US Rates Watch

Monthly rates models: Feb '24 edition

February rates models update

We update some of the rates models we use to gauge risk bias, positioning, and relative value across duration, curve, real yields, breakevens, and front-end spreads. Nominal yields continue to trade in a relatively tight range around fundamental fair value. Real yields look rich and breakevens wide. SOFR is likely to continue to trend higher, leading to tightening of the SOFR/FF basis. Portfolios were broadly risk-on over 4Q23 and stayed positive risk into early '24 with a bias towards carry.

Duration & curve

Fair value for 10yT is c.4.1% currently, that is c.15-35bp lower over the last couple of months. 10yT yields trade in line with fair values, pricing a soft-landing scenario almost to perfection. On the curve, the frontend drives progressively less of the 2s10s dynamic over the last 2 months. In 5s30s, the belly continues to lead. The curve dynamic reflects neutral rate expectations c.3-3.25%.

Breakevens, TIPS & real yields

10y BE trade c.10-15bp wide vs fundamentals. BE dynamic suggests expectations for a recoupling of inflation and growth fundamentals. 10y RY trade c.20bp rich vs our macro framework. The BE dynamic over last month suggests even likelihoods of expansion (resilience or reacceleration) vs. lower growth (soft- or hard-landing) scenarios.

Front end

We update our forecasts for SOFR/FF basis. We equally weight 3 regression outputs of SOFR-IORB spread vs Fed liquidity to GDP from 3 liquidity periods: (1) 3Q20-1Q21= ON RRP take-up < $200b, (2) 2Q21-2Q23 = ON RRP take-up > $200b, (3) 3Q23 to today = recent period of rapid ON RRP decline.

Allocations

Gauges of risk appetite show risk-on bias, albeit with a slight downgrade of momentum over the last couple of months (e.g., from 60% in Dec to 54% currently in our futures positioning monitor). Bias for carry seems to persist to some extent.

Refer to important disclosures on page 10 to 11.

12654955

Timestamp: 05 February 2024 06:33AM EST

05 February 2024

Rates Research
United States

Bruno Braizinha, CFA
Rates Strategist
BofAS
bruno.braizinha@bofa.com

Anna (Caiyi) Zhang
Rates Strategist
BofAS
caiyi.zhang@bofa.com

Katie Craig
Rates Strategist
BofAS
katie.craig@bofa.com

Glossary

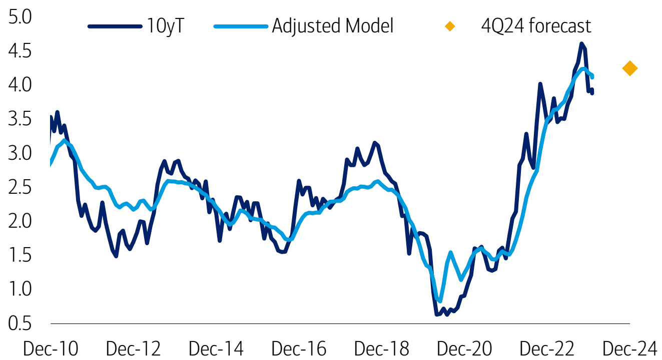
10y – 10-year
10yT – 10-year Treasury
BE – Breakeven
c. – circa
DM – Developed Markets
EM – Emerging Markets
EFFR – Effective Federal Funds Rate
ETF – Exchange Traded Funds
FF – Fed funds
GDP – Gross Domestic Product
IORB – Interest Rate on Reserve Balances
LC – Large Cap
ON RRP – Overnight Reverse Repo facility
PCA – Principal Component Analysis
QT – Quantitative Tightening
RV – Relative Value
RY – Real Yield
SC – Small Cap
SOFR – Secured Overnight Financing Rate
VAR – Vector Auto-Regressive

