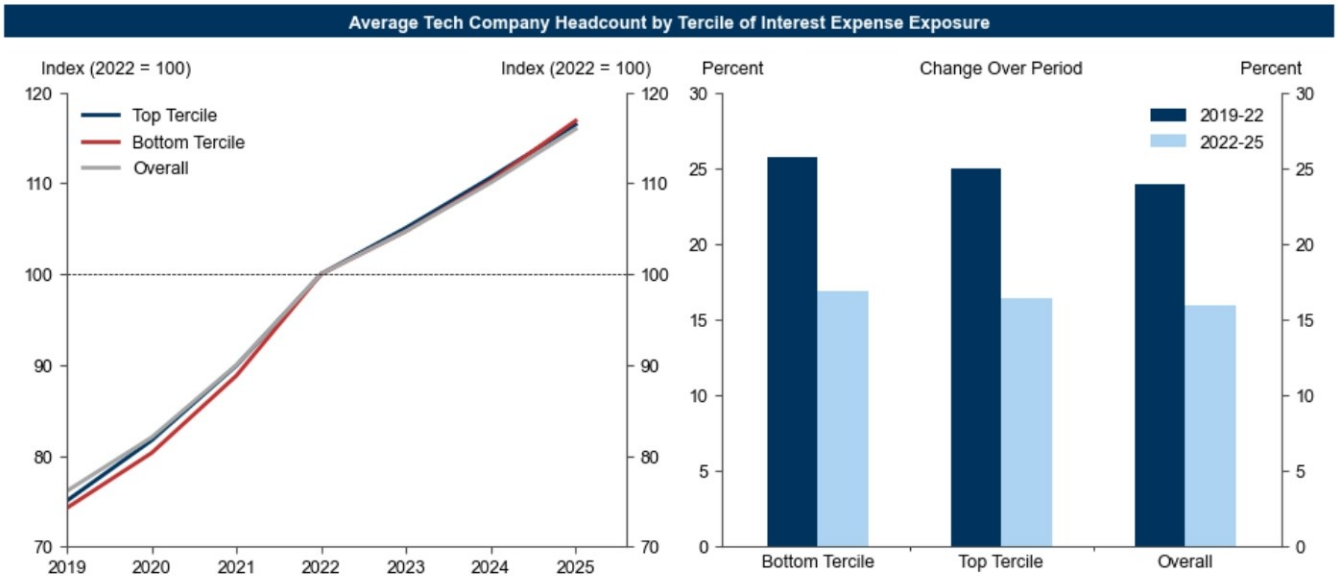
First, we find limited evidence that the tech labor market slowdown is driven by higher rates.

While the Fed's acceleration in rate hikes in late 2022 may have led to a broader downgrade in the tech sector's equity valuations, growth outlook, and hiring plans, we would expect hiring to slow more for companies that are more exposed to rate increases if they were the main driver of hiring underperformance the last several years

To test the effects of higher interest rates on tech hiring, we split our universe of public US tech companies based on changes in their interest coverage ratio (ICR, defined as annual revenue divided by annual interest expense) over the hiking cycle. We find essentially no difference in headcount evolution between the top and bottom ICR change terciles and both are essentially identical to overall tech industry trend (Exhibit

3). The lack of a relationship between interest rate exposure and tech hiring is confirmed by company-level regressions (not shown), leading us to conclude that the effect of higher rates had little impact on the tech sector's labor market underperformance.

Exhibit 3: Interest Exposure Appears to Have Had No Impact on Hiring



Source: Goldman Sachs Global Investment Research

Small Overall Impact, but Some Evidence AI Layoffs Are Credible

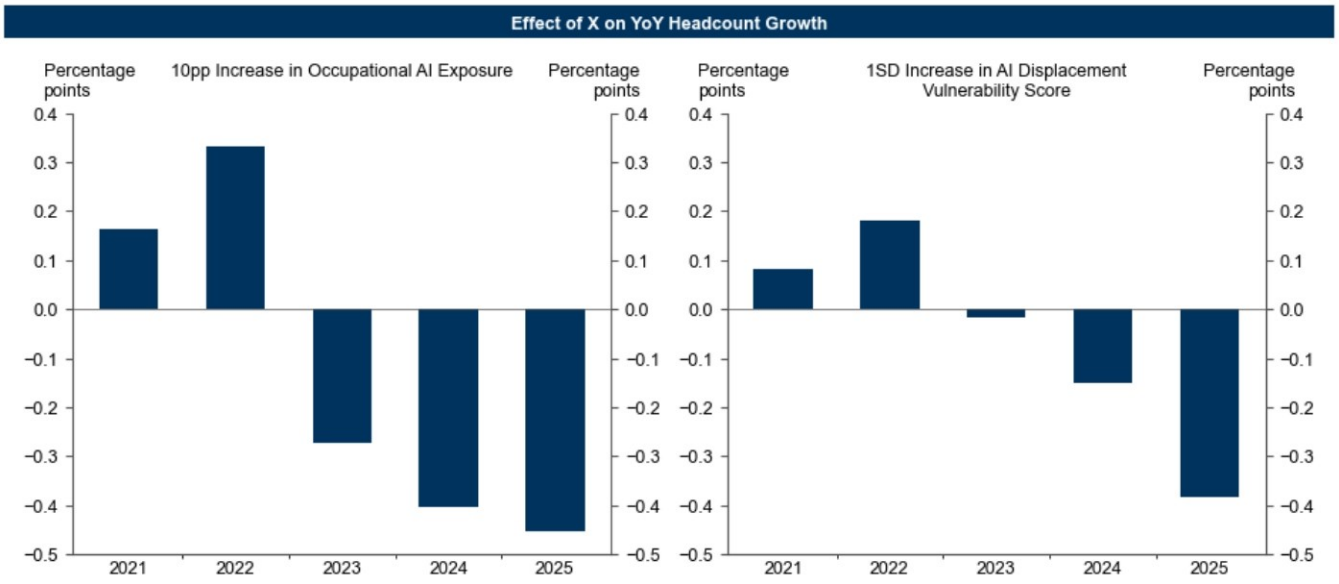
Second, we find evidence that AI has slowed hiring, but only modestly.

