Global Economics Analyst

Recession Risk is Low…For Now

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

Sven Jari Stehn
+44(20)7774-8061 | jari.stehn@gs.com
Goldman Sachs International

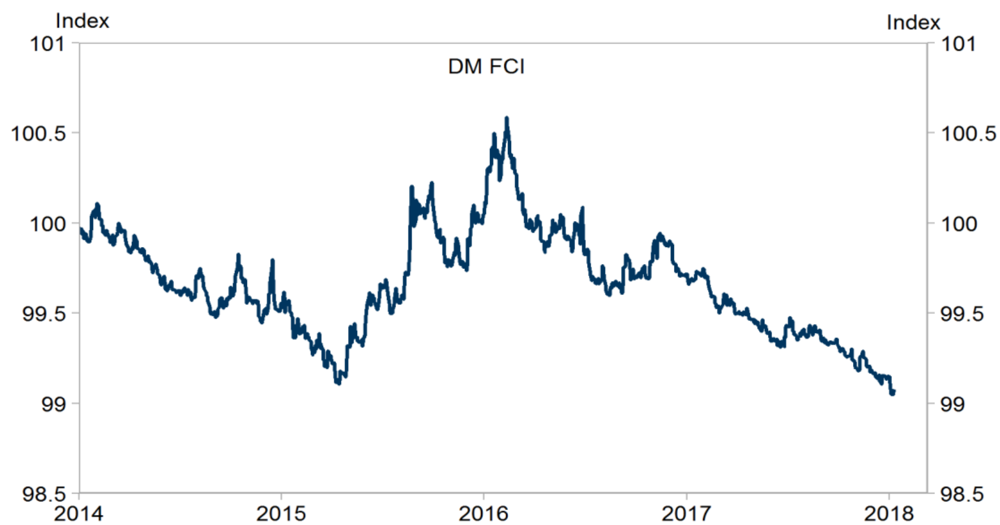
Nicholas Fawcett
+44(20)7051-8321 |
nicholas.fawcett@gs.com
Goldman Sachs International

Manav Chaudhary
+44(20)7051-3063 |
manav.chaudhary@gs.com
Goldman Sachs International

- We expect strong global growth this year, given firm current momentum, easing financial conditions, and supportive fiscal policy. But high asset valuations and the prospect of labor market overheating suggest that the recent strength might be "too much of a good thing" further down the road.
- We revamp our cross-country recession model to gauge the risk of a downturn across major advanced economies with our proprietary indicators. At short horizons of less than a year, weak growth momentum (as measured with our CAIs) and tightening financial conditions are the best recession predictors. At longer horizons, output above potential, and unusually accommodative FCI levels signal recession risk.
- Our model suggests that near-term recession risk is low. The probability of a downturn is also below normal over the next 2-3 years, but has been rising steadily in economies that are seeing unusually easy financial conditions and tightening labor markets. These include the US, Germany, the UK and a number of smaller G10 economies (such as Canada and Sweden). Medium-term recession risk, in contrast, remains subdued in countries with remaining slack, including Spain, Italy and France.
- Although our model is subject to a number of caveats, it confirms that we need to worry little about recession risk this year. But our analysis suggests that we should pay attention to measures of imbalances that signal rising recession risk further down the road. Our new recession model provides a tool to track these risks in real time.

The world economy has continued to grow very strongly. Our global current activity indicator (CAI) stands at 5.1% in December, after 5.6% in November. Financial conditions have continued to ease, providing a continued boost to growth across the globe (Exhibit 1). Fiscal policy has also turned expansionary with the US tax cuts, boosting growth by an estimated 0.4 percentage points (pp) across the large advanced economies this year. Given strong momentum and positive growth impulses from financial conditions and fiscal policy in advanced economies, we are optimistic about the world economy's outlook and expect global growth of 4.1% this year, with risks that still seem skewed to the high side.

