

US Economics Analyst

The Virus Resurgence and Vaccine: A Monthly Sector Breakdown (Choi)

- With a continued rise in new virus cases but mass vaccination on the horizon, high volatility in monthly growth and the wide dispersion in growth across industries and sectors will likely continue over the next year. We revisit the growth outlook and provide a monthly GDP breakdown by sector in this week's *Analyst*.
- Despite the rapid deterioration in the virus situation, overall services spending through November has not yet seen a large pullback. While we expect a further slowdown and significant downside risks remain, we have lowered our estimate of the peak hit from the virus resurgence based on the lower than expected sensitivity of services activity to the virus so far.
- News on the vaccine timeline has also been increasingly positive in recent weeks. We now expect the first available doses to go to high-risk groups from mid-December onwards, and have pulled forward our boost from a vaccine.
- While manufacturing activity also dropped off sharply during the initial stages of the pandemic, the lack of mandated restrictions, robust consumer goods demand, and prior adjustments to inventory and investment mean the drop off will be much smaller this time. Construction activity showed a comparatively modest decline in the first wave of the virus, and we expect an even smaller impact in the winter months.
- With the upgrade to our projections of November services activity and our forecast of a smaller hit to December, we are now tracking Q4 annualized GDP growth at +5.0% (vs. +3.2% previously).
- While we have left our end-2021 forecast for the level of real GDP unchanged, our more front-loaded vaccine impact implies a stronger Q1, and only modestly lower sequential growth in Q2. We now forecast a quarterly annualized growth path of +3%/+8.5%/+5%/+4% in 2021 Q1-Q4, vs. +1%/+9.5%/+7.3%/+4.5% previously, with the level of output now meaningfully higher in Q1, Q2 and Q3. Our new forecast would lift 2021 annual growth to +5.3% (vs. +5.0% previously) and lower Q4/Q4 growth to +5.1% (vs. +5.5% previously).

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

Daan Struyven

+1(212)357-4172 | daan.struyven@gs.com
Goldman Sachs & Co. LLC

David Choi

+1(212)357-6224 | david.choi@gs.com
Goldman Sachs & Co. LLC

Joseph Briggs

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

Blake Taylor

+1(202)637-3756 | blake.taylor@gs.com
Goldman Sachs & Co. LLC

Ronnie Walker

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

The Virus Resurgence and Vaccine: A Monthly Sector Breakdown

The growth outlook remains very uncertain, with rising new virus cases and fatalities, warnings of further state and local restrictions to come, and signs of an increasing drag on virus-sensitive industries, but overall a very resilient consumer in the midst of the virus resurgence. Our consumer spending tracker based on alternative data showed continued growth in overall consumer spending through November, despite a record number of new cases and the highest number of daily fatalities since early May.

With the virus resurgence well underway and mass vaccination on the horizon, high volatility in monthly growth and the wide dispersion in growth across industries and sectors will likely continue over the next year. We revisit the growth outlook and provide a monthly GDP breakdown by sector in this week's *Analyst*.

