

Global Economics Analyst

A Break in the Clouds

- We expect the global growth slowdown that began in early 2018 to end soon, in response to easier financial conditions and an end to the trade escalation. Although annual-average GDP growth is likely to rise only modestly from 3.1% in 2019 to 3.4% in 2020, this conceals a more pronounced sequential pattern of slowing growth this year and—in our forecast—gradually rising growth next year.
- The risk of a global recession remains more limited than suggested by the flat yield curve, which partly reflects a structural decline in the term premium, and the low unemployment rate, whose predictive value for inflation and aggressive monetary tightening has fallen. We also take comfort from the absence of significant private sector financial deficits in all but a few advanced economies.
- Our confidence that growth will improve sequentially is highest in the US, where demand is most responsive to financial conditions, and the UK, where we expect the Brexit drag to reverse and fiscal policy to ease. We look for a more gradual pickup in Europe, where the fiscal boost is likely to remain (too) limited, and Japan, where we are watching carefully for a negative impact from the October consumption tax hike. We expect growth in China to slow modestly from just above 6% to just below, in line with gradually decelerating potential.
- Across many advanced economies, we expect continued labor market improvement and upward pressure on wage growth, which is likely to push unit labor costs above central bank inflation targets. However, the pass-through to core price inflation should remain limited because the price Phillips curve is much flatter than the wage Phillips curve given stable inflation expectations.
- In our baseline forecast, most DM central banks stay on hold in 2020. At least in the early part of the year, however, the risk is on the side of further easing, especially in the Euro area and Japan where growth is weak and inflation far below target. We also expect further cuts in a number of EMs and smaller DMs.
- Slightly better growth, limited recession risk, and friendly monetary policy should provide a decent background for financial markets in the early part of 2020. However, concerns about the impact of higher corporate taxes on profits could rise in the runup to the US presidential election. Even aside from politics, rising wage growth looks set to reduce profit margins over the next several years.

Jan Hatzius

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

Daan Struyven

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

Ronnie Walker

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

A Break in the Clouds

Exhibit 1: Our Global Growth Outlook

Real GDP Growth								
Percent Change yoy	2017	2018	2019 (f)		2020 (f)		2021 (f)	
			GS	Cons*	GS	Cons*	GS	Cons*
US	2.4	2.9	2.3	2.3	2.3	1.8	2.4	1.9
Japan	1.9	0.8	0.9	0.9	0.4	0.3	0.8	0.8
Euro Area	2.7	1.9	1.2	1.1	1.1	1.0	1.4	1.3
Germany	2.8	1.5	0.6	0.5	0.8	0.7	1.4	1.2
France	2.4	1.7	1.3	1.3	1.3	1.2	1.4	1.4
Italy	1.8	0.7	0.2	0.1	0.5	0.5	0.7	0.6
Spain	2.9	2.4	2.0	2.0	1.7	1.7	1.7	1.7
UK	1.9	1.4	1.3	1.2	1.1	1.1	2.0	1.5
China	6.8	6.6	6.1	6.1	5.8	5.9	5.7	5.7
India	6.9	7.4	5.1	5.6	6.4	6.9	6.9	--
Russia	1.6	2.3	1.3	1.1	2.2	1.6	3.1	1.9
Brazil	1.1	1.1	1.0	1.0	2.2	2.0	2.4	2.5
Developed Markets	2.6	2.3	1.7	1.7	1.7	1.5	2.0	1.7
Emerging Markets	5.1	5.1	4.2	4.3	4.8	4.7	4.9	4.9
World	3.9	3.8	3.1	3.1	3.4	3.2	3.6	3.4

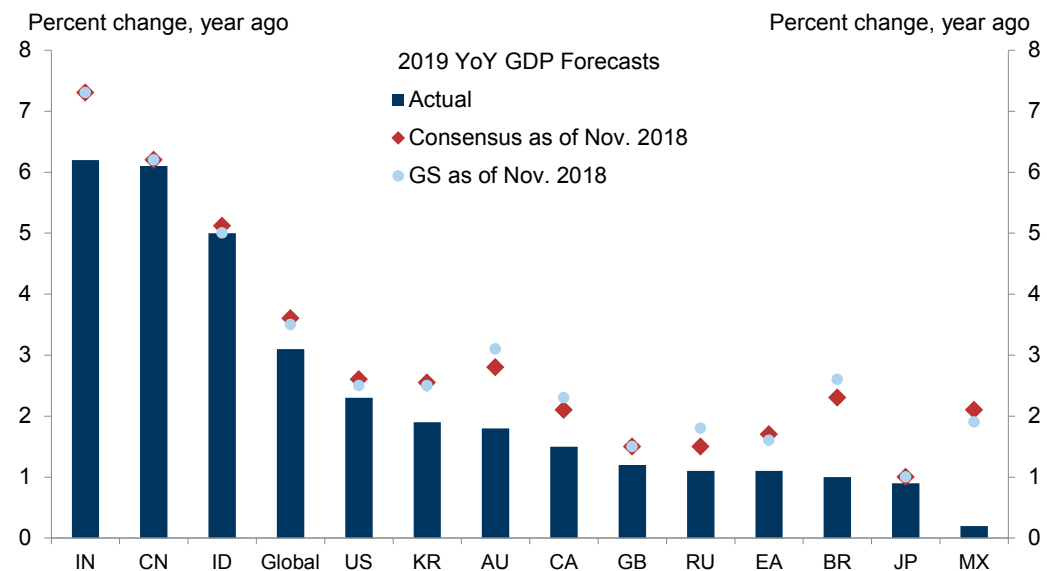
* Bloomberg consensus forecasts as of November.

Note: All forecasts, including consensus, calculated on calendar year basis.

Source: Bloomberg, Goldman Sachs Global Investment Research

A year ago, we predicted a slowdown in global growth from 3.8% in 2017-2018 to 3.5% in 2019, with deceleration relatively evenly spread across the major economies. There were two main demand-side reasons for this call, namely 1) reduced US fiscal stimulus and 2) tighter financial conditions.

In the event, the global economy slowed more sharply than we had anticipated. Exhibit 2 plots the 2019 GS and consensus growth forecast against the most recent consensus estimate (which should by now be fairly close to the ultimate print). We have seen negative surprises concentrated in Europe—especially Germany—, Australia, and several large EM economies such as Argentina, Brazil, Mexico, India, and South Africa. By contrast, a few other large economies—especially China and the US—saw growth relatively close to expectations, and a number of EM economies in Central and Eastern Europe actually beat forecasts.

Exhibit 2: Global Economy Slowed More Sharply than Expected

Source: Bloomberg, Goldman Sachs Global Investment Research

The downside surprises of 2019 were greater than suggested by the growth numbers alone, because these came despite the cushioning effects of a much lower than expected interest rate path. In particular, the Federal Reserve cut the funds rate three times in 2019, compared with its own forecast of three hikes and our forecast of four hikes as of a year ago. Many other central banks in both DM and EM countries followed suit.

The 2018-19 slowdown has taken global growth from clearly above potential in 2018 to roughly a potential pace in 2019. In fact, the latest high-frequency GDP and CAI numbers are below potential in a majority of economies, as shown in Exhibit 3. This means that the unemployment rate—in DM and those EM countries that produce reliable labor market statistics—will start trending higher unless growth picks up from the latest sequential pace.