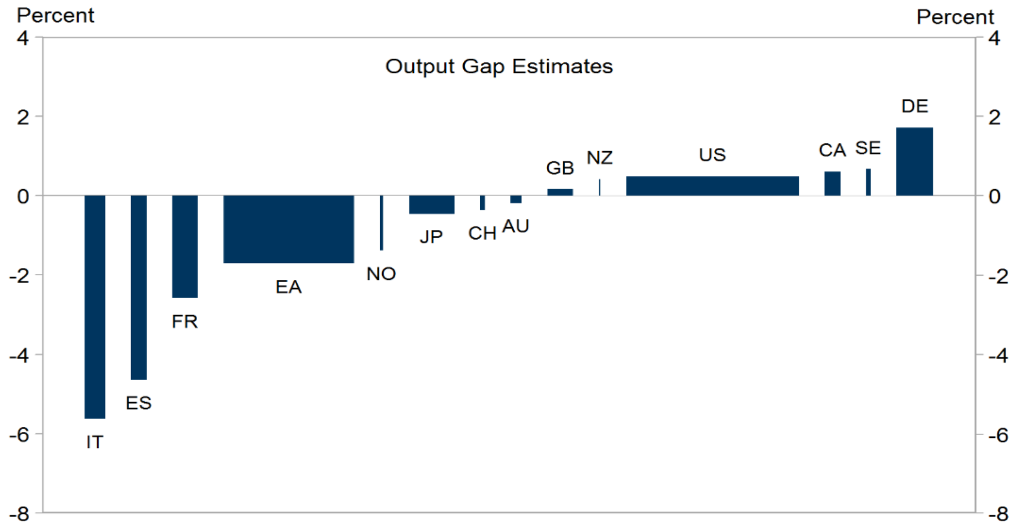
Exhibit 1: Financial Conditions Have Continued to Ease



Source: Goldman Sachs Global Investment Research

But early signs of overheating are beginning to emerge in a number of advanced economies. Although inflation has generally remained low, our analysis suggests that slack is diminishing rapidly across DM economies. We estimate that the US, Germany, the UK and a number of smaller G10s (including Canada, Sweden and New Zealand) have already moved past full employment (Exhibit 2). The global risk rally—with the S&P hitting new all-time highs day after day—has pushed our FCIs to unusually accommodative levels. Our global FCI, for example, is now at the most accommodative level since mid-2013. Overheating labor markets and stretching valuations could soon be "too much of a good thing," and might raise the probability of a risk further down the road.

Exhibit 2: Slack is Diminishing



Source: Goldman Sachs Global Investment Research

A New Cross-Country Recession Model

We revisit our global recession model to gauge the risk of recession across the advanced economies.[1] Our revamped model is similar in spirit to our previous approach in using economic and financial variables to predict recessions across major advanced economies. Using cross-country information adds statistical power (as recessions are rare events) and provides us with estimated recession probabilities for multiple economies. We again exclude emerging markets, which typically feature very different business cycles from the advanced economies.

But our new model differs from our previous work in a number of dimensions.

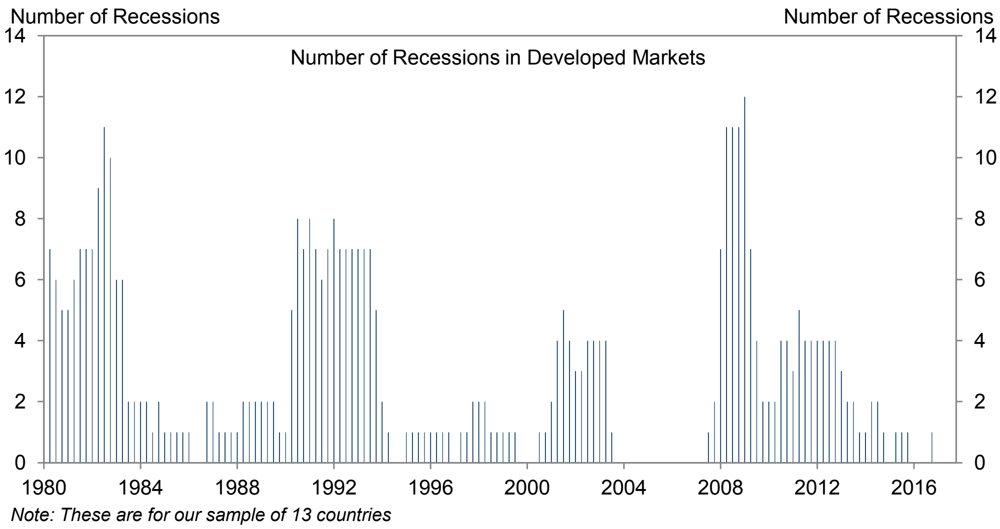
First, we put greater emphasis on our proprietary indicators to gauge recession risk. We include four domestic explanatory variables : (1) growth momentum, measured with our CAIs relative to our estimate of potential growth; (2) slack, measured with our output gap estimates;[2] (3) changes in financial conditions, measured with the year-over-year change in our FCIs; and (4) FCI levels, expressed in deviations from a five-year centered moving average. Using our proprietary indices has the advantage that they are much more timely than national-source data such as GDP, and this helps us monitor recession risk at a higher frequency.