To test for AI's impact, we leverage our company-occupational panel that measures headcount in over 800 distinct occupations for over 300 public tech companies from 2019-2025. We regress annual occupational headcount growth on the occupation's AI exposure—defined as the share of work tasks that are exposed to AI automation—with a time interaction to capture the evolution of the effect by year, while also controlling for company- and occupation-fixed effects.

The resulting coefficients on the AI exposure-time interaction are shown in the left chart of Exhibit 4. Prior to 2023, AI exposure was positively correlated with occupational headcount growth. But by 2025, a 10pp difference in occupational AI exposure was associated with a 0.4pp drag. We repeat this analysis with the AI displacement scores we developed last year in the right chart of Exhibit 4. Our results are similar, with a one standard deviation gap in vulnerability score having a positive relationship with headcount growth prior to 2022 but implying a 0.4pp drag in 2025.

Given that tech sector employees are, on average, just over 10pp more exposed to AI than the average worker in the US economy according to our scores, this estimate suggests that AI exposure can explain around ½pp of the tech sector's annual employment growth underperformance relative to economy-wide hiring.

Exhibit 4: Higher AI Exposure Has Weighed Slightly on Employment Growth Since 2023

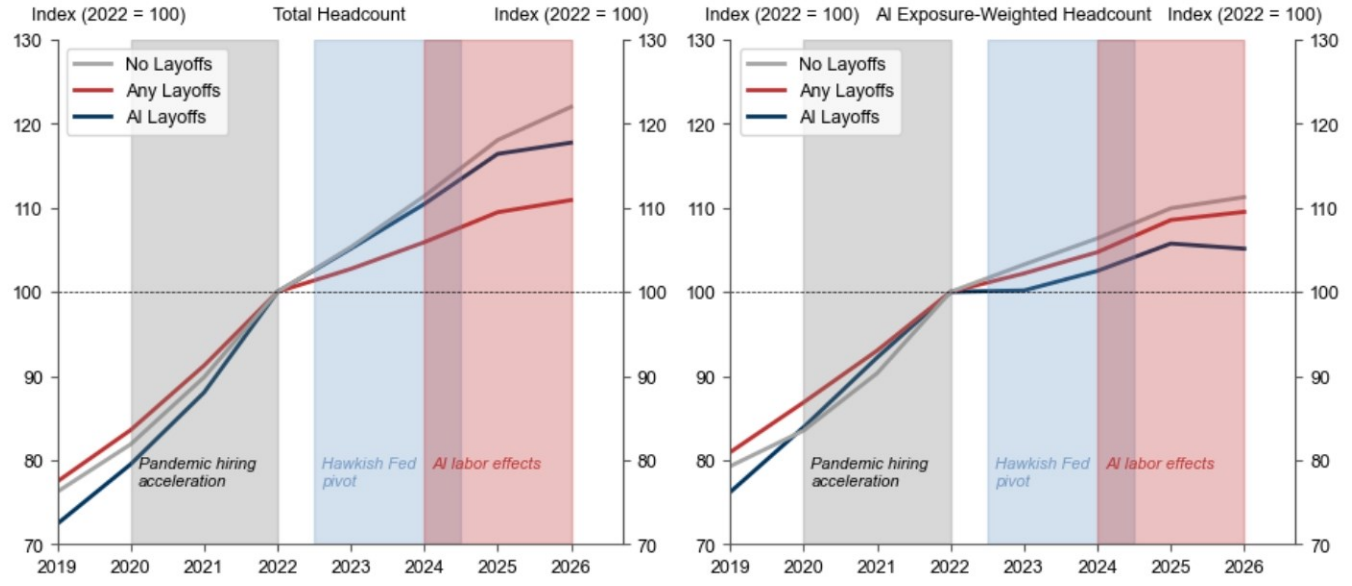


Source: Goldman Sachs Global Investment Research

We can also see evidence of AI's labor market effects in layoff announcements. To illustrate, we first collect data on public layoff announcements—stratified by those attributed to AI and those attributed to other factors—and merge them with our company-and occupation-level employment data. We then compare hiring trends across companies that did not announce layoffs, that announced layoffs but did not cite AI, and that attributed layoffs to AI.

