

## US Daily: What the Fed Has Said About Stablecoins and a Central Bank Digital Currency (Mericle)

- In today's note we discuss early comments on stablecoins and a possible US central bank digital currency (CBDC) from FOMC participants and Fed staff economists. Fed officials plan to release reports on these issues later this summer, though final decisions are likely to take a while and any future introduction of a CBDC would require support from Congress and the White House.
- Fed officials appear motivated mainly by the possibility that a CBDC platform could improve the payments system. They are examining whether it could make payment clearing faster, reduce fees, handle a higher volume of transactions than the current payments infrastructure, be more resilient to failure or attack, and facilitate innovation in payments technology. A CBDC might be an effective way to achieve some of these goals, though some can be achieved in other ways.
- Much of the recent discussion among Fed officials centers on whether to introduce a CBDC or to instead leave digital payments innovation to the private sector and simply ensure that private stablecoins are well regulated. The debate centers on three issues: financial stability concerns related to the risk of runs, the impact on commercial banks' deposit base, and whether the private or public sector should control the digital payments platform. Fed officials hold a range of views, and we expect to learn more when the Fed releases its reports later this summer.

**Jan Hatzius**

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

**Alec Phillips**

+1(202)637-3746 | alec.phillips@gs.com  
Goldman Sachs & Co. LLC

**David Mericle**

+1(212)357-2619 | david.mericle@gs.com  
Goldman Sachs & Co. LLC

**Spencer Hill, CFA**

+1(212)357-7621 | spencer.hill@gs.com  
Goldman Sachs & Co. LLC

**Joseph Briggs**

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

**Ronnie Walker**

+1(917)343-4543 | ronnie.walker@gs.com  
Goldman Sachs & Co. LLC

**Laura Nicolae**

+1(917)343-6594 | laura.nicolae@gs.com  
Goldman Sachs & Co. LLC

## What the Fed Has Said About Stablecoins and a Central Bank Digital Currency

---

In two recent reports on central bank digital currencies (CBDCs), we discussed what [introducing a CBDC in the US](#) might mean for the financial system and for monetary and fiscal policy, and provided a [status report on CBDCs around the world](#) covering early design choices and approaches to managing key risks.

In today's note we discuss early comments on CBDCs from FOMC participants and Fed staff economists.<sup>1</sup> We discuss the timeline for future decisions, the motivations for a possible US CBDC, and the key issues in an emerging debate about whether to introduce a CBDC or to simply regulate private stablecoins.

Fed officials plan to release reports on both the policy and technical aspects of CBDCs, and Chair Powell said this week that a report on digital payments in early September will cover CBDCs and stablecoins. A team at the Boston Fed is also already working on developing the technology for a potential CBDC. Any final decisions are likely to take a while, however. Fed officials might want to defer decisions until after they introduce FedNow, a real-time interbank settlement service that will provide some of the same improvements to the payments system as a CBDC might, in 2023. Chair Powell has said that Fed officials would also need support from Congress and the White House, ideally in the form of an authorizing law.

Fed officials have offered some early hints of what a CBDC could look like. They have emphasized that it would coexist with currency and would be designed not to replace bank deposits. The user experience could be similar to phone-based payments apps, or the CBDC could appear as an additional account in an individual's commercial bank account alongside checking or savings accounts.

Fed officials appear motivated primarily by the possibility that a CBDC platform could improve the payments system. First, it could make payment clearing faster, though as Fed officials often note, FedNow will also achieve this. Second, by increasing competition it could make payments cheaper, especially on credit card transactions and cross-border transfers, though here too alternative approaches might achieve the same goal. Third, it might be able to process a higher volume of transactions than the existing payments infrastructure, which might be necessary if digital dollar payments become available to people abroad who currently transact in physical dollars, or if much lower fees open the door to a vast volume of micropayments. Fourth, it could be more resilient to failure or attack, though this remains an open technological question. Fifth, it could facilitate innovation in payments technology and allow for programmable money that enables features such as delivery versus payment.

---

<sup>1</sup> Recent comments include Randal Quarles, "Parachute Pants and Central Bank Money"; Lael Brainard, "Private Money and Central Bank Money as Payments Go Digital: an Update on CBDCs"; Eric Rosengren, "Remarks at the Panel Discussion, 'Central Bank Perspectives on Central Bank Digital Currencies'"; Jerome Powell, "Message on Developments in the U.S. Payments System"; Matthew Malloy and David Lowe, "Global Stablecoins: Monetary Policy Implementation Considerations from the U.S. Perspective"; Tobias Adrian et al., "Central Banks and Digital Currencies"; Alexander Lee, "What is programmable money?"; and Fed staff, "Proposed guidelines to evaluate requests for accounts and services at Federal Reserve Banks."

Much of the recent discussion among Fed officials centers on whether to introduce a CBDC or to instead leave digital payments innovation to the private sector and simply ensure that private stablecoins are well regulated. The debate centers on three issues: 1) financial stability concerns related to the risk of runs; 2) the impact on the existing commercial banking system's deposit base; and 3) whether the private or public sector should control a dominant future digital payments platform.

Before diving into these issues, it is important to clarify the difference between a CBDC and private stablecoins. A CBDC is a liability of the Fed, similar to bank reserves but available to the broader public. A stablecoin would be operated by a private company or consortium that sells coins to the public and uses the funds raised as the asset backing for the coin. The stablecoin operator could place these assets in an account at a commercial bank, which might have to hold a higher percentage of high-quality liquid assets if regulators judged the risk of a run on the stablecoin to be high. Alternatively, the operator could place its assets in a "narrow" bank that functions solely as a custodian for the operator and holds the assets as reserves at the Fed, but does not lend, if the Fed allowed a narrow bank to have an account. Finally, the operator could directly hold its assets in a reserve account at the Fed without the formality of the narrow bank intermediary, if the Fed permitted. Recent papers and blog posts by Fed economists have discussed each of these scenarios.