Second, we now use the recession definitions published by the Economic Cycle Research Institute (ECRI). The ECRI follows the methodology of the US National Bureau of Economic Research (NBER) in timing troughs and peaks of the economic cycle. Exhibit 3 shows the implied number of recessions in our sample.

[1] For details of our earlier model, see Jan Hatzius, Sven Jari Stehn and David Mericle, "Doing the Numbers on DM Recession Risk," *Global Economics Analyst*, February 5, 2016.

[2] For details of our potential growth estimates in DM economies, see Sven Jari Stehn, "From Demand to Supply: Our New G10 Output Gap Estimates," *Global Economics Analyst*, November 5, 2017.

Exhibit 3: Counting Recessions



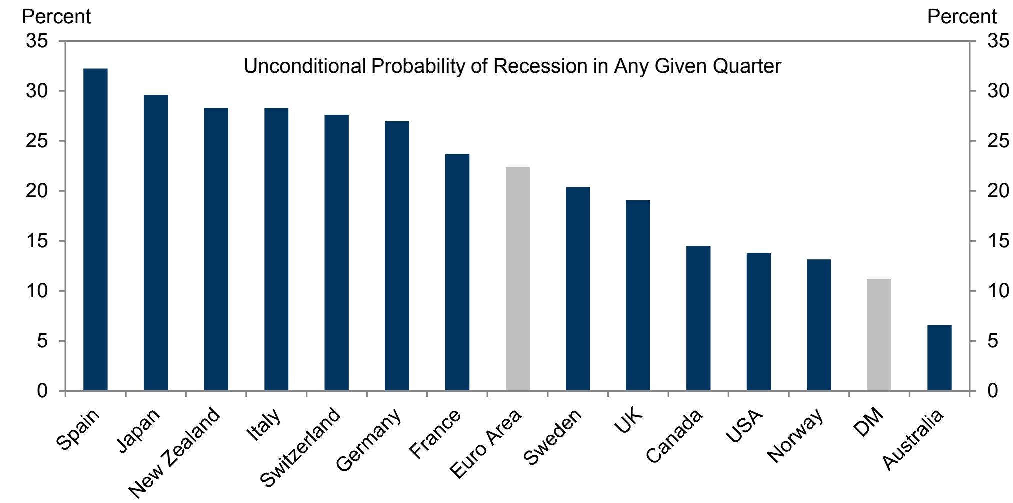
Source: Haver Analytics, Goldman Sachs Global Investment Research

Using these recession quarters, we construct recession "alarm" indicators for different horizons, including the current quarter, the next year, the next two years and the next three years (all of which include the current quarter). For example, the "next year" indicator would cover the incidence of a recession in 2018.[3]

Exhibit 4 shows the implied unconditional probabilities of being in recession in any given quarter since 1980. The main take-away is that unconditional recession probabilities are sizable. For the US economy, for example, the unconditional probability of being in recession is 14% in any given quarter, and as high as 31% over any given two years (not shown). Moreover, unconditional recession probabilities vary significantly across countries. For example, Italy and Japan have had high average recession risk—partly because of low potential growth—whereas the US and Australia have had relatively low recession risk.

[3] The one-year alarm, for example, is equal to 0 in general, but switches to 1 four quarters before the start of a recession; it remains at 1 until the end of the recession episode. The two-year alarm switches to 1 eight quarters before the start of the recession, and so on.