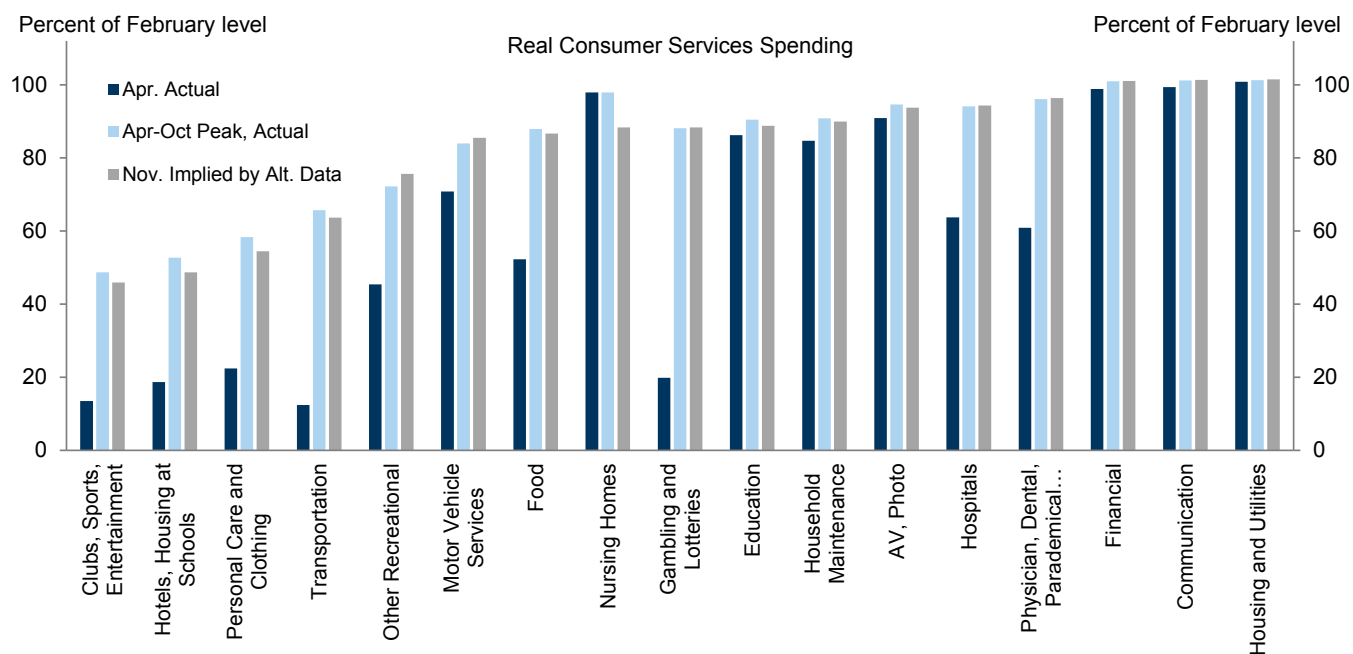
A Sector Breakdown

We break down our baseline growth forecast by component, focusing on the services, manufacturing, and construction sectors.

Services

The virus shock has had the biggest impact on the services sector, particularly services with a large amount of face-to-face interaction such as entertainment, travel, and food services. While many industries have found ways to adapt to the virus, the most virus-sensitive industries have more structural limitations, meaning that any hit from the virus in the current wave could be even more skewed toward these industries than in the first wave.

The data are so far consistent with this view. While many services industries saw large declines in activity in the initial stages of the virus, only the most virus-sensitive sectors have shown meaningful sequential declines in November, with most other industries close to or at their peak levels since the start of the pandemic (Exhibit 1). Aggregating our estimates of spending growth across sectors, we currently pencil in roughly flat overall PCE services growth in November, a sizable upgrade relative to our prior November projections.

Exhibit 1: Spending Has Declined in the Most-Virus Sensitive Sectors, but Has Remained Near the Pandemic Peak for Most Services Categories


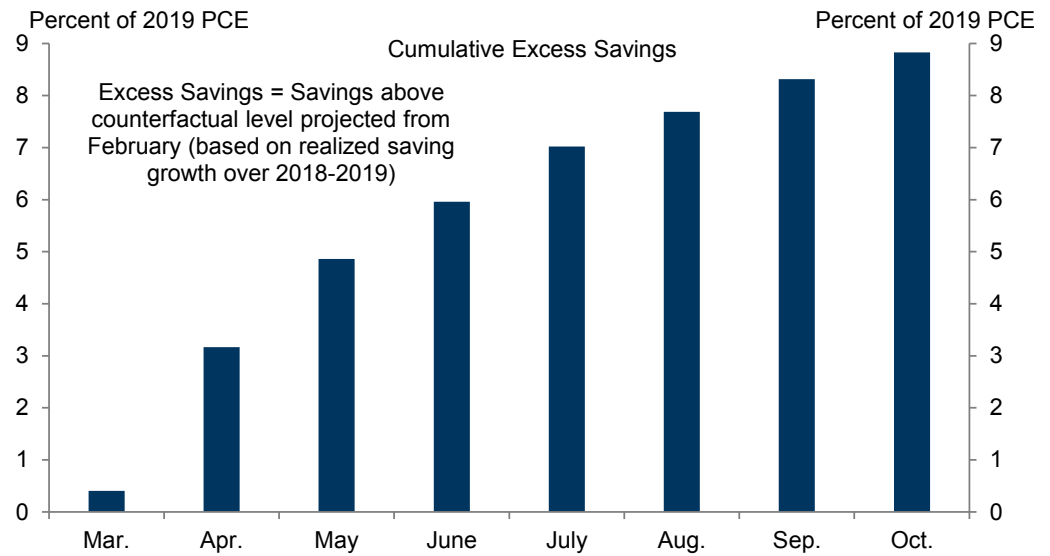
Google LLC "Google COVID-19 Community Mobility Reports". <https://www.google.com/covid19/mobility/> Accessed: Dec. 1, 2020.

