Goldman Sachs | Economics Research

2 September 2024 | 11:28AM BST

Global Markets Analyst

Lessons From G10 Cutting Cycles

- With most of the G10 either having just begun or about to begin cutting policy rates, we look at the return potential of a variety of rates investment strategies during G10 cutting cycles over the last three decades to understand how to position once cuts begin.
- We find that outright longs generate the highest leveraged returns during cutting cycles of all types, with the 2y point consistently on average best for both total and vol-adjusted returns. 2s10s steepeners offer the best volatility-adjusted returns among curve formats. Most of the returns to longs and steepeners are generated in the months into and immediately following the initial cut.
- At current levels of front-end inversion, such as 1y1y vs 1y, it would be unprecedented to generate significant positive returns to long positions in the absence of a recession. And although non-recessionary returns to steepeners are mixed, the initial flatness of the curve suggests the risk / reward to steepener positions is likely to be better.

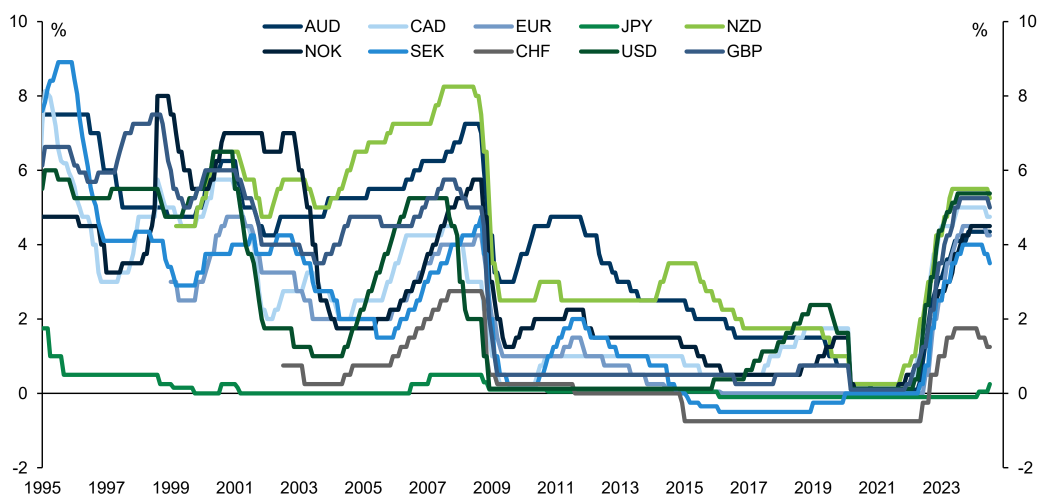
George Cole
+44(20)7552-1214 |
george.cole@gs.com
Goldman Sachs International

Friedrich Schaper
+44(20)7774-7906 |
friedrich.schaper@gs.com
Goldman Sachs International

Lessons From G10 Cutting Cycles

The majority of G10 central banks have either started or are poised to begin cutting rates. The eventual returns to fixed income will depend on the evolution of the data and the extent of cuts compared with the cuts already priced. To understand how the market has priced risks in the past and to shed light on the potential path for returns in the future, we analyse previous G10 cutting cycles and the returns to a variety of strategies across time (Exhibit 1).

Exhibit 1: G10 cuts are broadening
G10 policy rates



Source: Haver Analytics, Goldman Sachs Glolal Investment Research

We identify 74 cutting cycles in G10 (Exhibit 2). Defining a cutting cycle does require some judgement, given that cycles are inherently uncertain and can stop and start depending on incoming data. A series of cuts punctuated by extended pauses could be considered a single cycle, or multiple smaller cutting cycles - here we separate cutting cycles if there is a pause of six months or more. In some cases we are constrained by data availability – if not for the policy rate, for market rates across the curve. In our analysis we classify cutting cycles as:

1. Initial cuts, for which we require that the prior policy rate move was a hike. This distinguishes from cuts that may be a restarting of a cutting cycle after a pause.
2. Cuts that are associated with a recession.

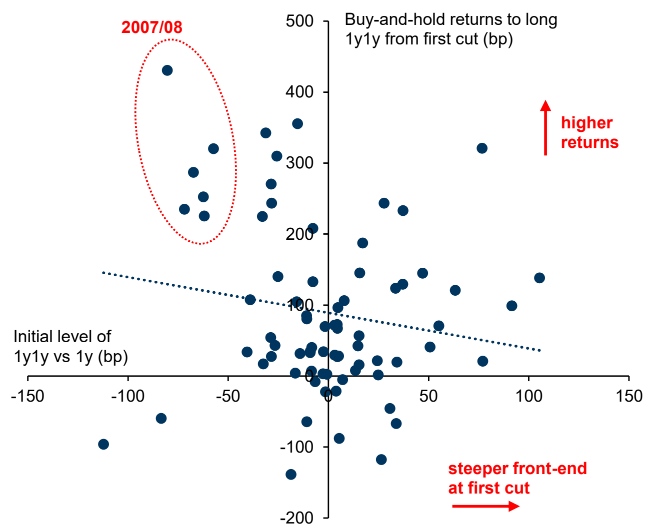
There is overlap between the categories, but this allows us to generate results depending on the different types of cutting cycles. Examining returns under the different flavours of cutting cycle then allows for a richer discussion of the risk / reward of each strategy given the uncertain path ahead.