Exhibit 4: Unconditional Recession Risk Across Countries



Note: We define DM and Euro Area recessions as when 50% or more of the constituent countries (PPP weighted) are in recession.

Source: Goldman Sachs Global Investment Research

Third, we explicitly take into account the cross-country correlation of recession risk. Exhibit 5 shows that recessions are generally correlated positively across advanced economies. The correlation pattern, however, differs across countries: recession risk in Sweden, for example, appears highly correlated with foreign downturns, while the correlation is much lower in Japan. We try to capture this pattern by including the export-weighted foreign output gap in each country's recession model. Moreover, we interact the foreign output gap with the trade openness of the home country in an attempt to capture the cross-country pattern of correlations in Exhibit 5.

Exhibit 5: Recessions are Correlated across Countries

	AU	CA	CH	DE	ES	FR	GB	IT	JP	NO	NZ	SE	US
AU	1.0	0.5	0.3	0.2	0.1	0.1	0.3	0.1	-0.2	0.1	0.3	0.5	0.3
CA	0.5	1.0	0.5	0.4	0.4	0.2	0.5	0.3	-0.1	0.2	0.3	0.6	0.6
CH	0.3	0.5	1.0	0.6	0.2	0.3	0.2	0.2	0.2	0.0	0.0	0.5	0.4
DE	0.2	0.4	0.6	1.0	0.3	0.4	0.3	0.4	0.3	-0.1	-0.1	0.7	0.5
ES	0.1	0.4	0.2	0.3	1.0	0.6	0.5	0.7	0.2	-0.1	0.0	0.5	0.3
FR	0.1	0.2	0.3	0.4	0.6	1.0	0.2	0.5	0.3	-0.1	0.0	0.4	0.2
GB	0.3	0.5	0.2	0.3	0.5	0.2	1.0	0.2	0.0	0.1	0.1	0.5	0.3
IT	0.1	0.3	0.2	0.4	0.7	0.5	0.2	1.0	0.2	-0.1	0.0	0.6	0.3
JP	-0.2	-0.1	0.2	0.3	0.2	0.3	0.0	0.2	1.0	-0.2	-0.1	0.0	0.1
NO	0.1	0.2	0.0	-0.1	-0.1	-0.1	0.1	-0.1	-0.2	1.0	0.3	0.0	0.2
NZ	0.3	0.3	0.0	-0.1	0.0	0.0	0.1	0.0	-0.1	0.3	1.0	0.2	0.3
SE	0.5	0.6	0.5	0.7	0.5	0.4	0.5	0.6	0.0	0.0	0.2	1.0	0.6
US	0.3	0.6	0.4	0.5	0.3	0.2	0.3	0.3	0.1	0.2	0.3	0.6	1.0

Source: Haver Analytics, Goldman Sachs Global Investment Research

Fourth, we now use simpler statistical techniques to estimate our recession model (replacing the "probit" specification with a linear probability model). The advantage of our new approach is that the estimated coefficients are much easier to interpret.[4] We include country-specific "dummy" variables to capture local average recession risk. We estimate our model using quarterly data for 13 advanced countries since the mid-1970s.

Predictors of Recession

Exhibit 6 shows our results. The first row for each variable in the table shows its economic importance and the second row shows the statistical significance (summarized with the t-statistic and asterisks that denote statistical significance).

Exhibit 6: Our Estimated Model

Recession Probability Model	1Q	4Q	8Q	12Q
Deviation of CAI From Trend (pp)	-2.4	-3.6	-3.3	-2.6
	[-7.8]**	[-8.5]**	[-6.5]**	[-4.7]**
Lagged Output Gap (% of GDP)	0.5	1.1	2.0	2.7
	[2.0]**	[3.0]**	[4.6]**	[5.5]**
FCI change (yoy, pp)	0.9	2.2	4.0	5.7
	[1.7]*	[2.8]**	[4.3]**	[5.6]**
Deviation of FCI from Trend (pp)	0.5	-1.0	-4.4	-8.2
	[0.6]	[-0.8]	[-3.0]**	[-5.2]**
Foreign Output Gap * Openness (lagged, pp)	0.1	0.2	0.3	0.3
	[5.6]**	[9.5]**	[11.6]**	[11.3]**

Note: The figures in the square brackets are the t-statistics for the point estimates, and highlight significance at the 10% (*) and 5% (**) level.