Source: FourSquare, Opportunity Insights, Second Measure, Google COVID-19 Community Mobility Reports, Goldman Sachs Global Investment Research

While still early, the data so far suggest that very high levels of virus spread may ultimately translate to a surprisingly small hit to overall activity this time around. Using our [bottom-up model](#) of services spending by Census region, we now assume a smaller sensitivity of services spending to the virus in all four regions, maintaining the assumption that the biggest pullback will come in the Northeast where lower temperatures will likely mean a larger virus headwind and where policymakers have indicated more willingness to impose restrictions. Although we continue to forecast sequential declines in overall services spending in December and January given our expectation that the virus situation will continue to deteriorate at the national level, our estimates now translate into a smaller peak hit to the level of spending in January. We now expect services spending to pull back to roughly September levels, compared to roughly July/August levels previously.

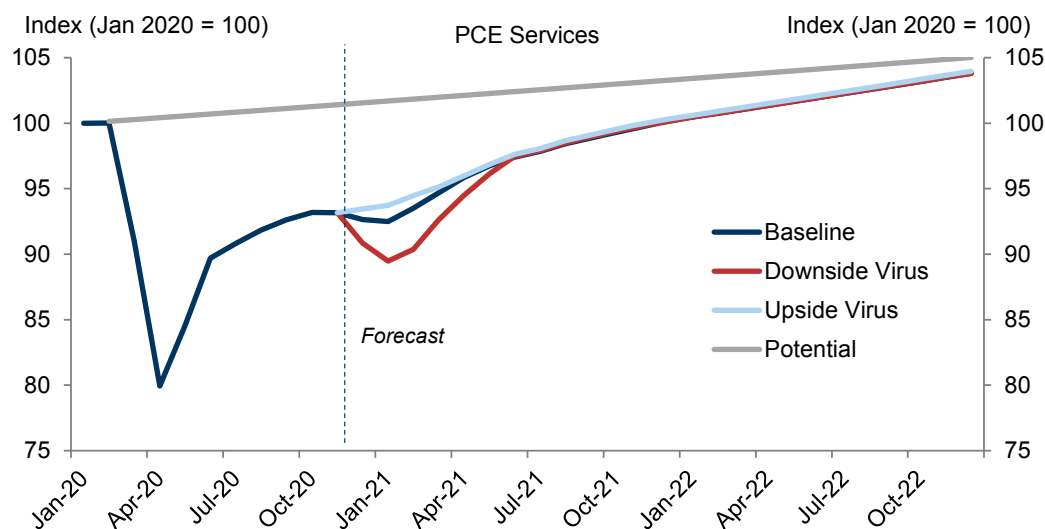
We have also pulled forward our boost from a vaccine based on increasingly positive news on the [timeline for vaccination](#), and expect a significant boost from Q1 onwards. We estimate the vaccine boost based on the assumption of a sharp bounceback in the most virus-sensitive industries, with reopening of businesses, reduced risks, pent-up demand for services, and a significant amount of accumulated excess savings all providing a tailwind. Assuming that half of the excess savings is spent over the next 2 years, our estimates would suggest an average boost of roughly 0.5% to the level of overall consumption each quarter following the arrival of a vaccine (Exhibit 2).

Exhibit 2: Households Have Accumulated a Significant Amount of Savings Through the Recession



Source: Department of Commerce, Goldman Sachs Global Investment Research

Despite the more encouraging near-term outlook, we nevertheless see significant downside risks if colder temperatures in coming months and the limited policy and consumer policy response so far mean that virus spread rises to much higher levels. In the other direction, tentative signs of a stabilization in hospitalizations and a decline in new cases in the Midwest, and encouraging signs in Europe, where case counts have dropped sharply despite only moderate restrictions, also suggest some upside if they foreshadow an earlier than expected improvement for the US as whole. Exhibit 3 shows our projections for services spending in our baseline, upside, and downside virus scenarios, maintaining the assumption of a front-loaded vaccine boost across all three scenarios.

Exhibit 3: The Near-Term Economic Risks from the Virus Are Skewed to the Downside