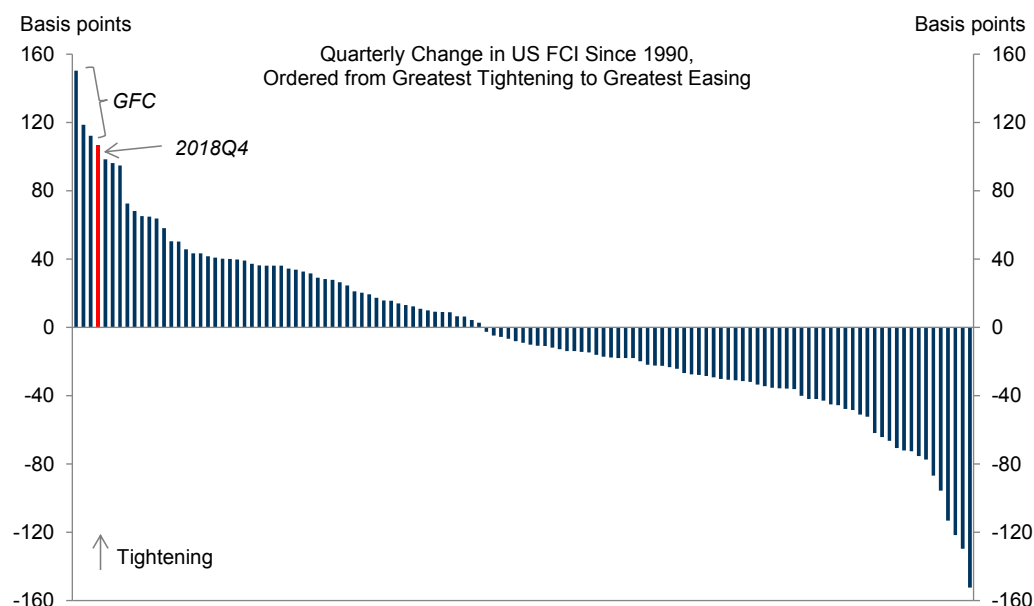
Exhibit 3: Growth Below Potential in Most Economies

Global Growth Heatmap				
	Q3 GDP (qoq ar)	CAI (3mma)	Average of GDP and CAI	Growth Vs. Potential
Brazil	1.8	2.9	2.4	0.3
Japan	0.2	1.6	0.9	-0.1
US	1.9	1.4	1.6	-0.1
China	5.5	5.6	5.6	-0.2
Euro Area	0.8	0.5	0.6	-0.5
Russia	4.9	-0.1	2.4	-0.8
UK	1.2	-0.5	0.3	-1.0
India	2.4	4.6	3.5	-3.7

Note: With the exception of the US and China, potential growth for these economies is based on our cross-country consistent models, which differ somewhat from the country teams' estimates. We use the latest GS GDP forecasts for Q3 where official data is not available yet.

Source: Goldman Sachs Global Investment Research

What lies behind this year's weakness? Our answer is a succession of negative shocks to financial markets and business confidence. The starting point was the sharp selloff in global risk assets in the fourth quarter of 2018, driven by the combination of negative data surprises in China and Europe coupled with a perceived hawkish Fed policy shock, encapsulated in Fed Chair Powell's "long way from neutral" comment in early October. As shown in Exhibit 4, the resulting 100bp tightening in our US FCI in Q4 was the largest quarterly tightening outside the financial crisis, and it led to a sharp slowdown in US and global aggregate demand growth in late 2018 and early 2019.

Exhibit 4: 2018Q4 Brought the Largest US FCI Tightening Move Outside the GFC

Source: Goldman Sachs Global Investment Research

By the spring, the impact of the FCI shocks seemed to diminish, aided by the Fed's pivot away from further rate hikes. But just as the improvement in financial conditions started to show up in a tentative stabilization in our global CAI, the world economy was hit with another set of shocks. Trade tensions moved up sharply in the wake of President Trump's tweets threatening higher tariffs on US imports of Chinese and Mexican goods, followed by several rounds of additional escalation in subsequent months. In addition, the ongoing Brexit negotiations and the related uncertainty weighed on UK (and to a lesser degree EU27) investment and output.

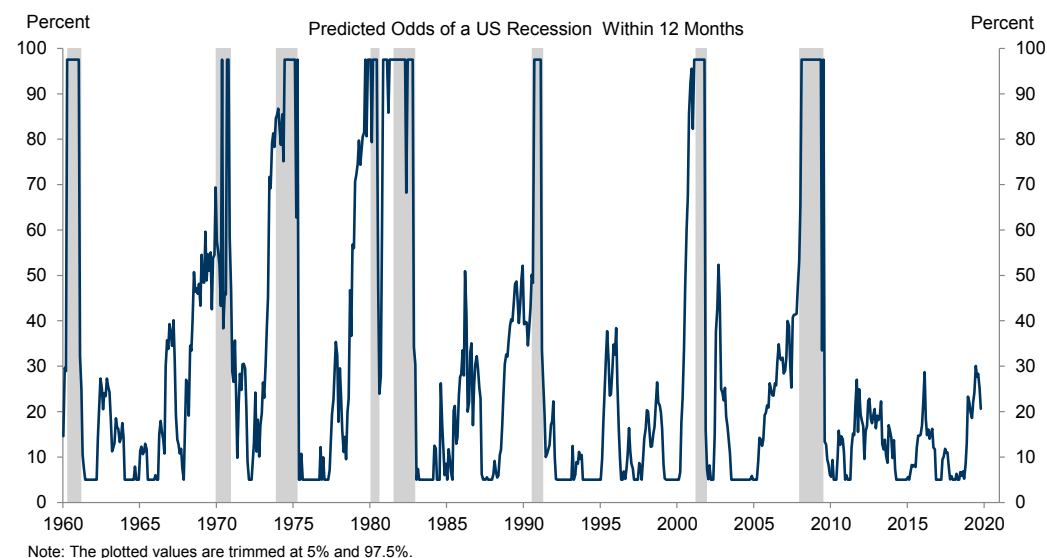
Recession Risk Still Limited

So where do we go from here? Some market participants worry that we are on an inexorable path to a hard landing. A recent Bloomberg survey shows that the median economic forecaster sees a 33% probability that the US economy will enter recession in the next 12 months. In fact, even this number may understate the true perceived risk as economists are often reluctant to adopt a recession baseline, perhaps because of the career risk involved in crying wolf prematurely. Moreover, the fears of a hard landing in other major economies such as Europe and China seem, if anything, greater than in the US.

However, our own view is that the risk of recession is considerably lower. We recently presented a statistical model that puts the risk of a US recession starting in the next 12 months at 20%, as shown in Exhibit 5.¹ This is partly because we think many recession models—and thus many forecasters—overstate the importance of factors such as a flat yield curve and a low unemployment rate. Many commonly used yield curve measures are distorted by the sharp decline in the term premium, which makes a flat or inverted yield curve both more frequent and less meaningful than in the past. And the low unemployment rate is probably a less reliable predictor of economic overheating and aggressive monetary tightening than in the past because of the flatter Phillips curve and more anchored inflation expectations. Correcting for these distortions substantially reduces the estimated recession risk.

¹ See Daan Struyven, David Choi, and Jan Hatzius, "Recession Risk: Still Moderate," US Economics Analyst, October 27, 2019.