Source: Goldman Sachs Global Investment Research

Our main results are as follows.[5] First, the state of the domestic cycle matters. Above-trend growth lowers recession risk while overheating raises the chance of a downturn. The effect of current growth momentum is stronger for the risk of near-term recession; but the output gap matters more for future recessions. For example, one-year recession risk is just over 3½pp lower for every one percentage point that the CAI exceeds trend. But two-year recession risk is 2pp higher for every one percentage point of overheating today.

Second, the change in financial conditions is a powerful recession predictor. Specifically, we find that FCI easing lowers recession risk. Thus, while the markets frequently sound false alarms, ignoring them entirely would be a grave mistake. For example, a 100bp easing in financial conditions over the last year lowers the chance of one-year-ahead recession by just over 2pp. The year-over-year change in the FCI closely resembles our FCI impulse.

Third, the level of financial conditions holds additional information. Accommodative financial conditions (relative to a moving average) suggest that recession risk is typically elevated. This effect operates through recession risk further out: if financial conditions

[4] The new approach also eliminates the bias in panel probit models with fixed effects.

[5] If the country was already in recession in the previous quarter, then this raises substantially the probability of being in recession in the current quarter. We do not report this effect in the Exhibit, and focus instead on the most important drivers, assuming that the economy is not already in recession.

are 100bp easier, the three-year recession probability rises by more than 8pp. In effect, one might say that our FCI is a financial analogue to the output gap: near-term strength reduces the chance of a downturn but a very strong level (relative to the long-term average) indicates a potential overheating that must be reversed, with adverse effects on financial markets and the real economy.

Fourth, foreign overheating matters for domestic recession risk. We find that the trade-weighted foreign output gap has a small, but statistically significant effect on domestic recession risk. Moreover, the strength of this relationship varies with the openness to trade; for example, German recession risk depends much more on the foreign cycle than US recession risk does.

We note that neither the age of the recovery nor the depth of the previous recession matter once the other variables in the model—especially the output gap—are included.

Recession Risk is Low…For Now

Exhibit 7 shows the estimated recession risks for the current quarter, and the next 4, 8, and 12 quarters for all the individual economies in our model. We also include the unconditional risks of recession at each horizon, which differ substantially across countries.[6] We truncate the recession probability estimates outside the 95% range as our confidence in their accuracy is low (showing, for example, <2.5% for very low probabilities).[7] We also provide joint probabilities for a Euro area recession (proxied with the 'big four' member states) and for recession risk across the majority of advanced economies.[8] Exhibit 8 decomposes the current recession probability into contributions from the explanatory variables included in the model.

[6] These differences are explained by factors such as the trend rate of growth, and volatility of growth.

[7] Since we use a linear model, rather than one tailored to probabilities that lie between 0 and 1, it is possible that extreme readings of the explanatory variables lead to implied recession probabilities of less than 0 or greater than 1. In these circumstances the model may not capture the true effect of the drivers on the recession risk. Reassuringly, this happens relatively infrequently, so this problem is not severe in practice.

[8] If enough countries in an area enter into recession at once, then the area as a whole may be tipped into recession. We consider all the possible combinations of countries which would satisfy this requirement, and use our assessment of risk for each country, to evaluate the risk for the area as a whole.