Exhibit 2: G10 cutting cycles
Assumes cutting cycle ends if rates on pause for at least 6m

G10 cycles	no. of cycles	Average length (m)	Average depth (bp)
Australia	11	7	-124
Canada	8	11	-220
Euro area	6	10	-125
Japan	6	6	-43
New Zealand	5	9	-190
Norway	9	10	-197
Sweden	8	11	-191
Switzerland	4	5	-100
US	8	8	-180
UK	9	6	-137
G10	74	8	-155

Source: Goldman Sachs Global Investment Research

Exhibit 3: Deep recessions influence front-end return averages
1y1y realised returns vs initial 1y1y vs 1y level



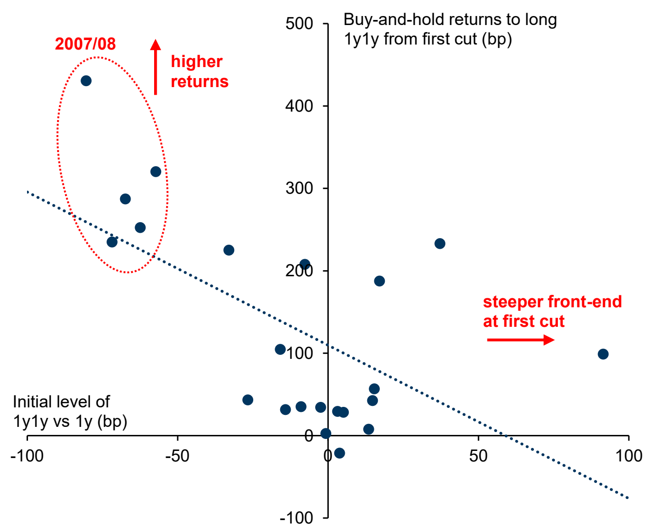
Source: Goldman Sachs Global Investment Research

Long 1y1y: better returns when curve is steeper, unless in recession

The first strategy we consider is simply receiving and holding to maturity 1y1y rates across cutting cycles. This tests the degree of inversion and/or premium against the realised value for 1y rates in one year's time. Exhibit 3 shows the initial front-end inversion, measured by 1y1y – 1y swap rates, vs. the gains made by receiving 1y1y rates for 1-year. In this instance, the y=x line would represent exactly meeting the forward curve.

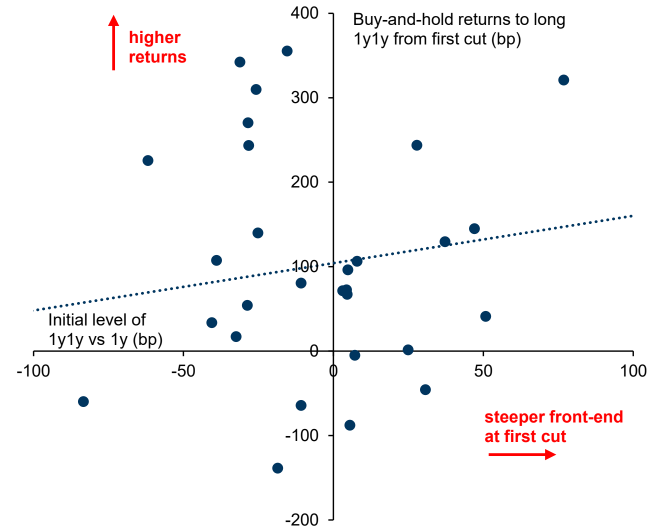
We find that returns are generally positive, indicating the existence of positive risk premium. A reasonable prior is that returns would be positive when the curve is steep – this is indeed what we see in the top right quadrant. But the overall relationship in the full sample is not positive – and in particular receiving inverted curves has generated significant profits in the past (circled points). These points are, however, G10 cutting cycles through 2007-2009, where meaningful cut pricing was eclipsed by the eventual cuts central banks ultimately delivered.