Exhibit 5: Our Model Suggests a 20% Chance that the US Economy Enters a Recession in the Next 12 Months

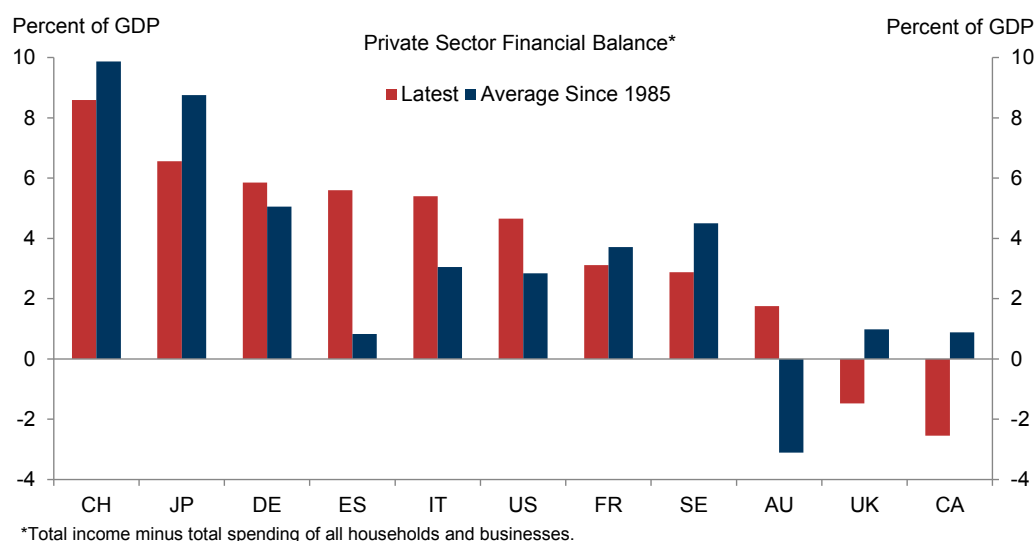


Source: Goldman Sachs Global Investment Research

The broader reason for our relatively optimistic view (which is also included in our formal US recession model) is the strong financial position of households and businesses across most advanced economies, as measured by the private sector financial balance. When the private sector runs a deficit—which often happens in response to major asset price booms such as the 1990s equity bubble and the 2000s housing bubble—this means that households and firms rely on ongoing net debt accumulation to fund the current level of spending. And demand then becomes very vulnerable to an asset price downturn or a tightening of credit availability, which can feed on itself in a vicious circle of weaker demand, output, employment, profits, asset prices, and in the extreme a financial crisis.²

At present, however, we are far away from this type of situation. As shown in Exhibit 6, the private sector in almost all the world's major economies runs a sizable financial surplus roughly in line with the long-term average. This is noteworthy because long expansions have in the past led to bigger and bigger increases in private sector spending relative to income, and because the current expansion is now the longest on record in the US and among the longest in many other economies around the world.

² See Jan Hatzius and Nicholas Fawcett, "The Private Sector Financial Balance: Mostly Clear Skies," Global Economics Analyst, August 23, 2019. A breakdown of the aggregate US private sector financial balance shows healthy balances for both the household and business sectors and for business segments. See Spencer Hill, "Stuck in the Middle with You: Searching for Corporate-Sector Imbalances," US Economics Analyst, November 12, 2018.

Exhibit 6: Private Sector Runs a Financial Surplus in Most Major DMs

Source: Haver Analytics, Goldman Sachs Global Investment Research

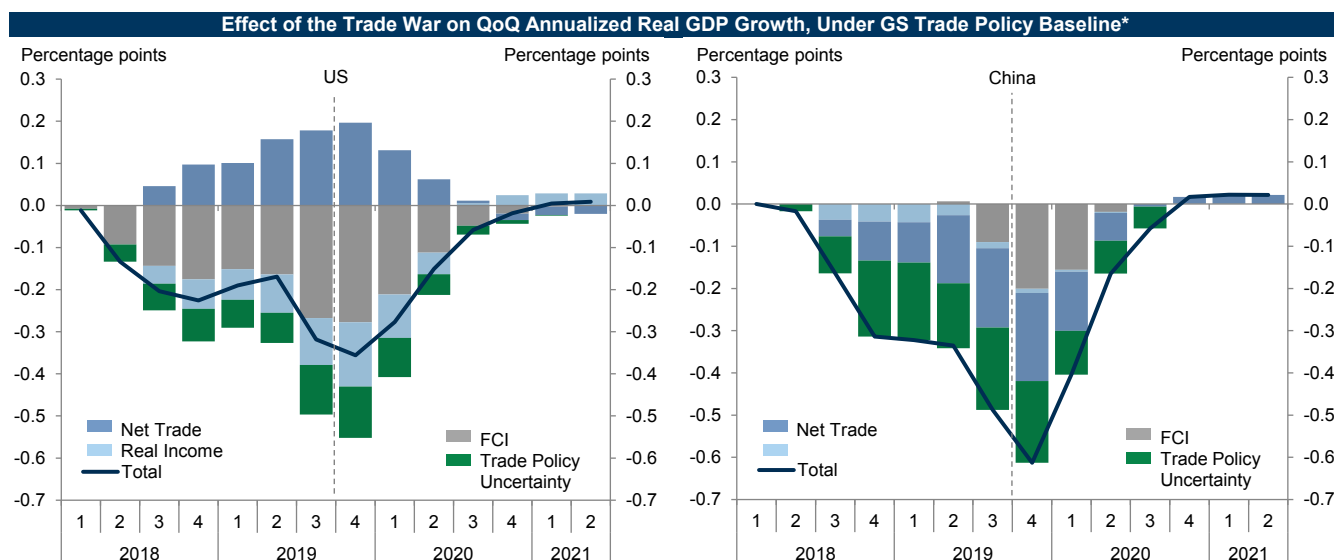
Of course, the absence of the types of imbalances—inflationary or financial—that have often proven decisive in the past does not mean that a recession cannot occur. In particular, the risk of further trade escalation and other policy-related shocks is clearly greater than in past cycles, and the increased integration of global financial markets implies that shocks in one part of the world economy spill over to other countries more quickly. This means that we cannot rule out an “exogenous” recession, in which the world economy suffers a shock large enough to overcome the relative absence of the classic imbalances that have set the stage for recessions in the past.

A Rising Tide ...

Although much could still go wrong, the news on trade policy—both US-China and issues related to Brexit—has gotten better in recent weeks. The “Phase 1” agreement—which looks likely to be signed in coming weeks—should remove the US threat of a 15% tariff on roughly \$150bn in imports from China currently scheduled for December 15. The agreement is also more likely than not to include a rollback of the 15% tariff on roughly \$100bn of imports from China that was imposed on September 1, in exchange for increased Chinese purchases of agricultural goods and other concessions related to currency and market access for US financial firms.³

If so, the impact of the trade war on GDP growth in the United States and China—and the world economy more broadly—should become less negative in 2020. Exhibit 7 shows our estimate that the trade war is currently subtracting about 0.4pp from quarterly annualized growth in the US and 0.6pp in China. Although the composition of this drag differs between the two countries, our expectation of a partial rollback implies that both should enjoy a “subtraction of negatives” as this drag on growth abates in

³ See Alec Phillips, “Tariff Rollback and Its Risks,” US Daily, November 11, 2019.