Exhibit 7: Recession Risk is Low…

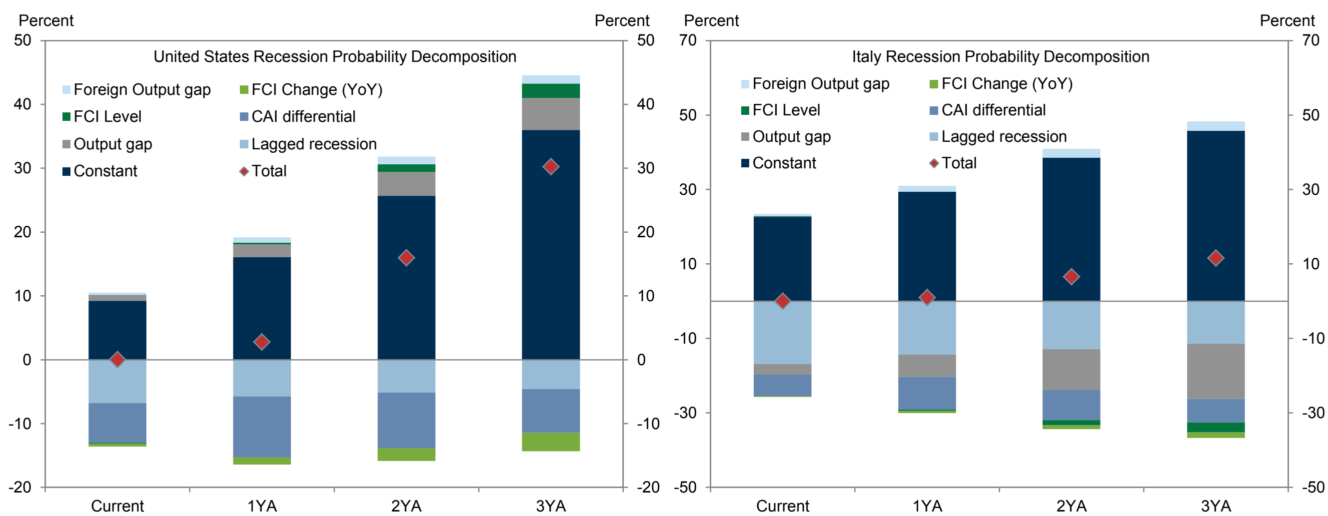
Recession Probabilities	1Q		4Q		8Q		12Q	
	Current	Average	Current	Average	Current	Average	Current	Average
US	<2.5	14	5	22	19	31	34	40
Japan	4	30	21	44	38	56	52	66
Euro Area*	<2.5	28	<2.5	36	7	45	12	52
Germany	<2.5	24	<2.5	33	4	44	12	55
France	<2.5	24	9	34	21	49	32	60
Italy	<2.5	28	<2.5	36	7	45	12	52
Spain	<2.5	32	<2.5	38	5	44	10	51
UK	4	19	12	24	23	30	32	37
Sweden	<2.5	20	4	25	15	31	26	38
Norway	<2.5	13	16	31	28	45	37	55
Switzerland	10	28	23	38	33	51	41	61
Canada	5	14	17	21	30	28	40	35
Australia	<2.5	7	7	11	12	17	15	22
New Zealand	7	28	20	40	32	51	42	60
Developed Markets*	<2.5	11	<2.5	20	12	29	27	36

**We define DM and Euro Area recessions as when 50% or more of the constituent countries (PPP weighted) are in recession.*

Source: Goldman Sachs Global Investment Research

Our model confirms that the risk of near-term recession is low across all advanced economies. For example, the one-year probability of recession is 5% in the US (compared with the unconditional risk of 22%), < 2.5% in the Euro area (versus 33%) and 21% in Japan (versus 44%). The decompositions for the US and Italy in Exhibit 8 show that—in general terms—recession risk is low primarily because growth momentum is strong and FCI impulses are positive. But while slight overheating in the US pushes up the risk in two to three years' time, the large negative output gap in Italy weighs down on risks over the same horizon.