The left chart of Exhibit 5 unsurprisingly shows that companies that announced layoffs (whether AI-related or not) slowed hiring by more than other companies since 2022, with companies that did not cite AI efficiencies seeing the largest headcount reductions. After reweighting headcount by AI exposure, however, the right chart of Exhibit 5 shows that headcount reductions have been larger for companies that attributed headcount reductions to AI. At a high level, this pattern suggests that companies are reducing headcount in a manner consistent with public announcements.

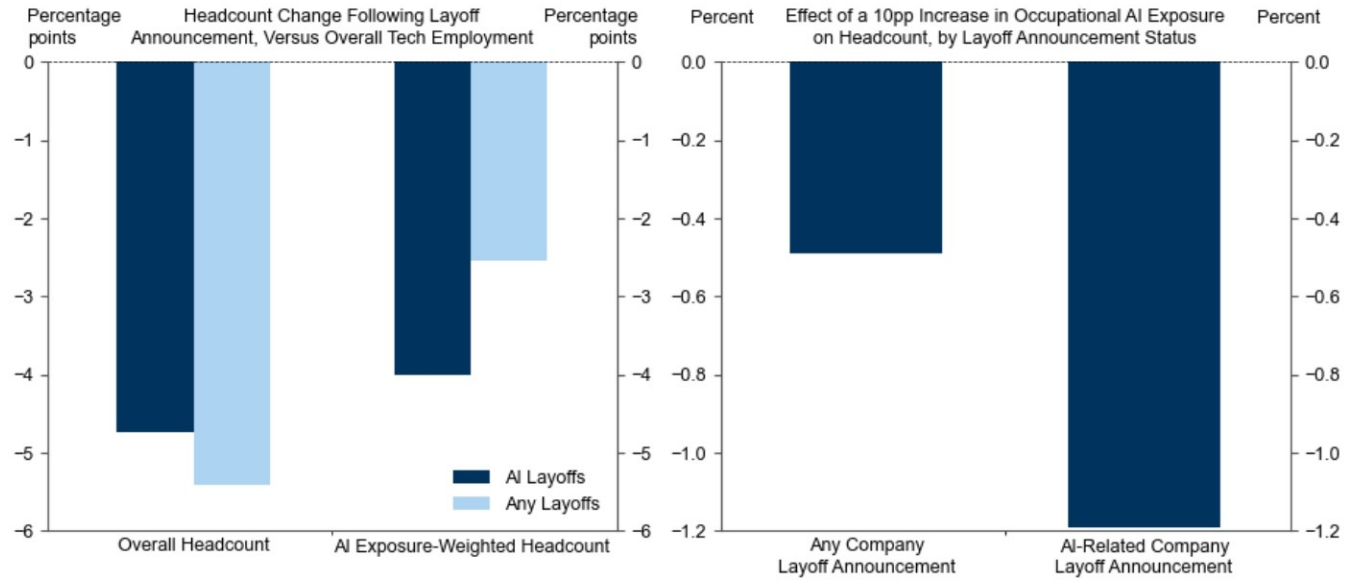
Exhibit 5: Companies That Attributed Layoffs to AI Experienced Smaller Headcount Reductions on an Overall Basis but Larger on an AI-Weighted Basis



Source: Goldman Sachs Global Investment Research

Exhibit 6 provides more rigorous statistical support for the view that AI-attributed layoff announcements are credible. After converting our panel to event time (and controlling for aggregate drivers), the left chart shows that overall headcount reductions following layoff announcements were similar across companies that did and did not cite AI as justification, but that AI-exposure weighted reductions were larger when layoffs were attributed to AI. The right chart considers the intensive margin of exposure and similarly finds that occupation-level headcount was more sensitive to AI exposure at companies that cited AI efficiencies as the reason for layoffs.

Exhibit 6: AI-Layoffs Led to Similar Overall Headcount Reductions (vs. Non-AI-Layoffs), but Larger Headcount Reductions on an AI-Weighted Basis



Source: Goldman Sachs Global Investment Research

Taken together, these analyses suggest that AI efficiencies have indeed weighed on tech

sector hiring over the last several years, particularly at companies that attributed headcount reductions to AI. Effects appear small, however, and the direct differences in occupational exposure can only explain about ½pp of the 5pp slowdown in annual tech employment growth since 2022.