Exhibit 4: Recessions generate returns to 1y1y longs despite inversion
1y1y realised returns vs initial 1y1y vs 1y level in recessions



Source: Goldman Sachs Global Investment Research

Exhibit 5: In the absence of recession, steeper front end implies higher returns
1y1y realised returns vs initial 1y1y vs 1y level in non-recessionary cycles



Source: Goldman Sachs Global Investment Research

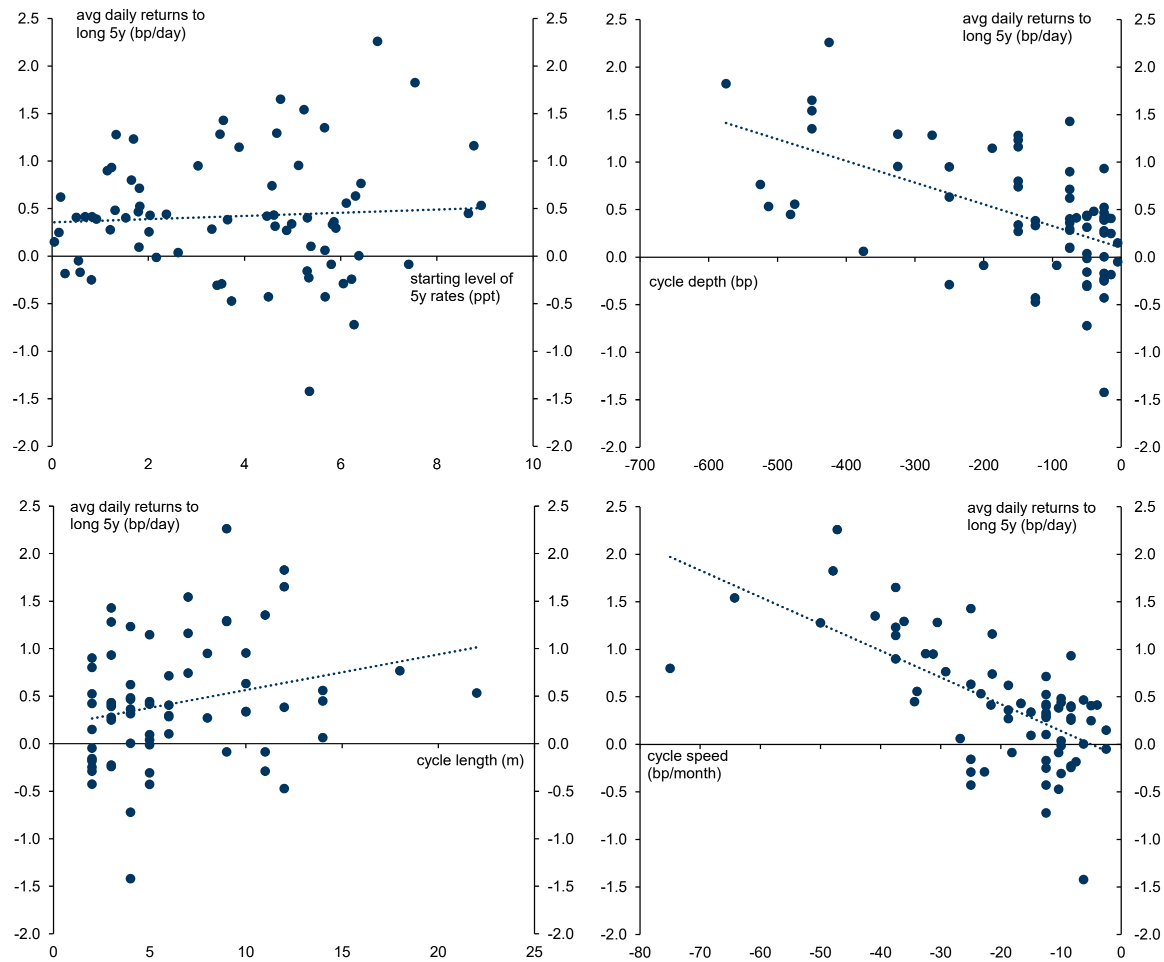
To see this we break down the sample into recessionary cuts – the start of cutting cycles associated with recession within 6m – and into cuts that represent the start of a cycle following hikes (as opposed to a paused cutting cycle) and that are non-recessionary. This latter category fits our modal macro forecasts most closely. Exhibit 4 and Exhibit 5 show this breakdown. We can see that the negative relationship is driven by recessionary cuts – when there is a recession, central banks reliably cut more than is initially priced.

In contrast, when cuts follow hikes and there is no subsequent recession, returns are more mixed – there are certainly still positive returns, but they are slightly positively correlated with initial inversion, such that greater inversion implies lower returns on average. This is particularly relevant given that current 1y1y-1y levels are close to or beyond the maximum levels of inversion we have seen at the start of previous hiking cycles.