Exhibit 8: …Owing to Strong Growth and Easing FCIs

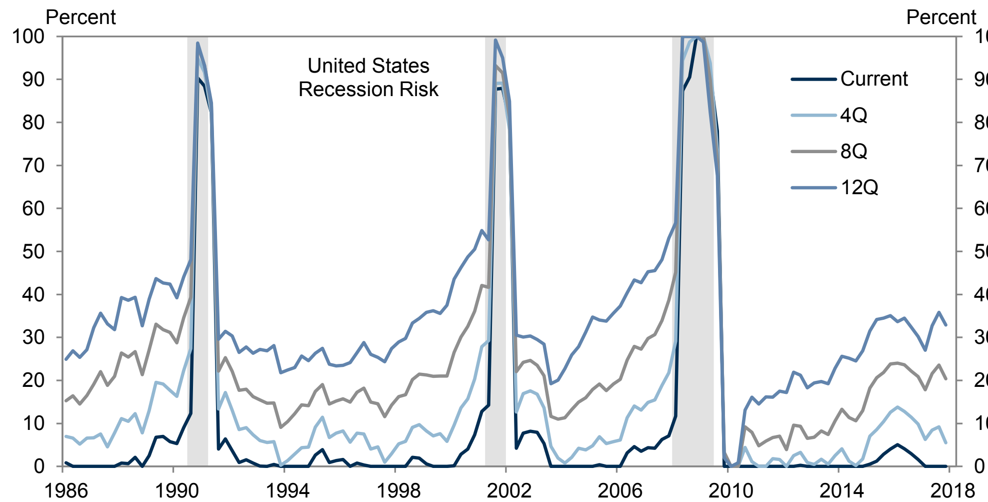


Note: the stacked bars show the contribution of individual variables to the overal conditional recession risk.

Source: Goldman Sachs Global Investment Research

Recession risk over the next 2-3 years is also below normal across the advanced economies. But Exhibit 9 shows that the medium-term risk has been rising steadily in the US given easy financial conditions and a tightening labor market. This is similar in the UK, Germany and a number of smaller G10 economies (including Canada and Sweden). Exhibit 10 shows that medium-term recession risk, in contrast, remains subdued in the Euro area, because southern Europe is still operating below capacity.

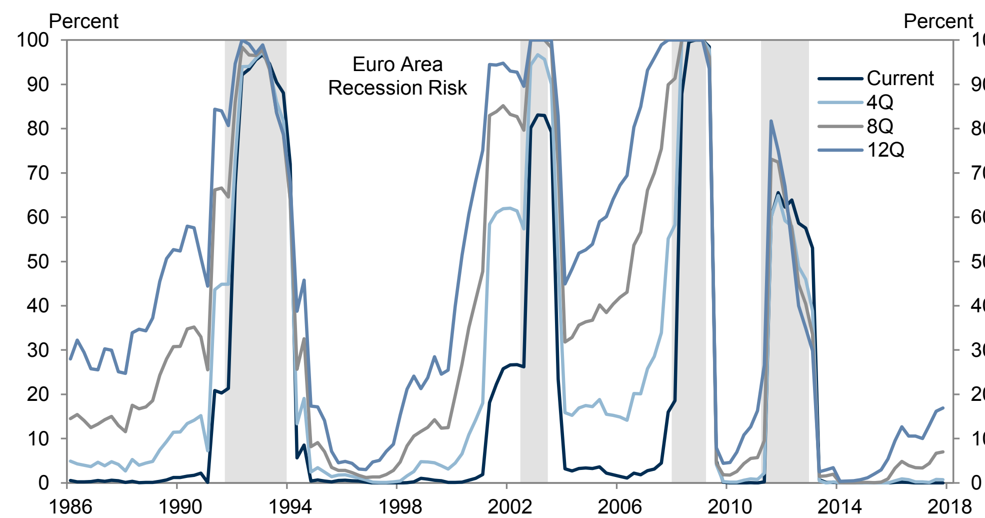
Exhibit 9: But 2-3 Year Risk is on the Rise in the US…



Note: Grey bars indicate recessions

Source: Haver Analytics, Goldman Sachs Global Investment Research

Exhibit 10: …Although Still Low in the Euro Area



Note: (i) Euro area recession is defined as at least 50% of EMU4 (PPP weighted) being in a recession, and (ii) grey bars denote recessions.

Source: Haver Analytics, Goldman Sachs Global Investment Research

Exhibits 9 and 10 suggest that the fit of the model is good. In general, recession risk was high before and during past recessions but not otherwise.[9] It is, however, important

[9] This is echoed by more formal comparisons of actual recessions to the predicted risk.

to stress a few caveats. First, the out-of-sample performance of the model may not match the in-sample fit. This is partly because the model is estimated using revised rather than first-release data and, more broadly, because no two recessions are the same. Second, our model does not capture a number of other risks, such as the effects of uncertainty or political instability. As a result, our recession probabilities might be understated for Italy (given the Italian elections) and the UK (in light of Brexit uncertainties).

With these caveats in mind, we conclude that we need to worry little about recession risk this year. But our results suggest that we should pay attention to measures of imbalances that signal rising recession risk further down the road. Our new recession model provides a tool to track these risks in real time.