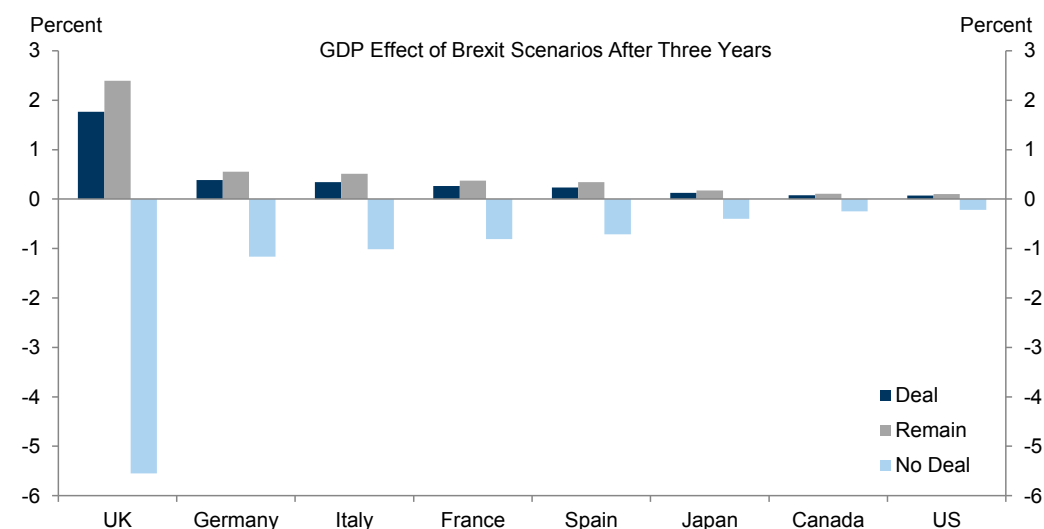
2020.⁴**Exhibit 7: The Trade War Drag on Growth Should Abate in 2020**

*Assumes 25% tariff on List 1-3 remains and a rollback of the 15% tariff on list 4A, with no further escalation.

Source: Goldman Sachs Global Investment Research

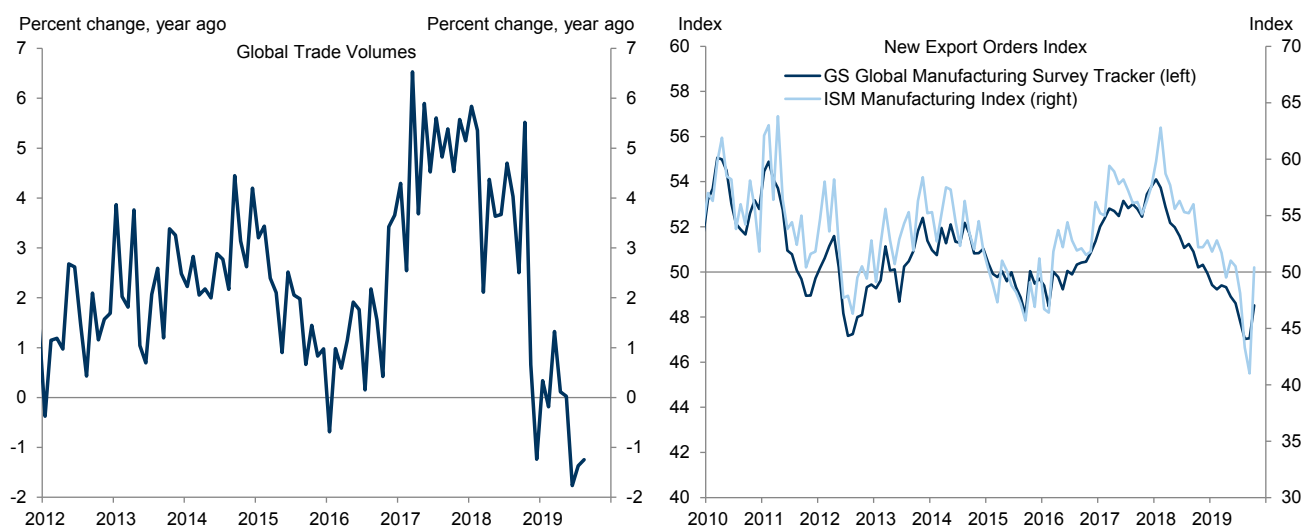
The Brexit story has also taken a turn for the better. The key shift is that UK Prime Minister Johnson has managed to unify the Conservative Party around his revised EU withdrawal agreement. With all other parties except the Brexit Party firmly opposed to “no deal,” this has further reduced the—in our view already low—likelihood of a negative tail outcome, despite the inevitable uncertainty injected by the general election scheduled for December 12. Exhibit 8 shows that avoiding “no deal” should boost growth in the UK and, to a lesser degree, other European countries. Partly for this reason and partly because we expect a sizable fiscal expansion, UK growth is likely to pick up materially in 2020.

⁴ See Daan Struyven, Hui Shan and Helen Hu, “The Trade War Drag on US-China Growth Should Abate in 2020,” Global Economics Comment, November 18, 2019.

Exhibit 8: Avoiding a “No Deal” Brexit Would Boost European Growth

Source: Goldman Sachs Global Investment Research

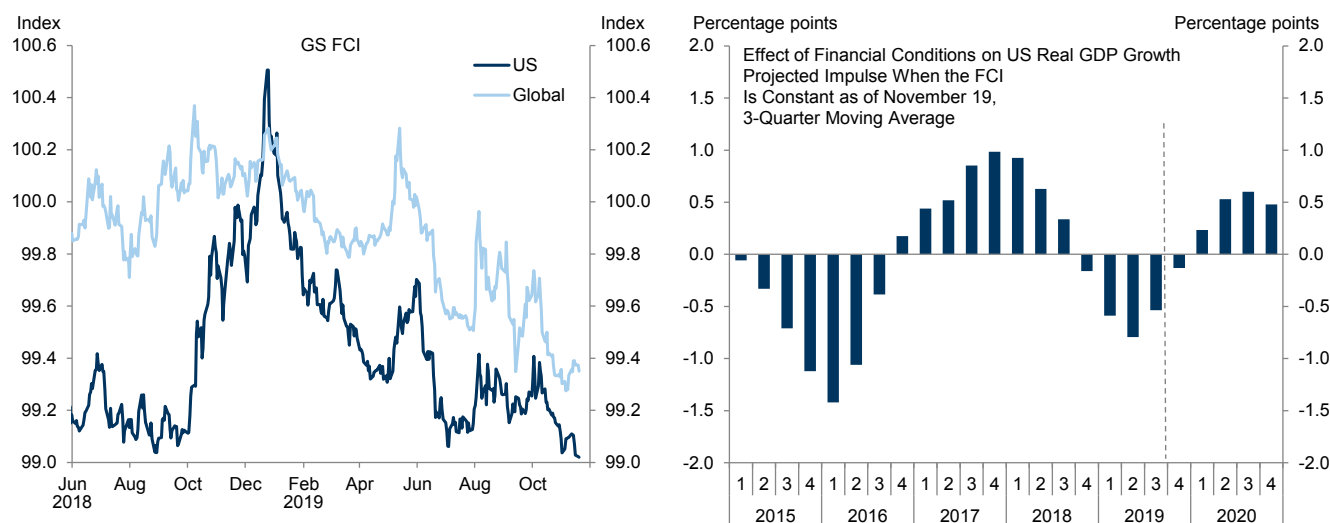
Together, the US-China détente and reduced Brexit uncertainty are likely to help global trade volumes recover from their drop over the past year. Exhibit 9 shows that no such improvement is visible yet in the hard data, taken from the Dutch Central Planning Bureau and covering the period through August. However, the latest purchasing manager indexes point to a pickup in new export orders in the last month. If sustained, this should benefit trade-sensitive economies such as Germany, Korea, and Taiwan more broadly. Germany—currently the weakest G7 economy according to our CAI—is showing some early signs of improvement, including an improvement in manufacturing orders in October and a notable pickup in the expectations component of national surveys (including the ZEW, Sentix and Ifo surveys).