Outright longs vs curve trades & trade timing

The next set of strategies we analyse are leveraged expressions on the spot curve. We look at leveraged long positions in 2y, 5y, 10y and 30y rates, as well as curve steepener positions across all combinations: 2s5s, 2s10s, 2s30s, 5s10s, 5s30s, and 10s30s. We base our total return series on swap rates and cap duration once yields go negative. We take the total return for each curve point net of the total return to long 3m rates. To allow for comparison between curve points and curve strategies, we match the dv01 of each expression by adjusting for the duration of the position. We calculate the average daily returns to each strategy from the month prior to the first cut, and then for the following six months or the end of the cutting cycle, whichever is shortest.

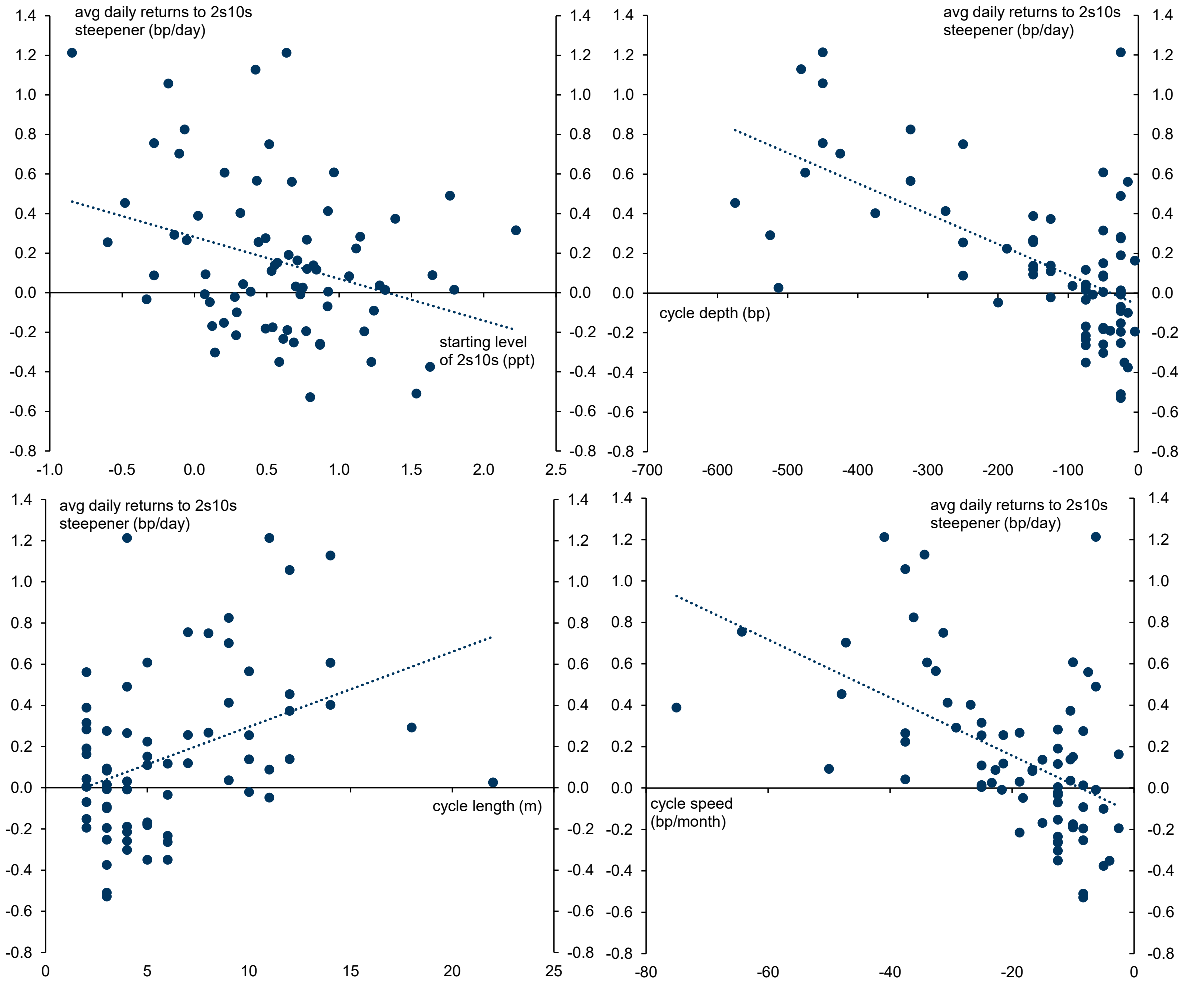
Exhibit 6: Fast and deep cutting cycles generate the returns, regardless of starting level of rates
Returns to long 5y outright vs initial 5y level, cycle length, depth and speed



Source: Goldman Sachs Global Investment Research

The panels in Exhibit 6 & Exhibit 7 show the unconditional results, where the returns to a subset of strategies – long 5y and 2s10s steepeners – on the vertical axis are scattered against a variety of cycle parameters, such as the length, depth, and speed of the cutting cycle, as well as the starting level of the curve slope (this has a better relationship than the starting level of the policy rate). Intuitively, and perhaps arithmetically, longer, deeper and faster cutting cycles are associated with higher returns to outright longs and curve steepeners. Steeper initial curves are weakly associated with lower returns.