We now turn to the three issues raised above in the Fed's discussion of stablecoins and a potential CBDC:

#### *Financial stability*

The first key question is how stablecoins or a CBDC would affect financial stability. Stablecoins with insufficient backing could be subject to runs, especially in times of market distress, and Fed officials have therefore emphasized the need for additional regulation similar to that for money market funds. Governor Quarles has argued that the Fed can easily address this risk, while Governor Brainard has instead emphasized that an earlier period of US history when private monies predominated was "notorious for inefficiency, fraud, and instability." That might argue for introducing a CBDC to crowd out private stablecoins and cryptocurrencies, a point Powell sympathized with in comments this week.

To limit the risk of runs on stablecoins, the Fed could impose tight requirements on the asset backing for stablecoin operators or their custodian banks, though it might need additional regulatory powers. In the limit case where the Fed required or allowed a stablecoin to be either directly or indirectly backed 100% by reserves at the Fed, it becomes a conduit for individuals to hold a Fed liability that is functionally similar to a CBDC and—like a CBDC—it creates a risk of a run toward it and away from other assets in times of distress. Fed officials have taken a skeptical view of narrow banking in the past because of this risk. In short, there is a tradeoff between making stablecoins less runnable and making everything else more runnable through the introduction of a fully-backed stablecoin or a CBDC. How these risks compare is difficult to judge.

#### *Impact on the banking system's deposit base*

The second key question is how stablecoins or a CBDC would affect the commercial banking system's deposit base. If stablecoins or a CBDC mainly displace demand for cash, then the impact would be modest. But if they substantially reduce demand for bank deposits, then what the stablecoin operator or the Fed does with the funds raised from selling the stablecoin or CBDC is important. A recent Fed paper envisions the operator making a deposit in a commercial bank account, effectively recycling deposit funding back to the banking system. Even this scenario raises some concerns: deposits might become more concentrated at the operator's bank; net interest margins might shrink if the operator seeks the best interest rate more actively than household depositors; and the commercial bank might need to hold more HQLA if the stablecoin is more subject to runs than regular household deposits. To the extent that the stablecoin becomes widely adopted and the operator's account becomes massive, its custodian bank might need to look more like a narrow bank than a commercial bank that lends.

The other two scenarios would have a larger impact on the commercial banking system's deposit base. Both a CBDC and a stablecoin whose operator stores its assets entirely in a narrow bank or a direct Fed account would have the same effect of removing deposits from the commercial banking system. We previously discussed arrangements in which a central bank could in theory recycle deposits by lending back to the commercial banking system, but this would likely face legal obstacles in practice. From this perspective then, the intermediate outcome of a stablecoin operator whose asset backing is well regulated but not entirely held in reserves at the Fed might be the least disruptive to commercial banks.

#### *Public vs. private control of the digital payments platform*

The third key question is whether the private or public sector should control a future digital payments platform. Quarles has argued that the Fed should focus on supporting private sector innovation in payments technology and set a "high bar" for introducing a CBDC. In contrast, Brainard has argued that the private sector could innovate on top of the foundation provided by a CBDC, and that the Fed should be wary of competing private currencies that could fragment the payments system or raise costs for households and businesses if a payments system operator became dominant due to network externalities. The public versus private sector question depends in part on the type of innovation one hopes to achieve with digital currencies. If the desired innovation is related to public policy goals—such as boosting financial inclusion or empowering monetary and fiscal policy—then it might be more natural for the public sector to control the platform so that it can impose platform-wide rules on transactions.

These are some of the main issues that Fed officials will discuss as they continue to debate the case for a CBDC. We expect to learn more when the Fed releases its reports later this summer.

**David Mericle**

# Disclosure Appendix

## Reg AC

We, Jan Hatzius, Alec Phillips, David Mericle, Spencer Hill, CFA, Joseph Briggs, Ronnie Walker and Laura Nicolae, 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 the Global Investment Research Division 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:** Goldman Sachs Canada Inc. is an affiliate of The Goldman Sachs Group Inc. and therefore is included in the company specific disclosures relating to Goldman Sachs (as defined above). Goldman Sachs Canada Inc. has approved of, and agreed to take responsibility for, this research report in Canada if and to the extent that Goldman Sachs Canada Inc. disseminates this research report to its clients. **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 U7140MH2006FTC160634, 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. **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 and Type II Financial Instruments Firms 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

The Global Investment Research Division of Goldman Sachs 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](mailto: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](mailto:contatogoldmanbrasil@gs.com). Horário de funcionamento: segunda-feira à sexta-feira (exceto feriados), das 9h às 18h; in Canada by either Goldman Sachs Canada Inc. or 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.

Effective from the date of the United Kingdom's departure from the European Union and the European Economic Area ("Brexit Day") the following information with respect to distributing entities will apply:

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, Portugal, the Republic of Cyprus and the Republic of Ireland; GS - Succursale de Paris (Paris branch) which, from Brexit Day, will be authorised by the French Autorité de contrôle prudentiel et de résolution ("ACPR") and regulated by the Autorité de contrôle prudentiel et de résolution and the Autorité des marchés 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 (Finansinspektionen) 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 our Global Investment Research Division. 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](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 the Global Investment Research division of GS 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.

© 2021 Goldman Sachs.

**No part of this material may be (i) copied, photocopied or duplicated in any form by any means or (ii) redistributed without the prior written consent of The Goldman Sachs Group, Inc.**