Exhibit 9: Manufacturing Surveys Suggest that Trade Has Bottomed

Source: CBP, Institute for Supply Management, Goldman Sachs Global Investment Research

Partly driven by the better trade news and partly by the earlier monetary policy easing, the other shock of the past year—the sharp tightening in financial conditions in late 2018—has now fully reversed. Our US FCI has moved back to the level seen in mid-2018 and our global FCI now stands near the lowest level since before the financial crisis. Easier financial conditions are likely to boost growth, especially in economies such as the United States where the empirical linkage between the FCI and growth is particularly close. Exhibit 10 shows that the US growth impulse from financial conditions is likely to move up from about $-\frac{1}{2}$ pp at the start of 2019 to $+\frac{1}{2}$ pp in early 2020 in the US (assuming markets stay around current levels).

Exhibit 10: The FCI Growth Impulse Is Turning Positive



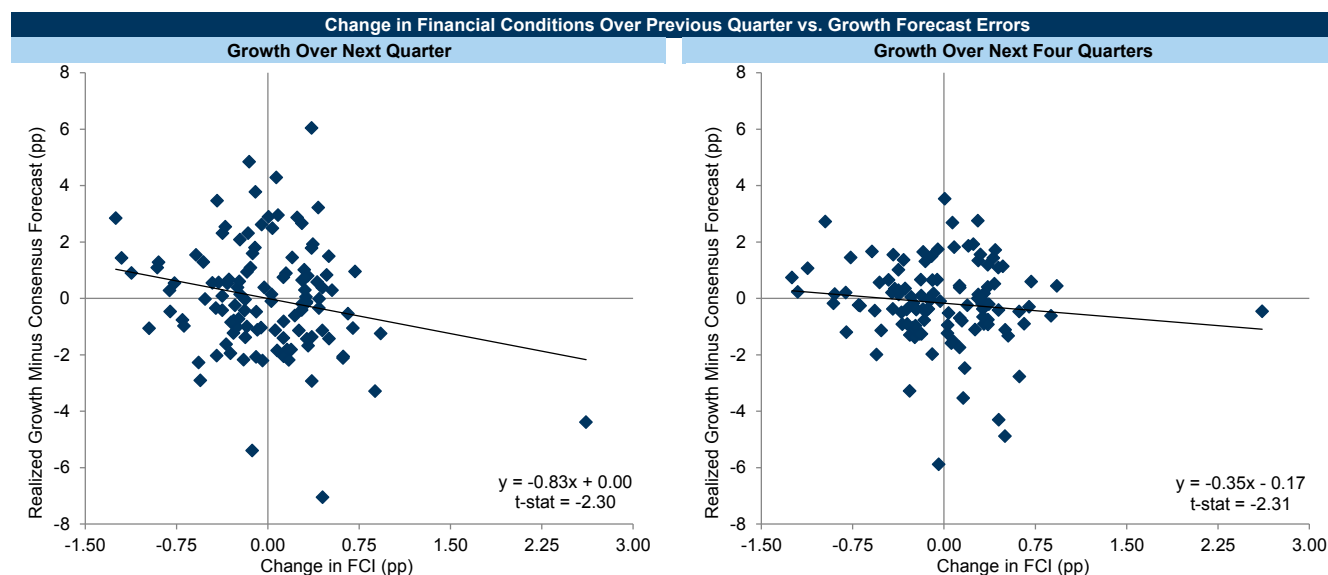
Source: Goldman Sachs Global Investment Research

This easing in financial conditions suggests not only that global growth is likely to pick up somewhat in absolute terms, but also that growth may come in stronger than currently predicted by the forecaster community. Exhibit 11 shows that large moves in financial conditions have statistically significant predictive value for subsequent surprises in growth relative to consensus expectations.⁵

⁵ See David Choi, "Do Forecasters Fully Account for Financial Conditions?" US Daily, November 12, 2019.

In other words, financial conditions not only affect the growth outlook, but they affect it by *more* than the median forecaster seems to assume.

Exhibit 11: FCI Easing Predicts Upside Growth Surprises



Source: Goldman Sachs Global Investment Research

This finding is “fragile” in the sense that forecasters may eventually learn from their past mistakes and incorporate financial conditions more prominently into their framework. But this does not seem to have happened yet, as the surprises in global growth in the past five years were well-flagged by preceding financial conditions moves—i.e. the downside surprises of 2016 and 2019 followed a sizable FCI tightening in the previous year, while the upside surprises of 2017 and 2018 followed a sizable FCI easing.

... Should Lift Most Boats

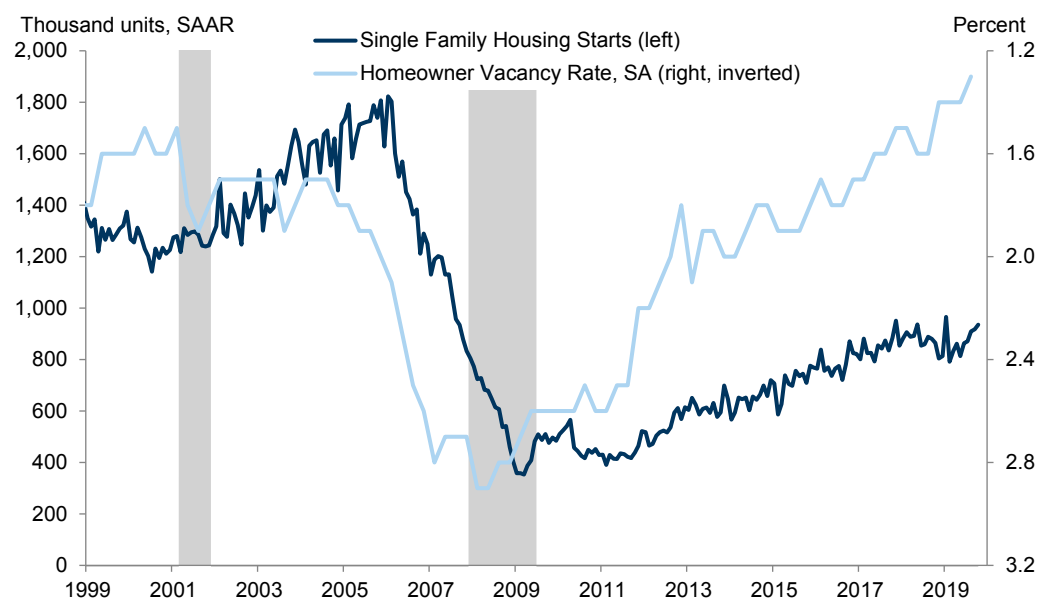
Although we expect the growth news in coming quarters to look more positive than for much of the past year, there are some important differences across the world’s biggest economies in terms of both the strength of growth and our confidence around it.