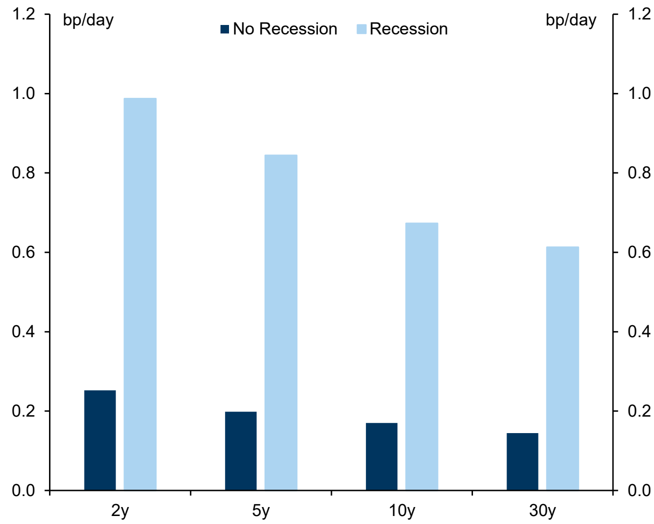
Exhibit 7: Curve steepener returns improve when curves are initially flat
Returns to 2s10s steepeners vs initial 2s10s level, cycle length, depth and speed



Source: Goldman Sachs Global Investment Research

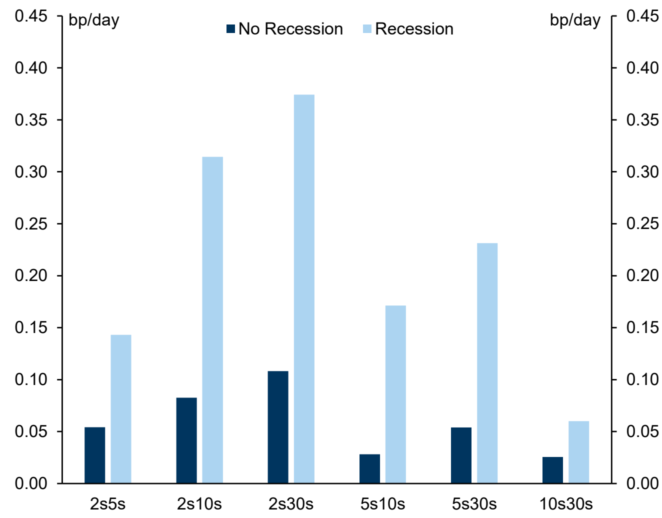
Once again, we can undertake a similar breakdown by cycles associated with recessions, and those representing non-recessionary cuts following hikes. When we do so, we see that average returns are higher to outright longs during recessions (Exhibit 8). In contrast, non-recessionary cuts have much lower returns on average. We also see that for curve trades, steepening expressions such as 2s10s, 2s30s generally offer the highest returns – this is intuitive given the highest absolute returns are generated by outright longs in the front-end (Exhibit 9).

Exhibit 8: Returns to long duration much higher in recession
Leveraged total returns to outright longs 1m prior to 6m into cycle



Source: Goldman Sachs Global Investment Research

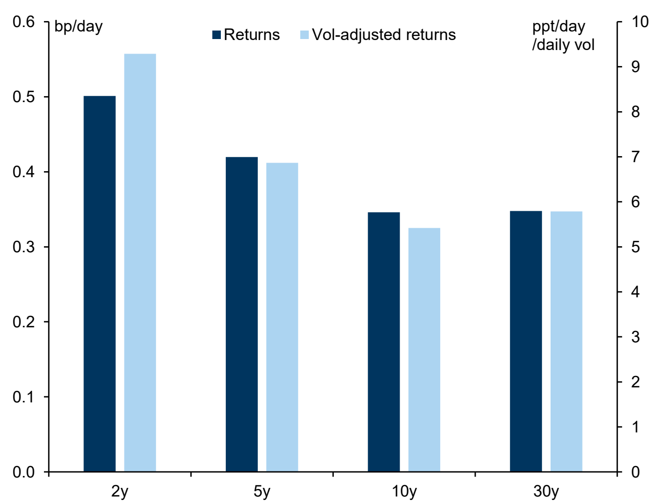
Exhibit 9: Returns to steepeners much higher in recession
Leveraged total returns to curve steepeners 1m prior to 6m into cycle