Duration

Macro model

Exhibit 1: 10yT macro fair value

10yT fair value consistent with current fundamentals c.4.1%



Source: BofA Global Research; Bloomberg

BofA GLOBAL RESEARCH

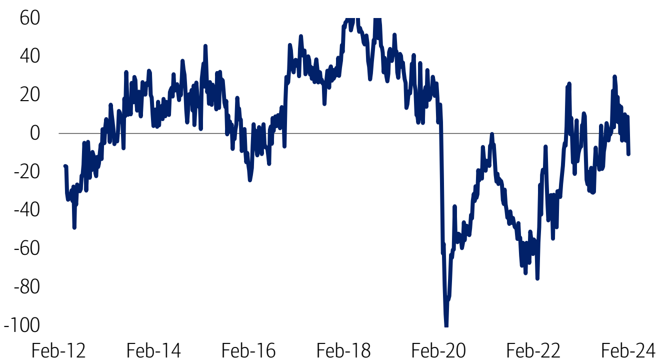
Our macro framework suggests that the 10yT fair value consistent with current US fundamentals is c.4.1-%. This is roughly 15bp lower over the last couple of months (see the report, Monthly rates models: Dec '23 edition).

Treasury yields trade just marginally rich vs fundamentals, after an excursion away from fair values where we saw up to 75bp of cheapness at the peak in mid-October.

Global yield framework

Exhibit 2: Residual of 10yT Global yield model

10yT fair value consistent with current global yields c.4.05%



Source: BofA Global Research

BofA GLOBAL RESEARCH

10yT fair value consistent with global yields is c.4.05%. This is c.35bp lower over the last couple of months.

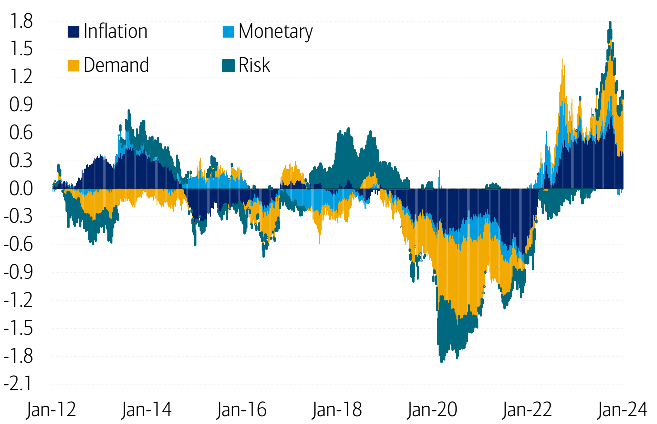
The late-cycle bias should be for USTs to trade fair to rich to global yields. In this framework, a more significant 10yT selloff beyond fair value levels likely needs to be supported by either: (1) a broader bearish momentum in global yields; or (2) a decoupling of US growth with the DM complex.

The 10yT yields are trading c.5bp rich relative to the global yield dynamic.

Decomposition of the 10yT dynamic

Exhibit 3: Decomposition of the 10yT dynamic

Monetary policy c.0bp, Risk c.10bp; Inflation c.40bp & Demand c.60bp



Source: BofA Global Research

BofA GLOBAL RESEARCH

Steady state is up from c.2% in early 2022 to 2.7% currently, suggesting an upgrade of the neutral rate view. We expect it to increase further towards c.2.75-3%

Current shocks:

- Monetary policy c.0bp, steady in the last couple of months
- Risk c.10bp; steady in the last couple of months
- Inflation c.40bp, +5bp in the last couple of months
- Demand c.60bp, -5bp in the last couple of months.