We are reasonably confident that US growth is improving, for three reasons. First, the sharp drop in mortgage rates—an important aspect of the FCI easing—has reinvigorated the housing recovery after a slowdown in 2018 and early 2019. The structural outlook for housing is also strong, as the level of building activity remains well below demographic demand and the homeowner vacancy rate has now fallen to a 38-year low in seasonally adjusted terms (see Exhibit 12). Second, we expect the strength in consumer spending to outlast the weakness in business investment, in line with the historical lead-lag pattern.⁶ Third, the drag on goods-sector output from the inventory adjustment is probably nearing an end. Since Q1, when inventory investment as a share of real GDP hit its highest level since mid-2015, the monthly numbers have slowed steadily and the inventory components of both the ISM and the Markit PMI have fallen below 50. Together, these three factors should boost US growth moderately from the current

⁶ See David Choi, “Consumption Leads the Way,” US Economics Analyst, November 2, 2019.

1¾% sequential pace to the 2¼-2½% range in 2020.

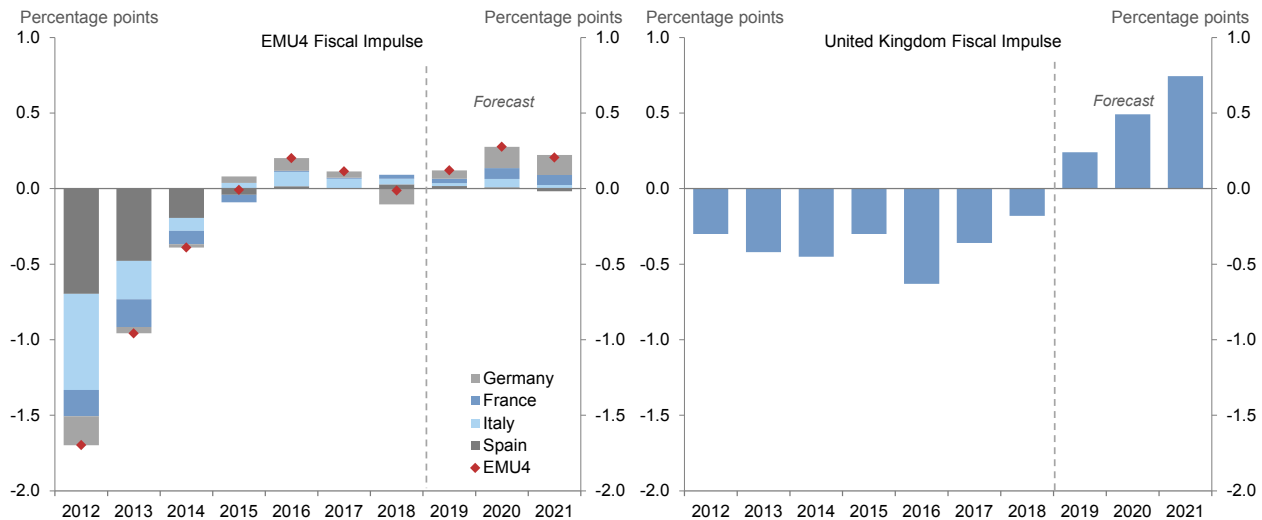
Exhibit 12: A Strong Structural Outlook for US Housing



Source: Census Bureau, Goldman Sachs Global Investment Research

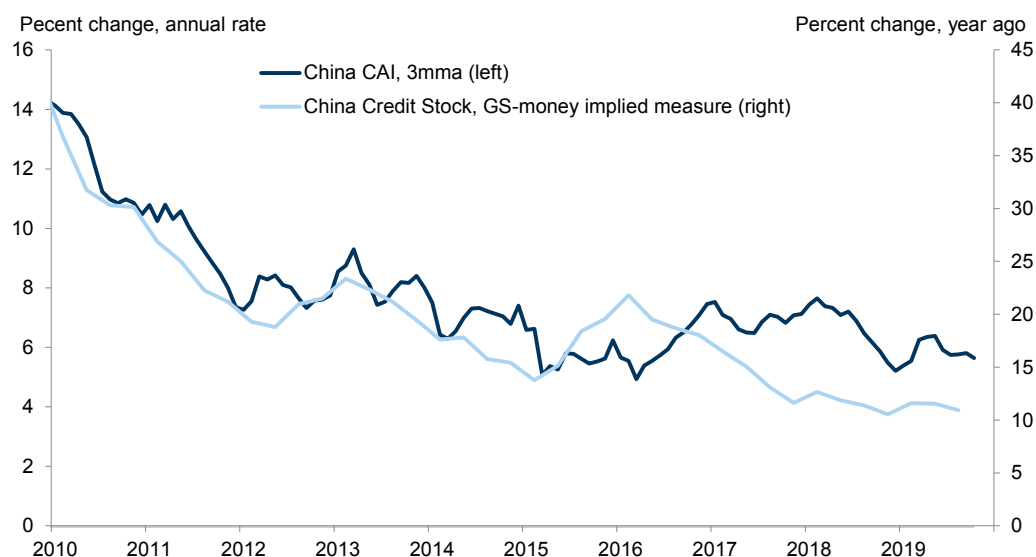
The starting point in Europe is considerably worse than in the US, as the average growth pace has slowed to a clearly below-trend pace and large economies such as Germany, Italy, and the UK are contracting (at least according to our CAI). Incrementally, however, the news has also turned more positive. The most important is early signs of stabilization in the manufacturing sector, which is twice as large relative to GDP in Germany as in the US. In addition, we also expect a moderate fiscal boost of about 0.3pp in the Euro area, mostly because Germany is—belatedly and incrementally—moving toward a more expansionary setting. All told, we expect the sequential annualized pace of Euro area growth to move up from the current 0.2% (based on our CAI) to just over 1% in 2020—only a little above trend but probably enough to keep the labor market recovery going in most countries. We see a more substantial pickup from slightly negative numbers now to a 2.4% sequential pace in 2020 H2 in the UK, which should benefit from a resolution of the Brexit uncertainty as well as a sizable fiscal boost after the December 12 election.⁷

⁷ See Adrian Paul, “UK—A Post-Election Pickup,” European Daily, November 13, 2019.

Exhibit 13: A Stronger Fiscal Tailwind in the UK than in the Euro Area

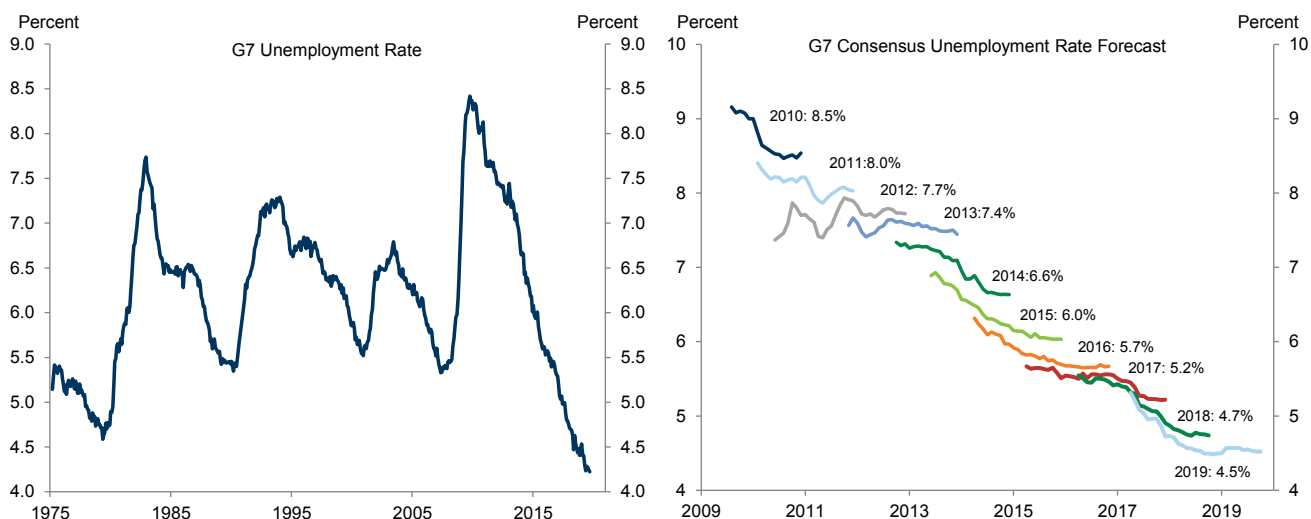
Source: Goldman Sachs Global Investment Research