Source: Goldman Sachs Global Investment Research

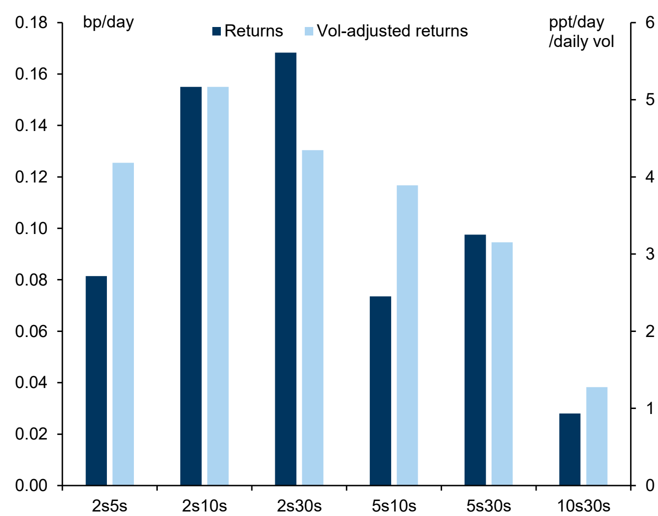
Little changes for the rank order of outright longs when we adjust by volatility (or by maximum drawdown, which is almost perfectly proportional to the daily vol of returns) – long 2y remains the best expression (Exhibit 10). But curve trades become more attractive, with 2s10s and 2s30s competing with outright long duration (10y and 30y) on a risk-adjusted basis (Exhibit 11).

Exhibit 10: 2y long optimal for outright and vol-adjusted returns
Leveraged total returns and vol-adjusted returns to longs 1m prior to 6m into cycle



Source: Goldman Sachs Global Investment Research

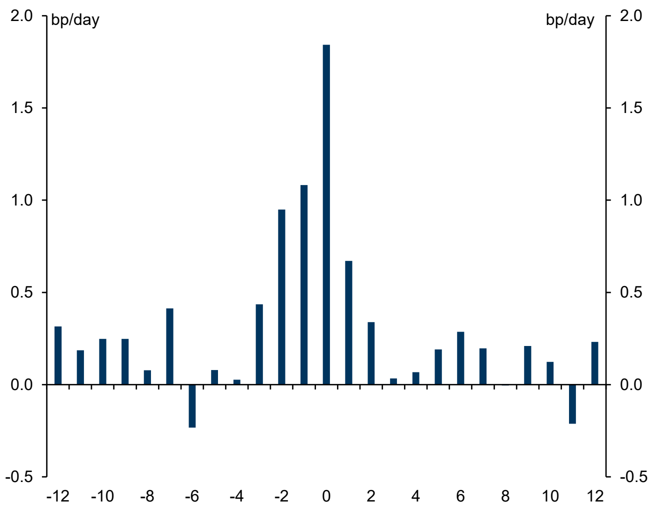
Exhibit 11: 2s10s offers best vol-adjusted returns for curve steepeners
Leveraged total returns and vol-adjusted returns to curve steepeners 1m prior to 6m into cycle



Source: Goldman Sachs Global Investment Research

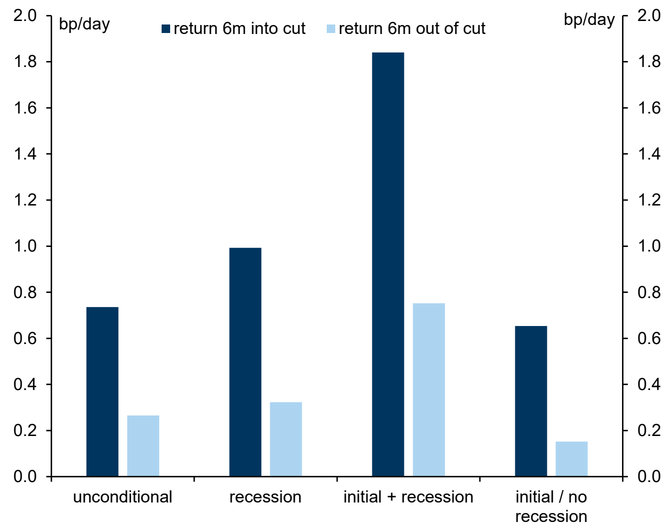
Next we look at when returns are generated during the cycle. To do this, we average the returns across the 12m into and out of the first cut of each cycle (note our cycles are selected to have a 12m gap in between). We find that most of the returns to long positions are generated in the months around the first cut, with limited follow-through beyond two months after the first cut (Exhibit 12). This pattern is true for cutting cycles of different types, although will be strongly affected by cutting cycles in response to sudden shocks, for example the 2008 or 2020 cuts (Exhibit 13).