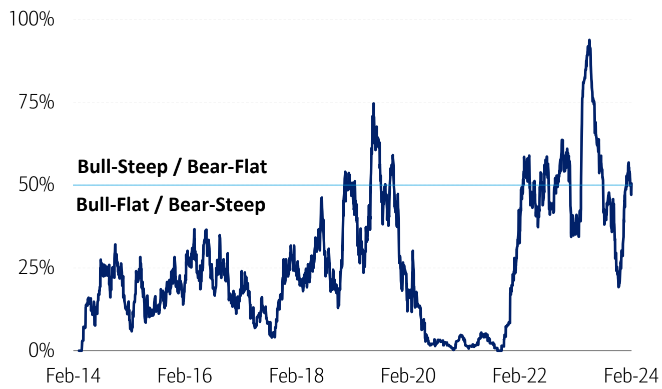
The moves reflect some buildup of inflation shock over the last couple of months, and some upgrade of demand. Risk backdrop expressed in the dynamic of yields has remains relatively flat, and monetary policy on-hold.

Curve

Curve directionality

Exhibit 4: 2s10s directionality Index

Frontend driving progressively less of the curve dynamic over the last 2 months



Source: BofA Global Research

BofA GLOBAL RESEARCH

Front-end drives 30% of the 2s10s curve dynamic over the last two weeks, down from 48% over the last month. Frontend (bull steepening and bear flattening moves) driving progressively less of the curve dynamic over the last 2 months.

Exhibit 5: Decomposition of the 2s10s dynamic

Frontend (bull steepening and bear flattening moves) driving progressively less of the curve dynamic over the last 2 months

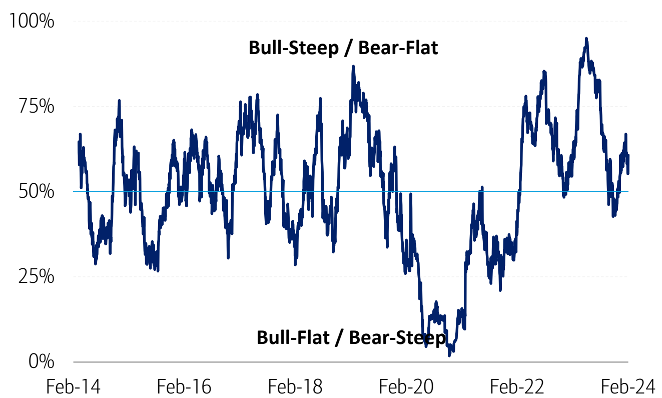
	bull-Steep	bear-Flat	bull-Flat	bear-Steep
2w	11%	19%	44%	26%
1m	21%	27%	21%	31%
2m	25%	25%	20%	30%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 6: 5s30s directionality Index

Frequency of bull steepening moves increased at backend



Source: BofA Global Research

BofA GLOBAL RESEARCH

Belly drives 66% of the 5s30s curve dynamic over the last two weeks, marginally up from 64% over the last month. The bias belly to outperform is fading, however, with a decrease of bull steepening frequencies & an increase of bear flattening.

Exhibit 7: Decomposition of the 5s30s dynamic

Belly continues to lead the dynamic

	bull-Steep	bear-Flat	bull-Flat	bear-Steep
2w	34%	32%	23%	10%
1m	37%	27%	18%	18%
2m	36%	25%	20%	19%

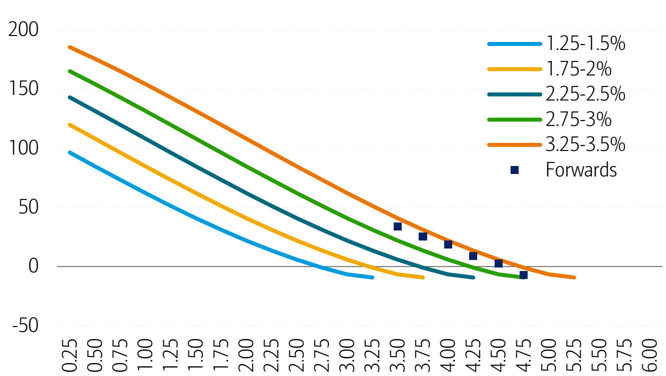
Source: BofA Global Research

BofA GLOBAL RESEARCH

Flattening dynamic in the cycle vs neutral rate view

Exhibit 8: 2s10s bull steepening dynamic vs neutral rate view

Curve levels (y-axis) vs fed funds (x-axis) ... curve forwards consistent with neutral rate expectations c.3-3.25%%