In contrast to the US and Europe, China is unlikely to see a meaningful sequential acceleration. This year, policymakers managed to prevent a sharp slowdown in growth by allowing the currency to depreciate and easing macro policy across a number of different levers summarized in our domestic macro policy proxy. That said, policymakers have taken a more conservative approach to policy stimulus than in the past. Next year we expect them to allow actual growth to slow in line with potential from just above 6% to just below, while aiming to boost the “quality” of growth by keeping a lid on property speculation and limiting the overall pickup in leverage. Barring further trade escalation, the spillovers from China to the rest of the region should be less adverse in 2020 than in 2019 with a likely recovery in China imports and no significant currency depreciation. Elsewhere in Asia, the news is more mixed, with a likely pickup in India on the back of the corporate tax cut and easier monetary policy but risk of a slowdown in Japan following the consumption tax increase in October.

Exhibit 14: Slower Growth and More Limited Debt Growth

Source: Wind, Goldman Sachs Global Investment Research

The slowdown in global growth has done only limited damage to the labor market so far. Despite weaker job gains, the unemployment rate is still trending sideways to lower in most advanced economies, as shown in Exhibit 15. Any pickup in global growth should enable labor markets to make renewed progress in the next year.

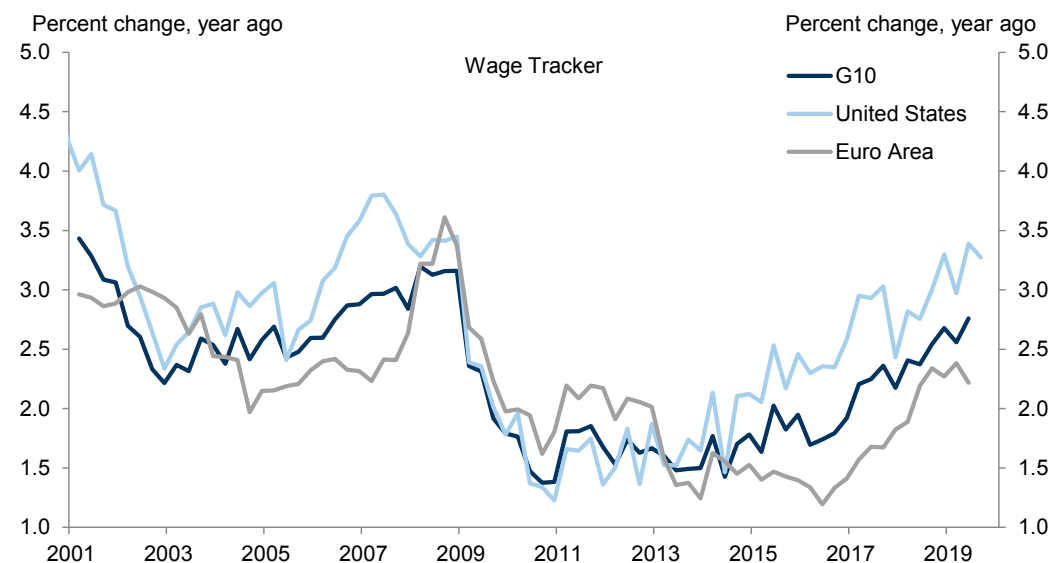
Exhibit 15: The G7 Unemployment Rate Is Still Trending Lower

Source: Bloomberg, Goldman Sachs Global Investment Research

In many advanced economies—including all of the G7 except France and Italy—this is likely to mean continued multi-decade lows in the unemployment rate and other measures of labor market slack. And lower unemployment is likely to result in continued, if gradual, upward pressure on wage growth. As shown in Exhibit 16, any further acceleration is likely to take wage growth in many advanced economies beyond

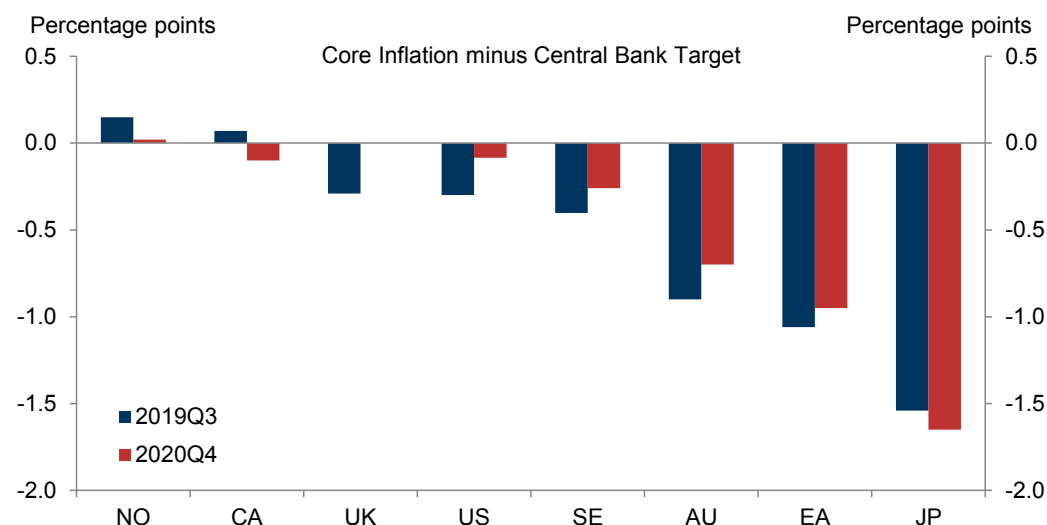
the sustainable pace, defined as the sum of the central bank's inflation target and the long-term trend rate of productivity growth.