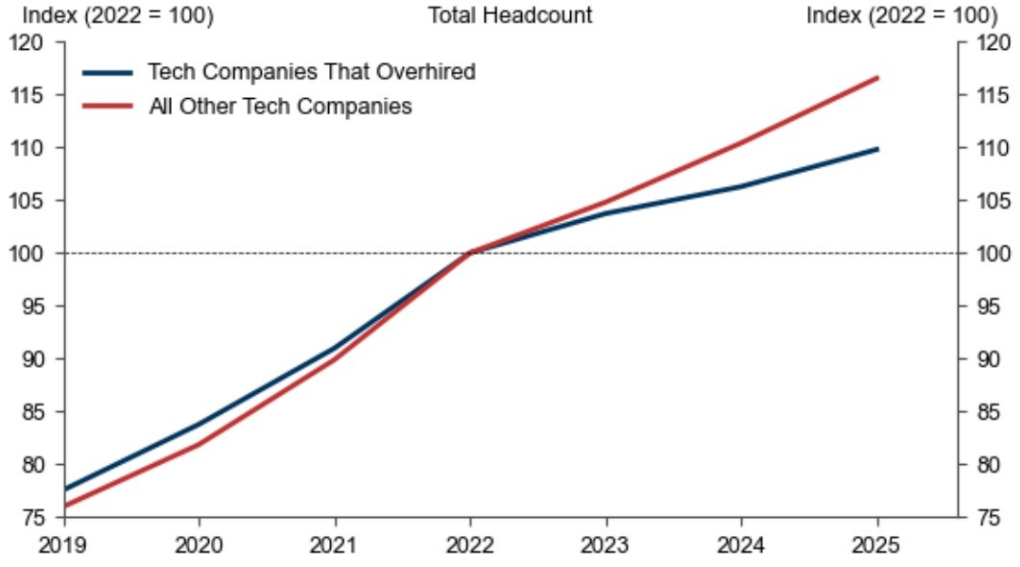
Post-Pandemic Overhiring Normalization Creates a Moderate Drag

Third, we find that pandemic-era overhiring has more meaningfully weighed on job growth in recent years.

The main challenge in testing for overhiring is that headcount is inherently tied to underlying demand, so that it is difficult to tell whether company-level hiring slowdowns reflect actual overhiring or more simply a worse growth outcome. We identify companies that overhired as those who accelerated their pace of headcount growth from 2019 to 2022 while also experiencing declining revenue per employee.[1] We then test whether this "overhiring" proxy predicts subsequent headcount growth in the post-2022 period.

Exhibit 7 provides an initial illustration of headcount trends stratified by our overhiring proxy. We find that since 2022 total headcount at companies that overhired has grown by 10%, underperforming the tech companies that did not overhire by roughly 7pp.

Exhibit 7: Companies Where Hiring Accelerated the Most from 2020-2022 Slowed More Since 2025, Possibly Due to Slower Productivity Growth



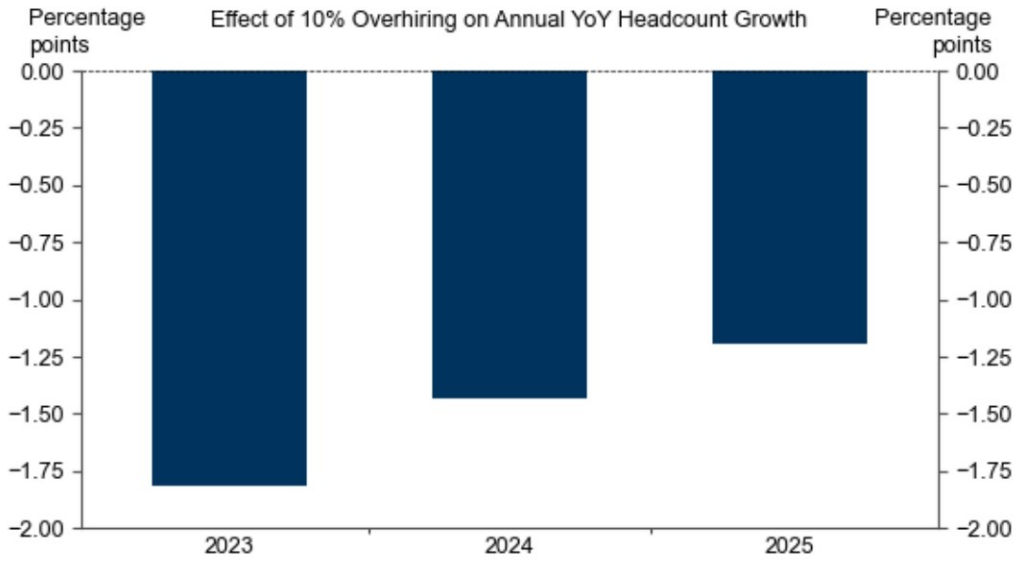
Source: Goldman Sachs Global Investment Research

To statistically test the effect of a pandemic normalization in overhiring, we regress occupation-level headcount growth on the change in hiring from 2020-2022 (vs. 2018-2020) interacted with an indicator for below-average revenue per employee growth. We again include fixed company-and occupation fixed effects to control for aggregate effects. Our resulting estimate implies that a 10pp acceleration in hiring from 2020-2022 was associated with a 1-2pp underperformance in annual occupation-level

[1] Subsequent results are robust if we exclude companies that saw outright revenue declines from our sample, suggesting our results are not driven by companies that experienced a deterioration in activity.

growth from 2023-2025 (Exhibit 8). Given that sector-wide hiring accelerated by roughly 10pp according to the Revelio data, our statistical estimates suggest that up to 2pp of the slowdown in tech sector hiring can be explained by headcount normalization.