Source: BofA Global Research

BofA GLOBAL RESEARCH

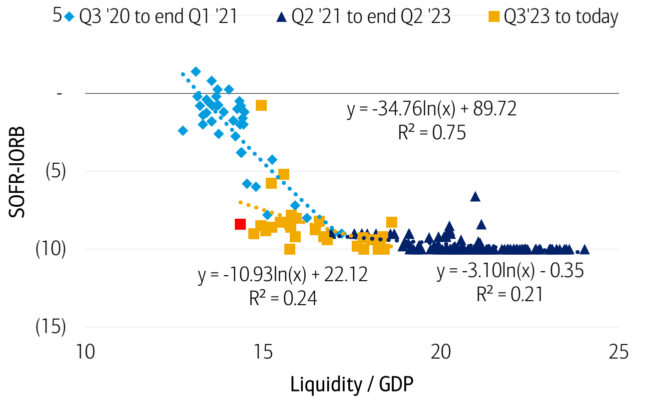
The 2s10s bull steepening trajectory priced in curve forwards vs 3m OIS fwds seems to be consistent with a neutral rate assumption around 3-3.25%.

Front end

SOFR/FF basis

Exhibit 9: SOFR-IORB spread versus Liquidity / GDP

As liquidity has declined, SOFR has begun to print higher in the range



Source: BofA Global Research, Bloomberg, FRB. Note, red dot implies latest week of data

BofA GLOBAL RESEARCH

We update our regression forecast for SOFR-IORB spread using a log linear regression of ON RRP + Fed Reserves (Fed liquidity) over GDP. We break out the regression into 3 periods, (1) 3Q20-1Q21: ON RRP take-up < $200b, (2) 2Q21-2Q23: ON RRP take-up > $200b, (3) 3Q23 to today: recent rapid ON RRP decline.

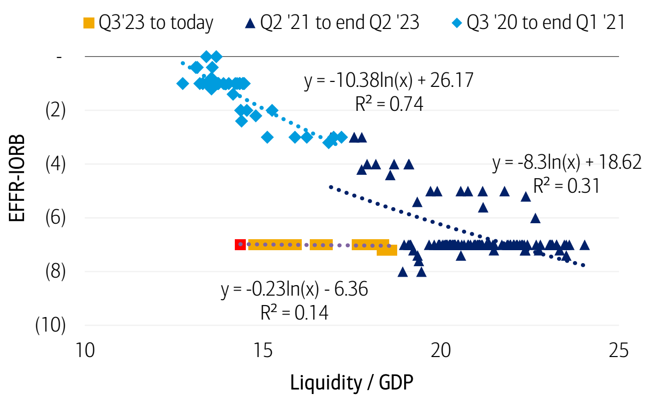
We have begun to see SOFR print higher as liquidity drained via QT, primarily on large settlement dates. High yellow dot is the week around end '24 where we see upward pressure in SOFR.

The most recent data point, in the red dot, shows that even at the lowest level of liquidity to GDP, we are not yet at the steeper part of the curve that we observed in the lower RRP take-up period of 3Q20 to 1Q21.

We expect to see liquidity continue to decline going forward, which should continue to put upward pressure on SOFR.

Exhibit 10: EFFR-IORB spread vs Liquidity / GDP

EFFR has been sticky despite liquidity drain



Source: BofA Global Research, Bloomberg, FRB. Note, red dot indicates latest week of data

BofA GLOBAL RESEARCH

We also updated our regression forecast for EFFR-IORB spread. We use a log linear regression of ON RRP + Fed Reserves (Fed liquidity) over GDP. We break out the regression into three periods, 3Q20-1Q21: ON RRP take-up < $200b, 2Q21-2Q23: ON RRP take-up > $200b, and 3Q23 to today: recent period of rapid ON RRP decline.