Nicholas Fawcett

Sven Jari Stehn

Manav Chaudhary

Global Economic Forecasts

Real GDP Growth (YoY)	2016	2017	2018	2019
World	3.1	3.8	4.1	4.0
Advanced Economies	1.7	2.3	2.4	2.0
Emerging Markets	4.5	5.1	5.5	5.6
G3				
United States	1.5	2.3	2.7	2.1
Euro area	1.8	2.3	2.2	1.8
Germany	1.9	2.6	2.5	2.0
France	1.1	1.8	2.0	1.8
Italy	1.1	1.5	1.1	0.9
Spain	3.3	3.1	2.5	2.2
Japan	0.9	1.8	1.6	1.3
Advanced Economies				
Australia	2.5	2.3	3.2	2.8
Canada	1.4	3.0	2.2	1.6
New Zealand	3.0	2.6	3.1	2.9
Norway	1.0	2.2	1.9	1.9
Sweden	3.0	2.7	3.0	2.6
Switzerland	1.4	1.0	1.8	1.8
United Kingdom	1.8	1.5	1.3	1.6
Asia				
China	6.7	6.8	6.5	6.1
India	7.9	6.2	7.6	8.4
CEEMEA				
Russia	-0.2	2.2	3.3	2.9
Turkey	3.2	7.0	3.5	3.5
Latin America				
Brazil	-3.5	1.1	2.7	3.1
Mexico	2.9	2.1	2.1	3.1

Core CPI Inflation (YoY)	2016	2017	2018	2019
G3				
United States (core PCE)	1.8	1.5	1.7	1.9
Euro area	0.9	1.0	0.9	1.2
Germany	1.1	1.3	1.2	1.5
France	0.6	0.6	0.8	0.9
Italy	0.5	0.8	0.4	1.1
Spain	0.7	1.3	1.1	1.6
Japan (ex freshfood)	-0.3	0.5	1.0	1.0
Advanced Economies				
Norway	3.1	1.4	2.1	2.3
United Kingdom	1.3	2.4	2.2	2.0

Policy Rate (%)	2016	2017	2018	2019
G3				
United States	0.5	1.3	2.4	3.4
Euro area	0.0	0.0	0.0	0.0
Japan	-0.1	-0.1	-0.1	-0.1
Advanced Economies				
Australia	1.5	1.5	2.0	2.5
Canada	0.5	1.0	2.0	3.0
New Zealand	1.8	1.8	2.0	2.5
Norway	0.5	0.5	1.0	1.8
Sweden	-0.5	-0.5	0.3	0.8
Switzerland	-0.8	-0.8	-0.8	-0.5
United Kingdom	0.3	0.5	0.8	1.0
Asia				
China	2.6	3.3	3.0	2.8
India	6.3	6.0	6.5	6.8
CEEMEA				
Russia	10.0	7.8	6.8	5.5
Turkey	8.5	12.8	14.3	12.5
Latin America				
Brazil	13.8	7.0	6.8	8.0
Mexico	5.8	7.3	7.3	6.0

Source: Goldman Sachs Global Investment Research

Disclosure Appendix

Reg AC

We, Jan Hatzius, Sven Jari Stehn, Nicholas Fawcett and Manav Chaudhary, 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

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 equity 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; Goldman Sachs AG and Goldman Sachs International Zweigniederlassung Frankfurt, regulated by the Bundesanstalt für Finanzdienstleistungsaufsicht, may also distribute research in Germany.

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 (http://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.

The analysts named in this report may have from time to time discussed with our clients, including Goldman Sachs salespersons and traders, or may discuss in this report, trading strategies that reference catalysts or events that may have a near-term impact on the market price of the equity securities discussed in this report, which impact may be directionally counter to the analyst's published price target expectations for such stocks. Any such trading strategies are distinct from and do not affect the analyst's fundamental equity rating for such stocks, which rating reflects a stock's return potential relative to its coverage group as described herein.

We and our affiliates, officers, directors, and employees, excluding equity and credit analysts, 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.

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 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 disclosure documents which are available from Goldman Sachs sales representatives or at http://www.theocc.com/about/publications/character-risks.jsp. 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.