Exhibit 8: Pandemic Overhiring Was Associated with Up to a 2pp Subsequent Slowdown in Job Growth, With Effects Largest for Companies Where Productivity Growth Slowed



Source: Goldman Sachs Global Investment Research

Interpreting Impacts on Overall Tech Labor Market

Our cross-company and cross-occupation estimates suggest that higher interest rates had a limited impact on tech hiring, that AI exposure has slowed hiring by up to ½pp, and that headcount normalization has slowed hiring by up to 2pp. Combined, these channels can explain up to 2½pp of the slowdown in annual tech sector headcount growth, or roughly half of its 5pp underperformance (vs. long-run trend) since 2022.

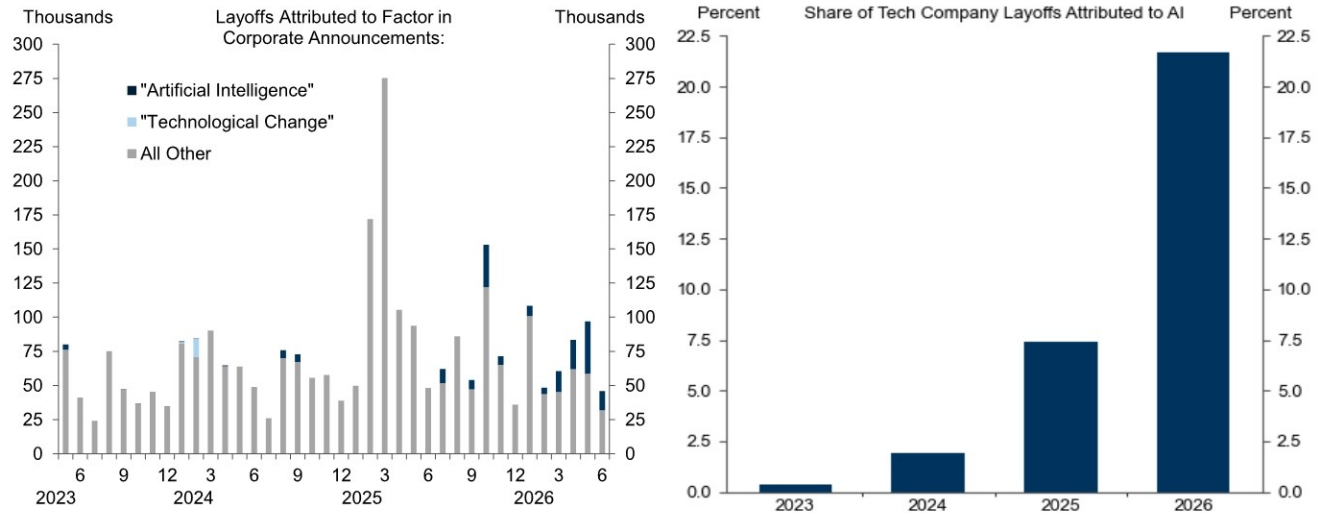
That leaves around half of the hiring underperformance unexplained by cross-company and cross-occupation variation, and therefore attributable to aggregate shocks that are common to all tech companies and workers. While it is hard to identify the source of these shocks, our estimates suggest that post-pandemic overhiring has been 3-4 times as important as AI efficiencies in explaining the slowdown in tech sector employment growth in recent years.

These relative rankings are generally consistent with tech companies' public comments on the role of AI in recent tech sector headcount reductions. The left chart of Exhibit 9 shows that prior to the last few months, very few layoffs in the overall economy were attributed to AI, while the right chart shows a similar pattern for the tech sector specifically. Only in the last year has the share of AI-attributed layoffs risen above 20%.

Although AI has not played a dominant role in slowing tech hiring so far, four patterns suggest that companies are not overstating the role of AI in layoff announcements. First, tech companies that cited AI-efficiencies as a main reason for layoffs have indeed reduced headcount in AI-exposed occupations. Second, most tech companies are still not citing AI as the main driver of layoffs. Third, the share of layoff announcements that cite AI are consistent with our estimates of the relative importance of AI in recent tech

company headcount reductions. Fourth, the time patterns shown in Exhibit 4 and Exhibit 8—which imply that AI-efficiencies played a small role in headcount reductions in 2023 and 2024 but a relatively more important role recently—align with the recent pickup in AI-attributed layoffs. As a result, we do not see "AI-washing" as a widespread issue.

Exhibit 9: Our Results Align with Patterns Suggesting That Most Layoff Announcements Are Not Attributable to AI, Although AI Efficiency Gains Have Contributed to Layoffs Recently



Source: Challenger, Haver Analytics, Goldman Sachs Global Investment Research

Joseph Briggs

Sarah Dong

The Global Economics Team

Jan Hatzius
+1(212)902-0394
jan.hatzius@gs.com
Goldman Sachs & Co. LLC

Joseph Briggs
+1(212)902-2163
joseph.briggs@gs.com
Goldman Sachs & Co. LLC

Sarah Dong
+1(212)357-9741
sarah.dong@gs.com
Goldman Sachs & Co. LLC

Megan Peters
+44(20)7051-2058
megan.l.peters@gs.com
Goldman Sachs International

Disclosure Appendix

Reg AC

We, Joseph Briggs and Sarah Dong, hereby certify that all of the views expressed in this report accurately reflect our personal views, which have not been influenced by considerations of the firm's business or client relationships.

Unless otherwise stated, the individuals listed on the cover page of this report are analysts in Goldman Sachs' Global Investment Research division.