We find that EFFR has been sticky at 7bps below IORB despite the rapid reduction in Fed liquidity since June and upward pressure in SOFR.

The 25th EFFR percentile declined in recent weeks, implying softness in the print but has since dissipated, implying that EFFR is likely to be steady here for the time being.

Going forward we expect EFFR to move upward in the range but lagged to SOFR

Exhibit 11: Regression outputs for FF-SOFR spread (bps)

Using equal weights for 3 regression periods we forecast SOFR/FF basis tightening

Date	SOFR-IORB	EFFR-IORB	FF-SOFR
Mar-2024	-5	-7	-2
Jun-2024	-5	-6	-1
Sep-2024	-3	-6	-3
Dec-2024	-3	-6	-3
Mar-2025	-4	-6	-2
Jun-2025	-4	-6	-2
Sep-2025	-1	-5	-4
Dec-2025	0	-5	-5

Source: BofA Global Research

BofA GLOBAL RESEARCH

To calculate our regression output, we equally weight the 3 regression periods (1) 3Q20–1Q21, (2) 2Q21–2Q23, (3) 3Q23 to today.

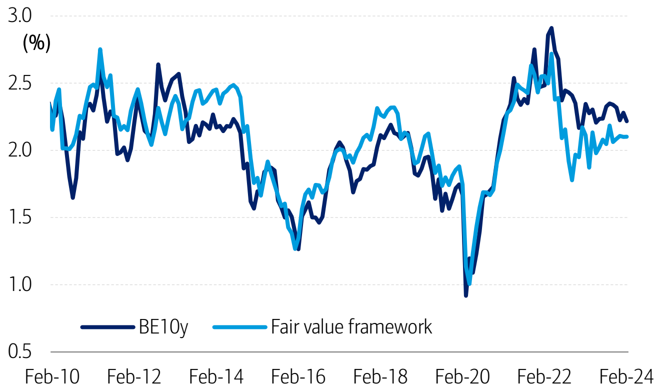
As a result, our forecasts show EFFR as stickier than SOFR, which is likely to drift higher.

The SOFR-FF basis is likely to tighten with risk of widening in 1H25 due to TGA drain from debt limit dynamics.

TIPS

Macro framework for breakevens (BEs)

Exhibit 12: Macro framework for 10y BE
10y BE fair value c.210bp, market trading wide versus fundamentals



Source: BofA Global Research; Bloomberg

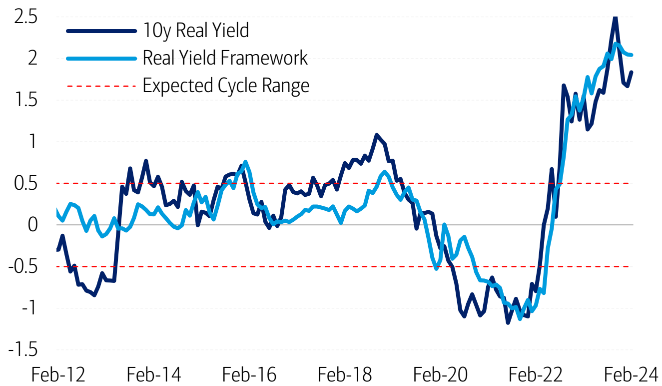
BofA GLOBAL RESEARCH

We model 10y BE as a function of inflation expectations, inflation risk premium, and inflation liquidity premium components.

US 10y breakevens fair value is c.210bp, roughly 10bp higher over the last couple of months. Market trading 10-15bp wide versus fundamentals.