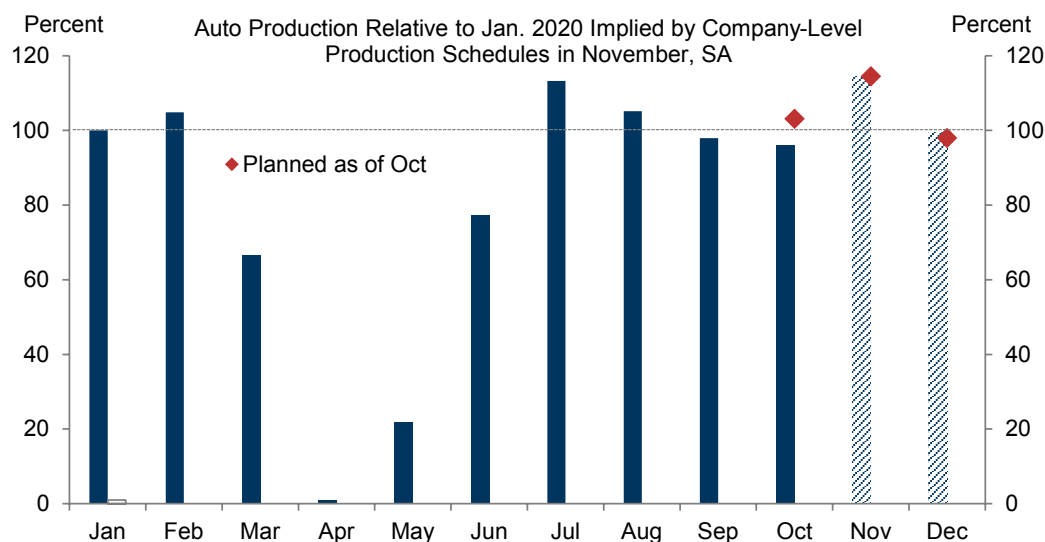
Source: Department of Commerce, Goldman Sachs Global Investment Research

Manufacturing

While the virus shock has had the largest direct impact on consumer services, factory activity also dropped off sharply during the initial stages of the pandemic, with a 46.7% annualized decline in manufacturing production in Q2. However, as we have previously noted there are several key reasons to expect a significantly smaller virus drag on manufacturing activity this winter than in the spring.

First, while many factories fully shut down due to government restrictions or voluntarily in the spring, there are few manufacturing restrictions or anecdotes of shutdowns so far despite the rapid acceleration in cases. Second, consumer goods demand now well exceeds its pre-virus trend, given continued job growth, earlier fiscal support, and substitution towards goods given physical constraints on services spending. Third, inventories are already at low levels and business investment has already adjusted lower. Fourth, a vaccine has provided some light at the end of the tunnel, meaning that forward-looking businesses have less reason to cut back in anticipation of a prolonged virus drag on the economy.

Recent survey data and company guidance from mid-to-end November—with the virus resurgence well underway—are consistent with a minimal virus impact on the manufacturing sector so far. Updated auto production schedules as of the end of November suggest auto production around pre-pandemic levels in Q4 and little revision in plans over the last month (Exhibit 4). Regional and national manufacturing surveys are still well in expansionary territory, declining only slightly in November. Even in Europe, which implemented much stronger and earlier restrictions in response to the virus resurgence, manufacturing PMIs suggest a significantly smaller hit to manufacturing activity than in the spring months and large outperformance relative to the services sector.

Exhibit 4: Auto Production Schedules Show Little Signs of a Virus Hit this Time

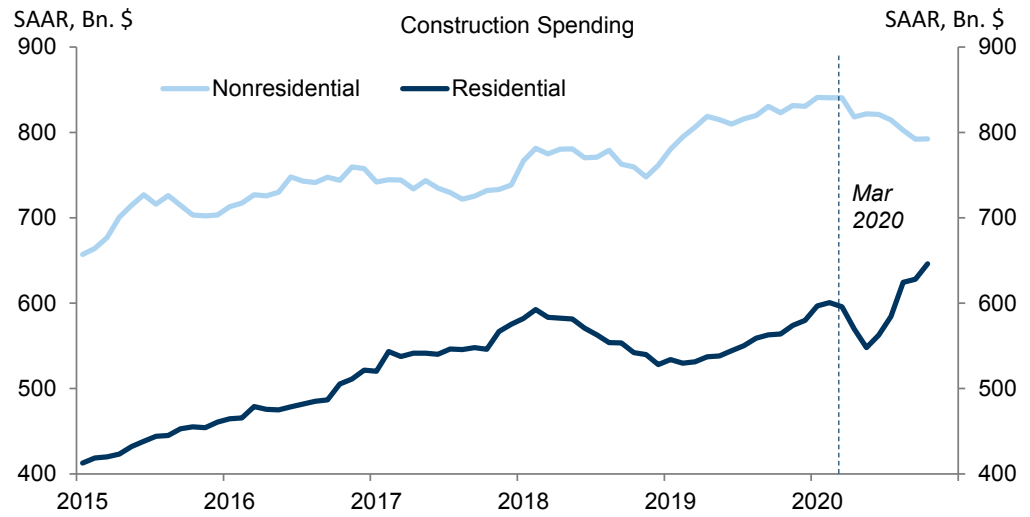
Source: Wards Intelligence, Goldman Sachs Global Investment Research

We thus overall see a much smaller virus impact on manufacturing relative to services, and less downside risk from uncertainty over the trajectory of the virus. We correspondingly expect a much smaller boost to manufacturing from the arrival of a vaccine as well. In addition, some of the boost to manufacturing from the virus—such as an increased demand for personal cars and home improvement, and a substitution away from services made unavailable by the virus towards goods—are likely to gradually reverse after the arrival of a vaccine.