Exhibit 12: Returns to longs generated at time of cut
Average monthly returns to long 5y. Zero is timing of first cut



Source: Goldman Sachs Global Investment Research

Exhibit 13: 6m prior to cuts generates much larger returns to longs
6m pre- vs 6m post- initial cut returns to long 5y

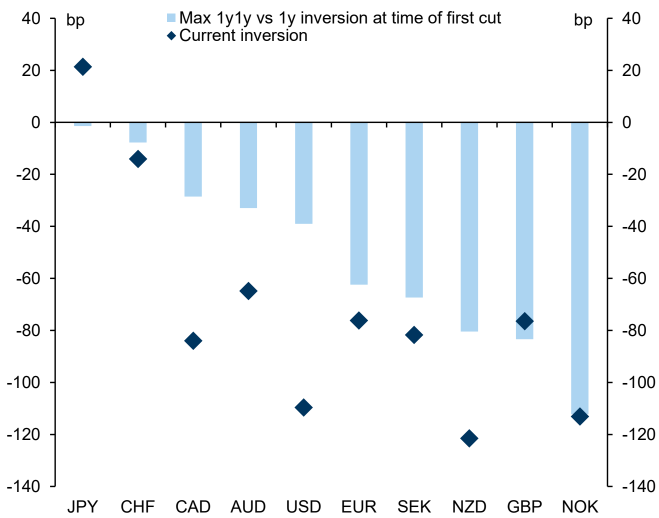


Source: Goldman Sachs Global Investment Research

Flat curves point to better risk / reward for steepeners

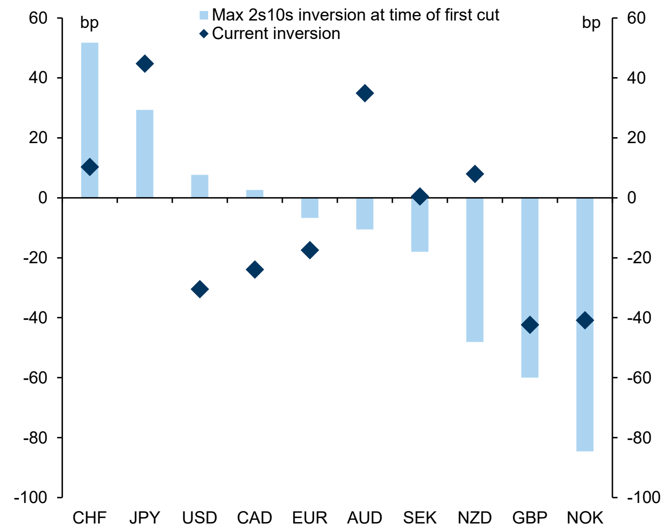
Current levels of inversion suggest a high hurdle for front-end outperformance. Exhibit 14 shows the current level of 1y1y vs 1y are almost everywhere lower than the maximum inversion at the time of previous initial cuts. In the absence of recession, this suggests that the bar to realised returns on long 1y1y is high. For 2s10s, the US, EU and Canada are more inverted than average at the time of initial cuts (Exhibit 15). This suggests that steepener risk is potentially more attractive given the flatness of the curve.

Exhibit 14: Current front-end inversion raises the bar to returns
Max inversion of 1y1y vs 1y time of first cut vs current 1y1y vs 1y



Source: Goldman Sachs Global Investment Research

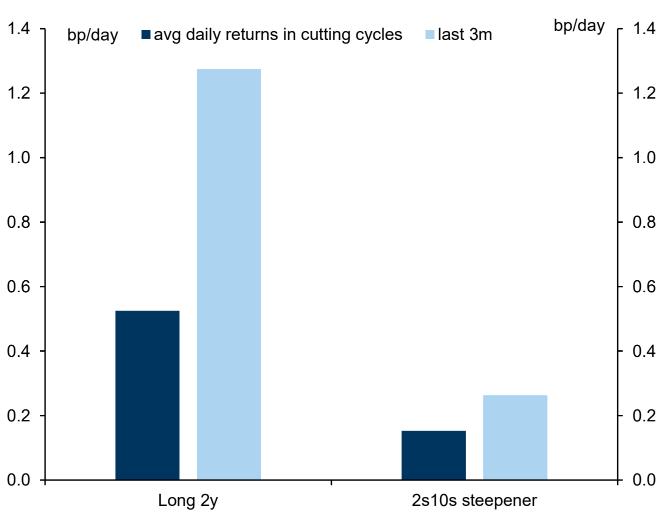
Exhibit 15: Better risk / reward to steepeners in USD, CAD, EUR
Flattest 2s10s at time of first cut vs current