Real yield (10y BE vs 10y nominal model)

Exhibit 13: 10y real yield framework
Fair value for 10y real yields in macro framework c.205bp



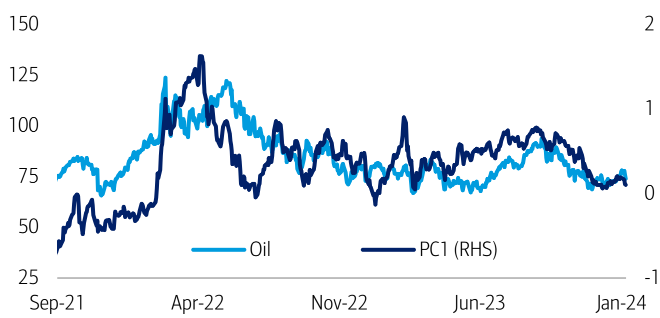
Source: BofA Global Research

BofA GLOBAL RESEARCH

US 10y real rate fair value is c.205bp, down 25bp over the last couple of months. The market is trading 10y real yields c.20bp rich to the fair value level suggested by our macro framework.

PCA on global 10y BEs

Exhibit 14: PC1 of breakeven trends well with 1st crude oil futures
Oil remains a key driver for global inflation expectations



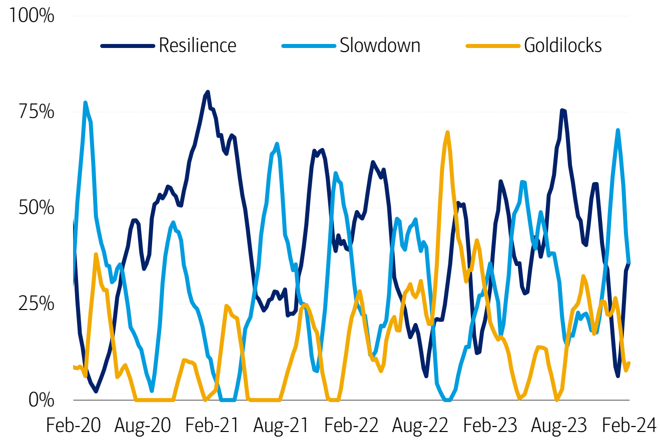
Source: BofA Global Research; PC1 = first principal component

BofA GLOBAL RESEARCH

The 1st principal component (PC) of global 10y BEs is in line with 1st crude oil futures. This suggests oil has been one of the main factors driving global inflation expectations.

Directionality of 10y BEs

Exhibit 15: Probability of slowdown vs resilience and goldilocks scenarios (2m average frequencies)
We see relatively even odds of slowdown vs expansion priced in the 10y BE dynamic over the last month



Source: BofA Global Research

BofA GLOBAL RESEARCH

10y BEs are showing a more standard directionality. Orthodox moves (bull tightening and bear widening) continue to dominate the dynamic (c.71%) but with frequencies slightly below the historical ones. This suggests market expectations for a higher correlation and causality between growth and inflation in 2023.

We see relatively even odds of slowdown vs expansion priced in the 10y BE dynamic over the last month.

Exhibit 16: 10y Breakeven directionality
Bull tightening and bear widening driving the 10yBE dynamic again

	bull-Tight	bear-Wide	bull-Wide	bear-Tight
Current	38%	33%	15%	14%
1m	36%	36%	19%	10%
2m	53%	21%	9%	17%
3m	48%	25%	8%	18%

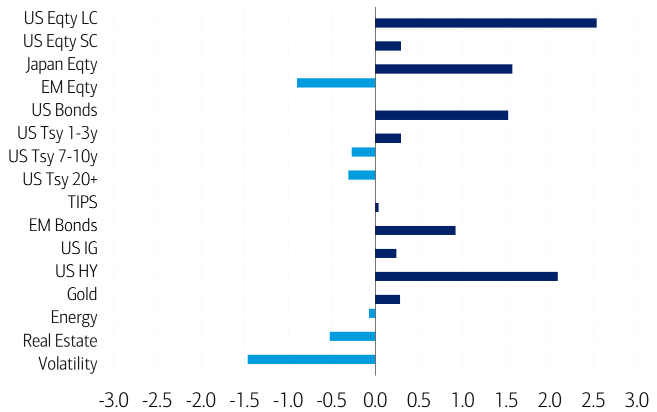
Source: BofA Global Research

BofA GLOBAL RESEARCH

Asset allocation

Flows and allocation bias

Exhibit 17: Gauge of risk profile obtained from ETF flows
Profile suggests fading of risk on bias but some bias still for a carry