Contributing Authors: Joseph Briggs Goldman Sachs & Co. LLC, Sarah Dong Goldman Sachs & Co. LLC.

Unless otherwise stated, the individuals listed in the Contributing Authors disclosure of this report are analysts in Goldman Sachs' Global Investment Research division.

Disclosures

Regulatory disclosures

Disclosures required by United States laws and regulations

See company-specific regulatory disclosures above for any of the following disclosures required as to companies referred to in this report: manager or co-manager in a pending transaction; 1% or other ownership; compensation for certain services; types of client relationships; managed/co-managed public offerings in prior periods; directorships; for equity securities, market making and/or specialist role. Goldman Sachs trades or may trade as a principal in debt securities (or in related derivatives) of issuers discussed in this report.

The following are additional required disclosures: **Ownership and material conflicts of interest:** Goldman Sachs policy prohibits its analysts, professionals reporting to analysts and members of their households from owning securities of any company in the analyst's area of coverage. **Analyst compensation:** Analysts are paid in part based on the profitability of Goldman Sachs, which includes investment banking revenues. **Analyst as officer or director:** Goldman Sachs policy generally prohibits its analysts, persons reporting to analysts or members of their households from serving as an officer, director or advisor of any company in the analyst's area of coverage. **Non-U.S. Analysts:** Non-U.S. analysts may not be associated persons of Goldman Sachs & Co. LLC and therefore may not be subject to FINRA Rule 2241 or FINRA Rule 2242 restrictions on communications with a subject company, public appearances and trading in securities covered by the analysts.

Additional disclosures required under the laws and regulations of jurisdictions other than the United States

The following disclosures are those required by the jurisdiction indicated, except to the extent already made above pursuant to United States laws and regulations. **Australia:** Goldman Sachs Australia Pty Ltd and its affiliates are not authorised deposit-taking institutions (as that term is defined in the Banking Act 1959 (Cth)) in Australia and do not provide banking services, nor carry on a banking business, in Australia. This research, and any access to it, is intended only for "wholesale clients" within the meaning of the Australian Corporations Act, unless otherwise agreed by Goldman Sachs. In producing research reports, members of Global Investment Research of Goldman Sachs Australia may attend site visits and other meetings hosted by the companies and other entities which are the subject of its research reports. In some instances the costs of such site visits or meetings may be met in part or in whole by the issuers concerned if Goldman Sachs Australia considers it is appropriate and reasonable in the specific circumstances relating to the site visit or meeting. To the extent that the contents of this document contains any financial product advice, it is general advice only and has been prepared by Goldman Sachs without taking into account a client's objectives, financial situation or needs. A client should, before acting on any such advice, consider the appropriateness of the advice having regard to the client's own objectives, financial situation and needs. A copy of certain Goldman Sachs Australia and New Zealand disclosure of interests and a copy of Goldman Sachs' Australian Sell-Side Research Independence Policy Statement are available at: https://www.goldmansachs.com/disclosures/australia-new-zealand/index.html. **Brazil:** Disclosure information in relation to CVM Resolution n. 20 is available at https://www.gs.com/worldwide/brazil/area/gir/index.html. Where applicable, the Brazil-registered analyst primarily responsible for the content of this research report, as defined in Article 20 of CVM Resolution n. 20, is the first author named at the beginning of this report, unless indicated otherwise at the end of the text. **Canada:** This information is being provided to you for information purposes only and is not, and under no circumstances should be construed as, an advertisement, offering or solicitation by Goldman Sachs & Co. LLC for purchasers of securities in Canada to trade in any Canadian security. Goldman Sachs & Co. LLC is not registered as a dealer in any jurisdiction in Canada under applicable Canadian securities laws and generally is not permitted to trade in Canadian securities and may be prohibited from selling certain securities and products in certain jurisdictions in Canada. If you wish to trade in any Canadian securities or other products in Canada please contact Goldman Sachs Canada Inc., an affiliate of The Goldman Sachs Group Inc., or another registered Canadian dealer. **Hong Kong:** Further information on the securities of covered companies referred to in this research may be obtained on request from Goldman Sachs (Asia) L.L.C. **India:** Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (India) Securities Private Limited, Research Analyst - SEBI Registration Number INH000001493, 10th Floor, Ascent-Worli, Sudam Kalu Ahire Marg, Worli, Mumbai-400 025, India, Corporate Identity Number U74140MH2006FTC160634, Phone +91 22 6616 9000, Fax +91 22 6616 9001. Goldman Sachs may beneficially own 1% or more of the securities (as such term is defined in clause 2 (h) the Indian Securities Contracts (Regulation) Act, 1956) of the subject company or companies referred to in this research report. Registration granted by SEBI and certification from NISM in no way guarantee performance of the intermediary or provide any assurance of returns to investors. Goldman Sachs (India) Securities Private Limited compliance officer and investor grievance contact details, a copy of the annual compliance audit report and other relevant information and disclosures can be found at this link: https://www.goldmansachs.com/worldwide/india/research-analyst. **Japan:** See below. **Korea:** This research, and any access to it, is intended only for "professional investors" within the meaning of the Financial Services and Capital Markets Act, unless otherwise agreed by Goldman Sachs. Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (Asia) L.L.C., Seoul Branch. **New Zealand:** Goldman Sachs New Zealand Limited and its affiliates are neither "registered banks" nor "deposit takers" (as defined in the Reserve Bank of New Zealand Act 1989) in New Zealand. This research, and any access to it, is intended for "wholesale clients" (as defined in the Financial Advisers Act 2008) unless otherwise agreed by Goldman Sachs. A copy of certain Goldman Sachs Australia and New Zealand disclosure of interests is available at: https://www.goldmansachs.com/disclosures/australia-new-zealand/index.html. **Russia:** Research reports distributed in the Russian Federation are not advertising as defined in the Russian legislation, but are information and analysis not having product promotion as their main purpose and do not provide appraisal within the meaning of the Russian legislation on appraisal activity. Research reports do not constitute a personalized investment recommendation as defined in Russian laws and regulations, are not addressed to a specific client, and are prepared without analyzing the financial circumstances, investment profiles or risk profiles of clients. Goldman Sachs assumes no responsibility for any investment decisions that may be taken by a client or any other person based on this research report. **Singapore:** Goldman Sachs (Singapore) Pte. (Company Number: 198602165W), which is regulated by the Monetary Authority of Singapore, accepts legal responsibility for this research, and should be contacted with respect to any matters arising from, or in connection with, this research. **Taiwan:** This material is for reference only and must not be reprinted without permission. Investors should carefully consider their own investment risk. Investment results are the responsibility of the individual investor. **United Kingdom:** Persons who would be categorized as retail clients in the United Kingdom, as such term is defined in the rules of the Financial Conduct Authority, should read this research in conjunction with prior Goldman Sachs research on the covered companies referred to herein and should refer to the risk warnings that have been sent to them by Goldman Sachs International. A copy of these risks warnings, and a glossary of certain financial terms used in this report, are