Exhibit 16: Wage Growth Is Picking Up



Source: Goldman Sachs Global Investment Research

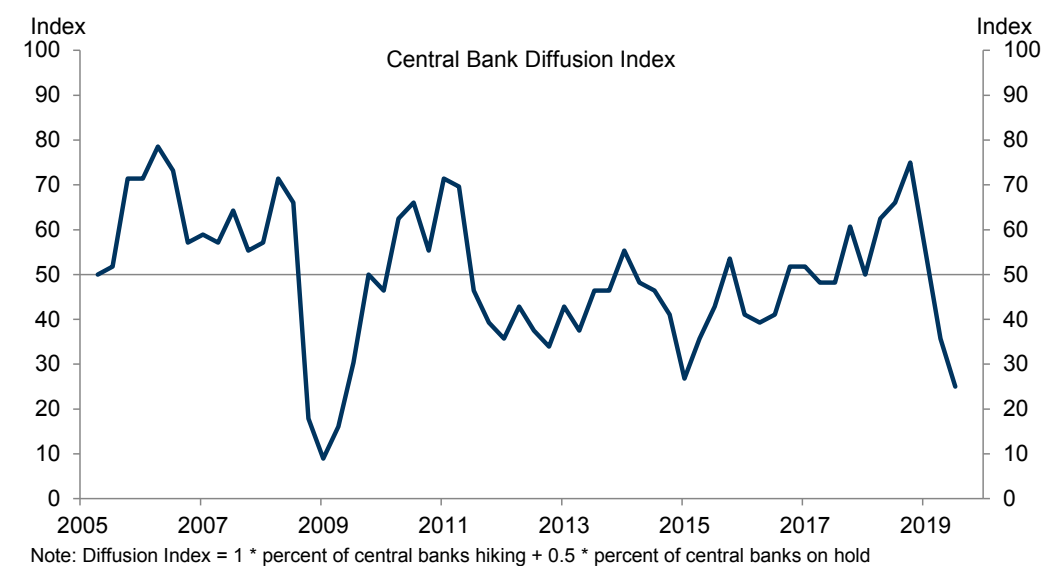
All else equal, excess unit labor cost growth is likely to imply upward pressure on core inflation, as firms try to defend their profit margins. However, it is important to remember that the price Phillips curve is only about one-quarter as steep as the wage Phillips curve. This means that only one-quarter of any unemployment-driven pickup in wage and unit labor cost growth typically shows up in higher price inflation. Indeed, we expect only a modest pickup in core inflation rates across most of the advanced economies to rates generally no greater than central bank inflation targets, as shown in Exhibit 17.

Exhibit 17: We Expect Core Inflation to Remain Below Target in Most DMs

Source: Haver Analytics, Goldman Sachs Global Investment Research

Central Banks Move to the Sidelines

Monetary policy has taken a much more dovish turn than we expected over the past year, with Fed officials moving from rate increases throughout 2018 to 75bp of cuts over the past three months. Other central banks followed suit, especially across the emerging world. Exhibit 18 shows that this was the sharpest turn for global central banks since the global financial crisis.

Exhibit 18: A Sharp Turn for Global Central Banks

Source: Goldman Sachs Global Investment Research

But the adjustment should now be mostly behind us. Under our economic forecast of slightly above-trend growth and 2% inflation, the Fed should be on hold throughout

2020. One reason why the risk to our call is still slightly on the downside is that we expect the Fed to tweak its policy framework in the direction of average inflation targeting, which would call for inflation slightly above 2% at this stage of the business cycle. But Fed officials would probably not implement this new regime mechanically, so inflation at 2% would not be a sufficient reason to cut further barring a renewed bout of weakness in economic activity or a sizable tightening in financial conditions.

In other advanced economies, it is a closer call. Given limited room for further easing, slightly better growth numbers and receding downside risks, we have removed the remaining 10bp cut in the ECB deposit rate from our forecast. However, given weak actual and expected inflation, it is possible that the debate could shift back to rate cuts and, in any case, we expect the ECB to maintain its EUR20bn/month QE program until end-2021. We also think additional rate cuts in Japan, Canada and—if Brexit takes an unexpected turn for the worse—the UK are possible, though none are our base case.

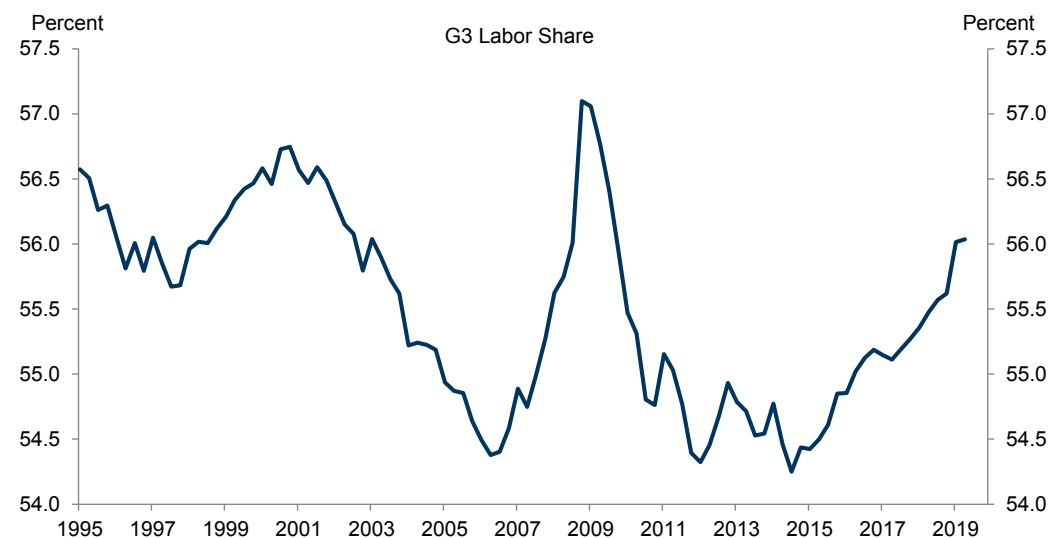
In parts of the emerging world, near-term rate cuts remain likely. In particular, we see further sizable moves in Turkey, Russia, Mexico, Brazil, South Africa, and Egypt on the back of below-potential growth and/or subdued inflation.

Profit Margins Under Pressure

The single biggest event of 2020 is likely to be the US election on November 3. Prediction markets currently imply a 36% probability of a Democratic majority in the Senate. In light of the fact that outcomes of competitive Senate seats and presidential elections are correlated, this is probably also close to the implied probability of unified Democratic control.

All four of the Democratic frontrunners in the prediction markets—Senator Warren, former Vice President Biden, Mayor Buttigieg, and Senator Sanders—have proposed at least a partial repeal of the 2017 Tax Cut and Jobs Act (TCJA), which cut the federal statutory corporate income tax rate from 35% to 21%. And if Democrats gain even a small majority in the Senate, we would expect an increase in the corporate tax rate. Our portfolio strategists have estimated that full repeal would reduce S&P 500 earnings in 2021 by 11%.

If Democrats fail to gain unified control, US tax policy would likely remain unchanged at least until 2023. But even in this case, the fundamentals for corporate profits—not only in the US but across many advanced economies—are likely to deteriorate. With unit labor costs growing faster than prices in most major economies, the share of national income going to labor is rising, as shown in Exhibit 19. A higher labor share is likely to come at the expense of profits, and this is one reason why our portfolio strategists expect fairly muted profit growth in most advanced economies in 2020.

Exhibit 19: The Labor Share Is Picking Up

Source: Haver Analytics, Goldman Sachs Global Investment Research

From a markets perspective, our 2020 outlook is therefore more mixed than our relatively sanguine view on both recession risk and central bank policy might suggest. After a long period in which profits and financial assets outperformed wages and the real economy, the next several years will likely see the reverse. There is a limit to this process. If the labor market tightens excessively, the downward pressure on margins might get so intense that companies react by either pushing up prices sharply (and thereby prompting central banks to hike rates aggressively) or cutting investment and hiring by enough to undercut aggregate demand (and thereby causing a recession). But in 2020, we still expect the swing in the pendulum to remain quite gradual and the global economy to clock yet another year of progress.

Jan Hatzius

Daan Struyven

Ronnie Walker

GS MACRO OUTLOOK 2020

[Explore >](#)

Disclosure Appendix

Reg AC

We, Jan Hatzius, Daan Struyven 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:** Further information on the covered companies referred to in this research may be obtained from Goldman Sachs (Singapore) Pte. (Company Number: 198602165W). **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 Brasil: 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.

© 2019 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.