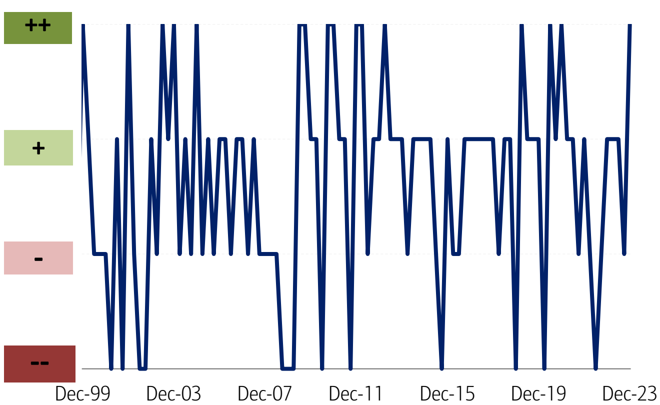
Source: BofA Global Research

BofA GLOBAL RESEARCH

Gauge of risk profile and allocations obtained from ETF flows suggests risk on bias:

- Bonds – Long bias at the fronted, short bias at the backend, marginally long TIPS, long EM bond.
- Equities – Long US LC & SC, Japan, and short in EM.
- Credit – Long IG & HY
- Alternatives – Long gold, marginally short Energy and short Real Estate
- Volatility – Short equity volatility suggesting a bias towards carry.

Exhibit 18: Regimes for quarterly performance across asset classes
US market dynamic in 4Q23 was closer to a risk-on regime



Source: BofA Global Research

BofA GLOBAL RESEARCH

Historical transition probabilities from risk-on suggest: (1) c.0% odds of a shift to risk off (hard-landing); (2) c.25% odds of a shift to moderate risk-off (soft-landing); (3) c.50-55% odds of a shift to moderate risk-on; and (4) c.20% of staying risk-on (reacceleration in the current context).

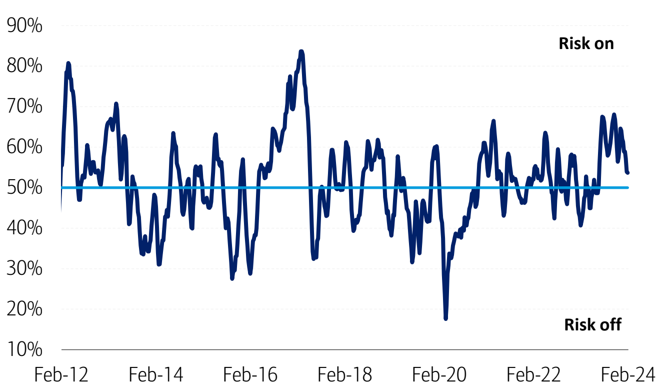
Exhibit 19: Transition probabilities between different states for the US market dynamic
From risk-on the highest transition probabilities are either into a moderate risk-on state (53%) or moderate risk-off (26%)

	--	-	+	++
--	21%	7%	21%	50%
-	19%	23%	46%	12%
+	13%	33%	46%	9%
++	0%	26%	53%	21%

Source: BofA Global Research

BofA GLOBAL RESEARCH

Exhibit 20: Positioning bias extracted from futures across assets
Risk-on bias faded only slightly over November



Source: BofA Global Research

BofA GLOBAL RESEARCH

Positioning bias extracted from futures across asset classes suggests the persistence of a risk on bias over the last couple of months c.54%, a slight downgrade from 60% in December.

Appendix: Model descriptions

Macro model

In our macro framework for the dynamic of Treasuries, we calculate the first two PCs of the rates curve (2s, 5s, 10s and 30s), and regress each of these on Fed funds (to define cycle dynamic) and the principal components of growth variables, inflation variables, and employment variables (see our report, A hitchhikers guide to RV on the UST curve).