Construction

Compared to services and manufacturing activity, overall construction activity showed a relatively modest decline in the initial stages of the pandemic, with construction deemed essential and thus allowed to operate in most states. The hit to construction in March and April was mostly concentrated on the residential side, with a collapse in permits and housing starts. Since then, housing construction has surged, while nonresidential construction has trended down given the exceptionally weak outlook for office buildings and the energy sector (Exhibit 5).

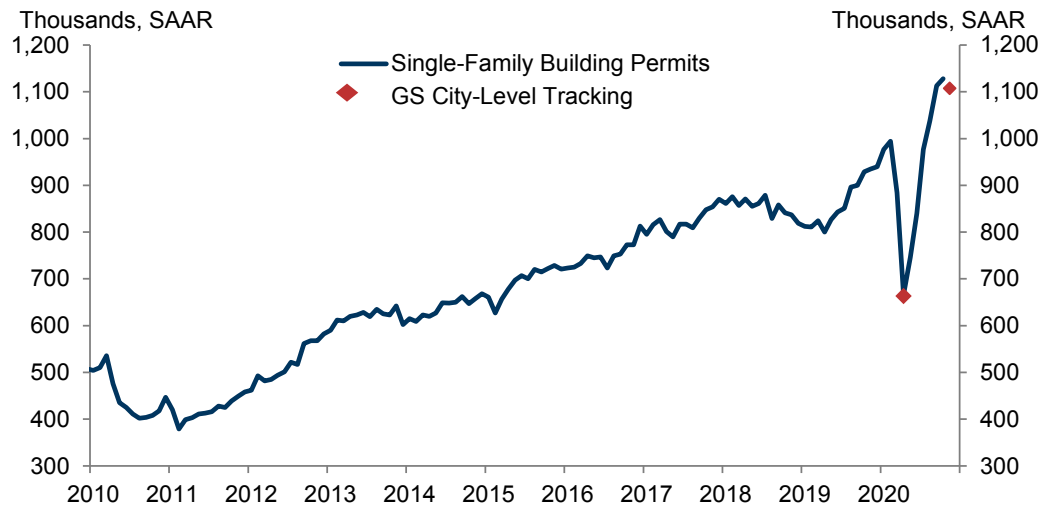
Exhibit 5: Construction Spending Fell Relatively Modestly in the Initial Stages of the Pandemic



Source: Department of Commerce, Goldman Sachs Global Investment Research

Timely data from city-level permits, which provided an early and accurate read on aggregate single-family permits in April, suggest a repeat of the residential construction fall is unlikely this winter. A city-level tracking estimate suggests only a very small pullback in single-family permits through the end of November from an elevated level (Exhibit 6). This likely reflects not only less restrictions on construction activity, but robust housing demand from low mortgage rates, a virus-driven boost for single-family homes, and low existing supply.

Exhibit 6: Timely City-Level Data Suggest Little Impact of the Virus Resurgence on Housing Permits



Source: Department of Commerce, Goldman Sachs Global Investment Research

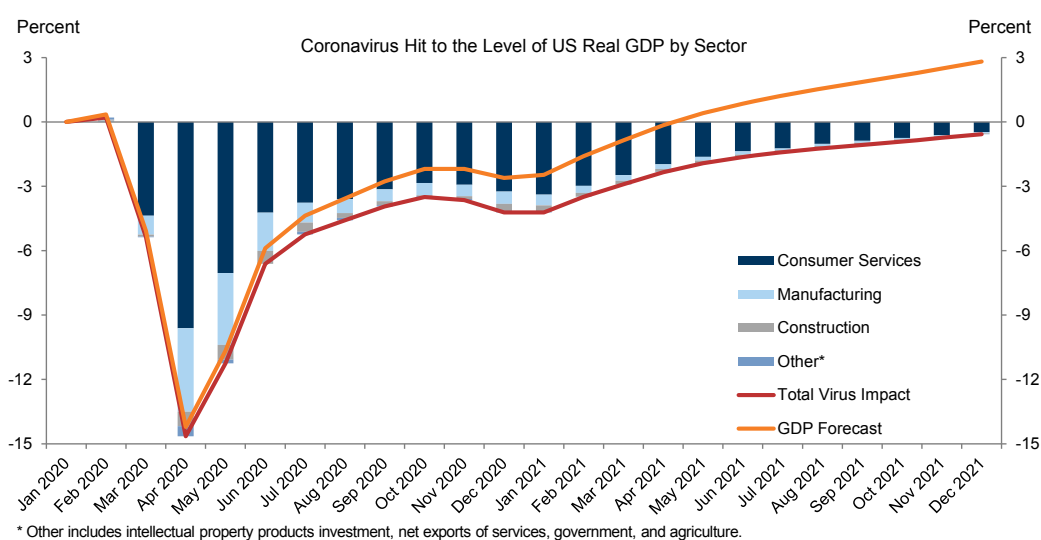
Our construction activity forecast incorporates our expectation for continued strong residential investment at levels above the pre-virus trend, but continued soft nonresidential construction at levels below the pre-virus trend. Given the relatively