Source: Goldman Sachs Global Investment Research

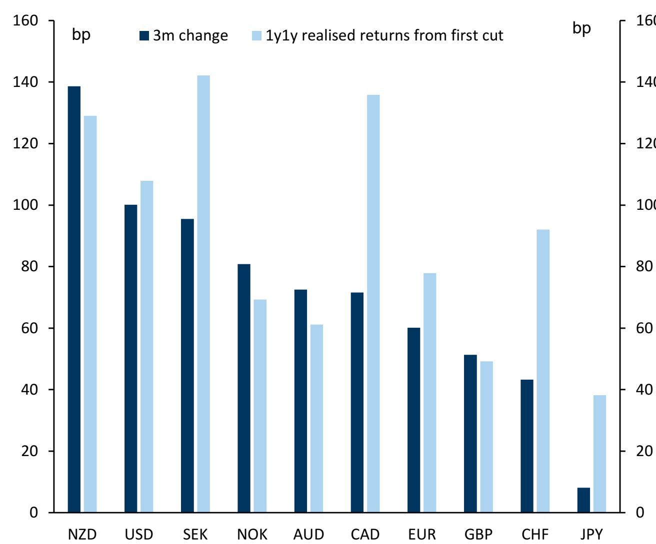
However, the recent rally in rates and curve steepening in the last three months has generated returns similar to or above the average for the months surrounding cutting cycles (Exhibit 16 and Exhibit 17). Together with the initial level of inversion already priced, this suggests further activity data weakening would be necessary to generate significant returns to longs.

Exhibit 16: Recent returns have been elevated vs average around initial cuts
G10 average daily returns in 6m around cutting cycles vs last 3m



Source: Goldman Sachs Global Investment Research

Exhibit 17: 1y1y returns have been substantial in recent months
1y1y 3m change vs 1y1y cutting cycle avg realised returns



Source: Goldman Sachs Global Investment Research

George Cole

Andrew Li*

Friedrich Schaper

**Andrew is an intern with the Global Markets team*

Disclosure Appendix

Reg AC

We, George Cole and Friedrich Schaper, 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.

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 subject company, public appearances and trading securities held 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, 951-A, Rational House, Appasaheb Marathe Marg, Prabhadevi, 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. Investment in securities market are subject to market risks. Read all the related documents carefully before investing. 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 Investor Grievance E-mail: india-client-support@gs.com. Compliance Officer: Anil Rajput |Tel: + 91 22 6616 9000 | Email: anil.m.rajput@gs.com. **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, The Investment Trusts Association, Japan, and Japan Investment Advisers Association. 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: GSI, authorised by the PRA and regulated by the FCA and the PRA, disseminates research in the following jurisdictions within the European Economic Area: the Grand Duchy of Luxembourg, Italy, the Kingdom of Belgium, the Kingdom of Denmark, the Kingdom of Norway, the Republic of Finland and the Republic of Ireland; GSI - Succursale de Paris (Paris branch) which is authorised by the French Autorité de contrôle prudentiel et de resolution ("ACPR") and regulated by the Autorité de contrôle prudentiel et de resolution and the Autorité des marches financiers ("AMF") disseminates research in France; GSI - Sucursal en España (Madrid branch) authorized in Spain by the Comisión Nacional del Mercado de Valores disseminates research in the Kingdom of Spain; GSI - Sweden Bankfilial (Stockholm branch) is authorized by the SFSA as a "third country branch" in accordance with Chapter 4, Section 4 of the Swedish Securities and Market Act (Sw. lag (2007:528) om värdepappersmarknaden) disseminates research in the Kingdom of Sweden; 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 in the Federal Republic of Germany and those jurisdictions within the European Economic Area where GSI is not authorised to disseminate research and additionally, GSBE, Copenhagen Branch filial af GSBE, Tyskland, supervised by the Danish Financial Authority disseminates research in the Kingdom of Denmark; GSBE - Sucursal en España (Madrid branch) subject (to a limited extent) to local supervision by the Bank of Spain disseminates research in the Kingdom of Spain; GSBE - Succursale Italia (Milan branch) to the relevant applicable extent, subject to local supervision by the Bank of Italy (Banca d'Italia) and the Italian Companies and Exchange Commission (Commissione Nazionale per le Società e la Borsa "Consob") disseminates research in Italy; GSBE - Succursale de Paris (Paris branch), supervised by the AMF and by the ACPR disseminates research in France; and GSBE - Sweden Bankfilial (Stockholm branch), to a limited extent, subject to local supervision by the Swedish Financial Supervisory Authority (Finansinpektionen) disseminates research in the Kingdom of Sweden.

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.fiadocumentation.org/fia/regulatory-disclosures_1/fia-uniform-futures-and-options-on-futures-risk-disclosures-booklet-pdf-version-2018. 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.