available from Goldman Sachs International on request.

European Union and United Kingdom: Disclosure information in relation to Article 6 (2) of the European Commission Delegated Regulation (EU) (2016/958) supplementing Regulation (EU) No 596/2014 of the European Parliament and of the Council (including as that Delegated Regulation is implemented into United Kingdom domestic law and regulation following the United Kingdom's departure from the European Union and the European Economic Area) with regard to regulatory technical standards for the technical arrangements for objective presentation of investment recommendations or other information recommending or suggesting an investment strategy and for disclosure of particular interests or indications of conflicts of interest is available at https://www.gs.com/disclosures/europeanpolicy.html which states the European Policy for Managing Conflicts of Interest in Connection with Investment Research.

Japan: Goldman Sachs Japan Co., Ltd. is a Financial Instrument Dealer registered with the Kanto Financial Bureau under registration number Kinsho 69, and a member of Japan Securities Dealers Association, Financial Futures Association of Japan Type II Financial Instruments Firms Association, and Investment Management Association of Japan. Sales and purchase of equities are subject to commission pre-determined with clients plus consumption tax. See company-specific disclosures as to any applicable disclosures required by Japanese stock exchanges, the Japanese Securities Dealers Association or the Japanese Securities Finance Company.

Global product; distributing entities

Goldman Sachs Global Investment Research produces and distributes research products for clients of Goldman Sachs on a global basis. Analysts based in Goldman Sachs offices around the world produce research on industries and companies, and research on macroeconomics, currencies, commodities and portfolio strategy. This research is disseminated in Australia by Goldman Sachs Australia Pty Ltd (ABN 21 006 797 897); in Brazil by Goldman Sachs do Brasil Corretora de Títulos e Valores Mobiliários S.A.; Public Communication Channel Goldman Sachs Brazil: 0800 727 5764 and / or contatogoldmanbrasil@gs.com. Available Weekdays (except holidays), from 9am to 6pm. Canal de Comunicação com o Público Goldman Sachs Brasil: 0800 727 5764 e/ou contatogoldmanbrasil@gs.com. Horário de funcionamento: segunda-feira à sexta-feira (exceto feriados), das 9h às 18h; in Canada by Goldman Sachs & Co. LLC; in Hong Kong by Goldman Sachs (Asia) L.L.C.; in India by Goldman Sachs (India) Securities Private Ltd.; in Japan by Goldman Sachs Japan Co., Ltd.; in the Republic of Korea by Goldman Sachs (Asia) L.L.C., Seoul Branch; in New Zealand by Goldman Sachs New Zealand Limited; in Russia by OOO Goldman Sachs; in Singapore by Goldman Sachs (Singapore) Pte. (Company Number: 198602165W); and in the United States of America by Goldman Sachs & Co. LLC. Goldman Sachs International has approved this research in connection with its distribution in the United Kingdom.

Goldman Sachs International ("GSI"), authorised by the Prudential Regulation Authority ("PRA") and regulated by the Financial Conduct Authority ("FCA") and the PRA, has approved this research in connection with its distribution in the United Kingdom.

European Economic Area: Goldman Sachs Bank Europe SE ("GSBE") is a credit institution incorporated in Germany and, within the Single Supervisory Mechanism, subject to direct prudential supervision by the European Central Bank and in other respects supervised by German Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht, BaFin) and Deutsche Bundesbank and disseminates research within the European Economic Area.