modest impact of the virus on construction activity in the initial stages of the pandemic, and the even smaller response thus far in the third wave, we expect only a modest impact from the vaccine on construction activity.

A Monthly GDP Path

Exhibit 7 combines our bottom-up sector forecasts to illustrate our real GDP forecast at the monthly level. We base our historical estimates using monthly PCE services spending data, a mix of industrial production and manufacturing employment data, and construction spending and construction employment data, fitting the data to the official statistics in the national accounts. We then project by sector the forward growth path based on its sensitivity to the virus and vaccine and other sector-specific factors.

Exhibit 7: Our Monthly GDP Path Incorporates a Near-Term Slowdown and a Reacceleration Following Vaccination



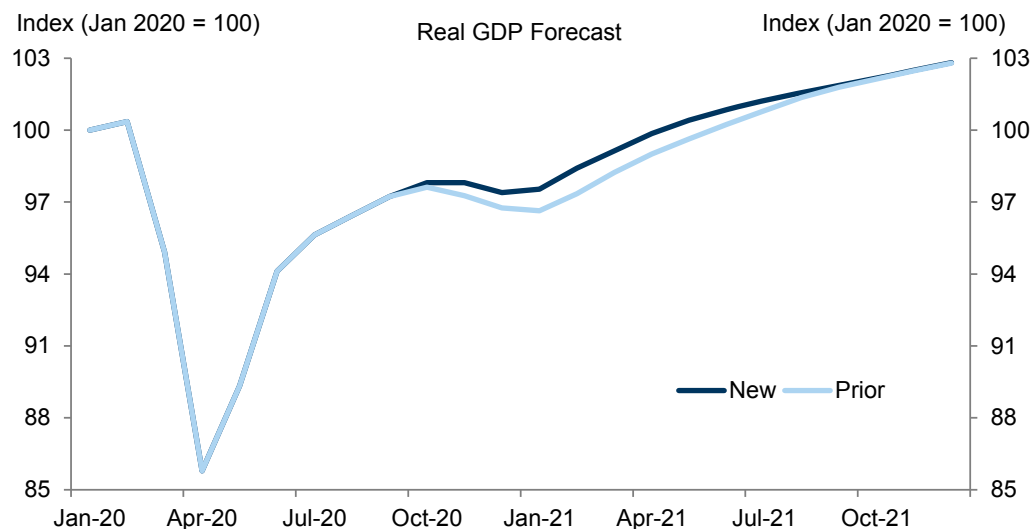
Source: Department of Commerce, Goldman Sachs Global Investment Research

With large changes in sequential growth from month to month, a monthly GDP path provides significantly more information than a quarterly growth path, as illustrated in our Q4 growth forecast. Despite our projections of a meaningful deceleration in November and a slight decline in activity in December, the strong starting point relative to the Q3 average and the strong start to the quarter in October implies quarterly growth well above trend for Q4. With our upgrade to November services activity and our forecast of a smaller hit to December, we are now tracking Q4 GDP at +5.0% (vs. +3.2% previously).

While we have left our end-2021 forecast for the level of real GDP unchanged, our more front-loaded vaccine impact implies a stronger Q1, and only modestly lower sequential growth in Q2. We now forecast a quarterly annualized growth path of +3%/+8.5%/+5%/+4% in 2021 Q1-Q4, vs. +1%/+9.5%/+7.3%/+4.5% previously, with the level of output now meaningfully higher in Q1, Q2, and Q3. Our new forecast would lift 2021 annual growth to +5.3% (vs. +5.0% previously) and lower Q4/Q4 growth to +5.1% (vs. +5.5% previously). Exhibit 8 compares our new forecast to our prior one at

the monthly level.

Exhibit 8: Our New Forecast Upgrades the Near-Term Outlook and Pulls Forward the Boost from a Vaccine



Source: Goldman Sachs Global Investment Research

Large discrete events such as a fiscal deal, the possibility of further lockdowns, and the start of mass vaccination can have a dramatic impact on the high frequency cadence of growth. Recently, the odds of a near-term fiscal deal have increased, which by our monthly estimates would boost Q1 growth by roughly 1.5pp relative to our current baseline of further fiscal aid arriving in late Q1. We will continue to update our monthly GDP estimates as we receive high-frequency activity data and new information about the timing of fiscal policy and the rollout of vaccines.