General disclosures

This research is for our clients only. Other than disclosures relating to Goldman Sachs, this research is based on current public information that we consider reliable, but we do not represent it is accurate or complete, and it should not be relied on as such. The information, opinions, estimates and forecasts contained herein are as of the date hereof and are subject to change without prior notification. We seek to update our research as appropriate, but various regulations may prevent us from doing so. Other than certain industry reports published on a periodic basis, the large majority of reports are published at irregular intervals as appropriate in the analyst's judgment.

Goldman Sachs conducts a global full-service, integrated investment banking, investment management, and brokerage business. We have investment banking and other business relationships with a substantial percentage of the companies covered by Global Investment Research. Goldman Sachs & Co. LLC, the United States broker dealer, is a member of SIPC (https://www.sipc.org).

Our salespeople, traders, and other professionals may provide oral or written market commentary or trading strategies to our clients and principal trading desks that reflect opinions that are contrary to the opinions expressed in this research. Our asset management area, principal trading desks and investing businesses may make investment decisions that are inconsistent with the recommendations or views expressed in this research.

We and our affiliates, officers, directors, and employees will from time to time have long or short positions in, act as principal in, and buy or sell, the securities or derivatives, if any, referred to in this research, unless otherwise prohibited by regulation or Goldman Sachs policy.

The views attributed to third party presenters at Goldman Sachs arranged conferences, including individuals from other parts of Goldman Sachs, do not necessarily reflect those of Global Investment Research and are not an official view of Goldman Sachs.

Any third party referenced herein, including any salespeople, traders and other professionals or members of their household, may have positions in the products mentioned that are inconsistent with the views expressed by analysts named in this report.

This research is focused on investment themes across markets, industries and sectors. It does not attempt to distinguish between the prospects or performance of, or provide analysis of, individual companies within any industry or sector we describe.

Any trading recommendation in this research relating to an equity or credit security or securities within an industry or sector is reflective of the investment theme being discussed and is not a recommendation of any such security in isolation.

This research is not an offer to sell or the solicitation of an offer to buy any security in any jurisdiction where such an offer or solicitation would be illegal. It does not constitute a personal recommendation or take into account the particular investment objectives, financial situations, or needs of individual clients. Clients should consider whether any advice or recommendation in this research is suitable for their particular circumstances and, if appropriate, seek professional advice, including tax advice. The price and value of investments referred to in this research and the income from them may fluctuate. Past performance is not a guide to future performance, future returns are not guaranteed, and a loss of original capital may occur. Fluctuations in exchange rates could have adverse effects on the value or price of, or income derived from, certain investments.

Certain transactions, including those involving futures, options, and other derivatives, give rise to substantial risk and are not suitable for all investors. Investors should review current options and futures disclosure documents which are available from Goldman Sachs sales representatives or at https://www.theocc.com/about/publications/character-risks.jsp and https://www.goldmansachs.com/disclosures/cftc_fcm_disclosures. Transaction costs may be significant in option strategies calling for multiple purchase and sales of options such as spreads. Supporting documentation will be supplied upon request.

Differing Levels of Service provided by Global Investment Research: The level and types of services provided to you by Goldman Sachs Global Investment Research may vary as compared to that provided to internal and other external clients of GS, depending on various factors including your individual preferences as to the frequency and manner of receiving communication, your risk profile and investment focus and perspective (e.g., marketwide, sector specific, long term, short term), the size and scope of your overall client relationship with GS, and legal and regulatory constraints.

As an example, certain clients may request to receive notifications when research on specific securities is published, and certain clients may request that specific data underlying analysts' fundamental analysis available on our internal client websites be delivered to them electronically through data feeds or otherwise. No change to an analyst's fundamental research views (e.g., ratings, price targets, or material changes to earnings estimates for equity securities), will be communicated to any client prior to inclusion of such information in a research report broadly disseminated through electronic publication to our internal client websites or through other means, as necessary, to all clients who are entitled to receive such reports.

All research reports are disseminated and available to all clients simultaneously through electronic publication to our internal client websites. Not all research content is redistributed to our clients or available to third-party aggregators, nor is Goldman Sachs responsible for the redistribution of our research by third party aggregators. For research, models or other data related to one or more securities, markets or asset classes (including related services) that may be available to you, please contact your GS representative or go to https://research.gs.com.

Disclosure information is also available at https://www.gs.com/research/hedge.html or from Research Compliance, 200 West Street, New York, NY 10282.

© 2026 Goldman Sachs.

You are permitted to store, display, analyze, modify, reformat, and print the information made available to you via this service only for your own use. You may not resell or reverse engineer this information to calculate or develop any index for disclosure and/or marketing or create any other derivative works or commercial product(s), data or offering(s) without the express written consent of Goldman Sachs. You are not permitted to publish, transmit, or otherwise reproduce this information, in whole or in part, in any format to any third party without the express written consent of Goldman Sachs. This foregoing restriction includes, without limitation, using, extracting, downloading or retrieving this information, in whole or in part, to train or finetune a machine learning or artificial intelligence system, or to provide or reproduce this information, in whole or in part, as a prompt or input to any such system.