Fed Implications

We previously noted that the FOMC was most likely to extend the average maturity of asset purchases if the economy weakened, even though participants have expressed only lukewarm support for this option because of its limited effectiveness in offsetting the winter virus shock. While we believed our earlier forecasts of weaker economic activity in November and December would meet that bar, better than expected data thus far, positive news on an earlier possible timeline for a vaccine, and the further easing in financial conditions have made it a close call. If a fiscal deal materializes before the FOMC meeting or looks very likely to materialize immediately after, we think FOMC would probably not extend the maturity of its asset purchases. We will revisit this topic in our December FOMC preview next week in light of the latest fiscal developments.

David Choi

The US Economic and Financial Outlook

Forecast Changes

With the upgrade to our projections of November services activity and our forecast of a smaller hit to December, we are now tracking Q4 annualized GDP growth at +5.0% (vs. +3.2% previously).

We now forecast a quarterly annualized growth path of +3%/+8.5%/+5%/+4% in 2021 Q1-Q4, vs. +1%/+9.5%/+7.3%/+4.5% previously. Our new forecast would lift 2021 annual growth to +5.3% (vs. +5.0% previously) and lower Q4/Q4 growth to +5.1% (vs. +5.5% previously).

THE US ECONOMIC AND FINANCIAL OUTLOOK

(% change on previous period, annualized, except where noted)

	2018	2019	2020	2021	2022	2023	2024	2020				2021			
			(f)	(f)	(f)	(f)	(f)	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
OUTPUT AND SPENDING															
Real GDP	3.0	2.2	-3.5	5.3	3.7	2.4	2.1	-5.0	-31.4	33.1	5.0	3.0	8.5	5.0	4.0
Real GDP (annual=Q4/Q4, quarterly=yoy)	2.5	2.3	-2.3	5.1	2.7	2.2	2.0	0.3	-9.0	-2.9	-2.3	-0.3	11.8	5.4	5.1
Consumer Expenditures	2.7	2.4	-3.8	5.5	4.1	2.4	2.1	-6.9	-33.2	40.6	4.3	1.5	9.0	5.5	4.5
Residential Fixed Investment	-0.6	-1.7	6.1	14.4	5.0	2.7	2.0	19.0	-35.5	62.3	37.6	8.0	7.0	7.0	6.0
Business Fixed Investment	6.9	2.9	-4.5	5.1	4.8	3.9	3.6	-6.7	-27.2	21.8	5.6	5.1	7.0	6.1	4.6
Structures	3.7	-0.6	-11.2	-7.0	2.4	3.1	2.5	-3.7	-33.6	-15.8	-12.1	-1.0	1.0	1.0	1.0
Equipment	8.0	2.1	-5.6	11.6	4.8	2.7	2.5	-15.2	-35.9	66.6	16.2	7.0	10.0	8.0	5.0
Intellectual Property Products	7.8	6.4	1.1	4.6	6.1	5.7	5.5	2.4	-11.4	6.0	4.0	6.0	6.5	6.5	6.0
Federal Government	2.8	4.0	4.6	1.6	0.1	0.0	0.0	1.5	16.5	-6.2	3.0	3.0	1.0	0.0	0.0
State & Local Government	1.2	1.3	-0.9	-1.8	-0.1	0.0	0.0	1.1	-5.4	-4.0	-2.5	-1.0	-1.0	0.0	0.0
Net Exports (\$bn, '09)	-878	-918	-906	-1,048	-1,012	-993	-982	-788	-775	-1016	-1043	-1049	-1057	-1050	-1037
Inventory Investment (\$bn, '09)	53	49	-89	108	79	65	65	-81	-287	-4	15	60	125	125	120
Industrial Production, Mfg.	2.3	-0.2	-6.5	9.9	5.3	2.7	2.0	-5.5	-46.7	55.2	17.9	6.5	11.1	8.4	6.4
HOUSING MARKET															
Housing Starts (units, thous)	1,248	1,295	1,358	1,440	1,519	--	--	1,484	1,079	1,440	1,430	1,398	1,370	1,502	1,492
New Home Sales (units, thous)	614	685	814	736	803	795	795	701	703	994	857	720	706	746	774
Existing Home Sales (units, thous)	5,334	5,330	5,341	5,493	5,595	5,698	5,803	5,483	4,313	6,137	5,433	5,457	5,480	5,505	5,530
Case-Shiller Home Prices (%yoy)*	4.0	3.4	4.2	3.7	2.4	2.5	--	4.2	3.8	4.3	4.2	3.9	4.7	4.2	3.7
INFLATION (% ch, yr/yr)															
Consumer Price Index (CPI) (annual=Q4/Q4)	2.2	2.0	1.0	1.8	1.9	2.1	2.3	2.1	0.4	1.3	1.0	1.2	2.6	1.7	1.8
Core CPI (annual=Q4/Q4)	2.2	2.3	1.5	1.8	2.1	2.3	2.5	2.2	1.3	1.7	1.5	1.4	2.3	1.6	1.8
Core PCE** (annual=Q4/Q4)	2.0	1.6	1.4	1.6	1.7	1.9	2.0	1.8	1.0	1.4	1.4	1.3	2.0	1.5	1.6
LABOR MARKET															
Unemployment Rate (%)^	3.9	3.5	6.7	5.2	4.8	4.3	3.9	4.4	11.1	7.9	6.7	6.6	6.3	5.6	5.2
U6 Underemployment Rate (%)^	7.6	6.7	11.7	9.5	8.9	8.3	7.8	8.7	18.0	12.8	11.7	11.2	10.7	9.9	9.5
Payrolls (thous, monthly rate)	193	178	-772	470	215	159	155	-303	-4,427	1,322	318	283	617	558	422
GOVERNMENT FINANCE															
Federal Budget (FY, \$bn)	-779	-984	-3,132	-2,250	-1,450	-1,400	--	--	--	--	--	--	--	--	--
FINANCIAL INDICATORS															
FF Target Range (Bottom-Top, %)^	2.25-2.5	1.5-1.75	0-0.25	0-0.25	0-0.25	0-0.25	0-0.25	0-0.25	0-0.25	0-0.25	0-0.25	0-0.25	0-0.25	0-0.25	0-0.25
10-Year Treasury Note^	2.69	1.92	0.75	1.30	1.65	1.85	2.05	0.70	0.66	0.69	0.75	0.85	1.00	1.15	1.30
Euro (€/€)^	1.15	1.12	1.21	1.25	1.28	1.30	1.30	1.10	1.12	1.17	1.21	1.17	1.20	1.23	1.25
Yen (\$/¥)^	110	109	104	100	100	99	99	108	108	106	104	103	102	101	100

* Weighted average of metro-level HPIs for 381 metro cities where the weights are dollar values of housing stock reported in the American Community Survey.

** PCE = Personal consumption expenditures. ^ Denotes end of period.

Note: Published figures in bold.

Source: Goldman Sachs Global Investment Research.

Source: Goldman Sachs Global Investment Research

Economic Releases

Date	Time (ET)	Indicator	Estimate			
			GS	Consensus	Last Report	
Tue	Dec 08	6:00	NFIB Small Business Optimism (November)	n.a.	102.5	104.0
		8:30	Nonfarm Productivity (Q3 final)	+4.9%	+4.9%	+4.9%
		8:30	Unit Labor Costs (Q3 final)	-8.6%	-8.9%	-8.9%
Wed	Dec 09	10:00	Wholesale Inventories (October final)	n.a.	+0.9%	+0.9%
		10:00	JOLTS Job Openings (October)	n.a.	6,300k	6,436k
Thu	Dec 10	8:30	Consumer Price Index (November)	+0.09%	+0.1%	Flat
			Ex Food and Energy	+0.06%	+0.1%	Flat
		8:30	Initial Jobless Claims	750k	725k	712k
			Continuing Claims	n.a.	5,270k	5,520k
Fri	Dec 11	8:30	Producer Price Index, Final Demand (November)	+0.2%	+0.1%	+0.3%
			Ex Food and Energy	+0.2%	+0.2%	+0.1%
			Ex Food, Energy, and Trade	+0.2%	+0.2%	+0.2%
		10:00	UMich Consumer Sentiment (December preliminary)	77.0	76.0	76.9

Source: Goldman Sachs Global Investment Research

Disclosure Appendix

Reg AC

We, Jan Hatzius, Alec Phillips, David Mericle, Spencer Hill, CFA, Daan Struyven, David Choi, Joseph Briggs, Blake Taylor and Ronnie Walker, 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 Instruction 598 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 Instruction 598, 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 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. **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: 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 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.; Ombudsman Goldman Sachs Brazil: 0800 727 5764 and / or ouvidoriagoldmansachs@gs.com. Available Weekdays (except holidays), from 9am to 6pm. Ouvidoria Goldman Sachs Brasil: 0800 727 5764 e/ou ouvidoriagoldmansachs@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 and European Union.

European Union: Goldman Sachs International authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority, has approved this research in connection with its distribution in the European Union and United Kingdom.

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. 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.

© 2020 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.