Macro models are calibrated over long historical windows, generally longer than the average cycle length (somewhere between 7 years and 15 years) to capture the broader dynamic of Treasuries throughout the cycle. Significantly, these models tend to break down in periods of significant non-economic buying of Treasuries. We have seen several of these periods over the last couple of cycles, for example the following:

- The Greenspan conundrum, when we saw the back end of the Treasury curve rallying even as the Fed hiked rates in the early stages of the 2004-06 tightening cycle, driven foreign central bank buying.
- Quantitative easing (QE) periods, when the Fed acts as a non-economic buyer. Indeed, in general, these periods drive a negative correlation between growth and yields, and it is a challenge to avoid solutions that converge to these sorts of non-economic betas in macro frameworks for the dynamic of yields
- Global yield demand in a context of very low global yields. Indeed, global demand for USTs may be driven less by US fundamentals but more by yield differentials to other DM yields and the cost of hedging the FX exposure

To account for the pressures on the Treasury curve from these non-economic distortions, we include in our independent data set the dynamic of the Fed balance sheet and the first principal component of global DM rates. In our framework, therefore, we converge to two solutions: one whereby we express fair value consistent with US macro fundamentals alone and an adjusted framework whereby we incorporate the impact of overseas demand on the Treasury curve.

Global yield framework

This framework is an alternative approach to PCA, which addresses the shortcoming of PCA not being able to capture trends in the data to a large extent. The framework can achieve this by capturing the shared covariances in the dataset through hidden state processes and also allows for the modeling of the time-varying dynamic of these factors explicitly. In a relatively simple specification, a number of factors (determined a-priori) are defined through a given state equation:

$$x(t) = B * x(t - 1) + w(t)$$

while the independent variables are modeled as a function of these factors:

$$y(t) = Z * x(t) + v(t)$$

where:

$$w(t) \sim MVN(0, Q)\ ,\ \ v(t) \sim MVN(0, R)\ ,\ x(0) \sim MVN(X0, V0)$$

The factors (*x's*) are calibrated to explain the dynamic of the independent variables (*y's*) through the linear combinations defined by the calibrated projection matrix (*Z*). The projection matrix Z can be constrained to add more intuition to the interpretability of the factors.

Decomposition of the 10yT dynamic

In statistics, the traditional frequentist approach assumes that each parameter has a "true" value, and the goal is to find a close estimate to that (fixed) value. In contrast, the Bayesian approach views each parameter as a random variable, characterized by some underlying probabilistic distribution, along with constraints on the relative dynamic of the different parameters. The latter allows the analyst to avoid non-economic solutions, for example models where Treasury yields are negatively correlated with growth.

The vector auto-regressive framework is used to capture the relationship between multiple time series as they evolve over time, versus lagged levels. A *p*th-order VAR refers to a VAR model with a time lag for the last *p* time periods and is denoted VAR(*p*). This can be expressed as follows:

$$y(t) = a0 + A1 * y(t-1) + \ldots + Ap * y(t-p) + \varepsilon(t) \text{ with } \varepsilon(t) \sim N(0,\Sigma)$$

Where $y(t)$ is the $M \times 1$ vector of endogenous variables, $a0$ is the $M \times 1$ vector of constants, Ai is the $M \times M$ time-variant coefficient matrix, and $\varepsilon(t)$ is the $M \times 1$ exogenous factor or the error terms with a Gaussian distribution with mean zero and variance-covariance matrix Σ.

In our formulation, we adapt an existing European Central Bank (ECB) framework[1] to decompose the dynamic of 10yT yields in terms of monetary policy, demand, risk, and inflation shocks. The key in this model is to define the sign restriction priors that transform the dynamic of the underlying variables in the model (10yT yields, 5y5y inflation, real effective exchange rate for the dollar, and cyclical adjusted P/E ratios) into the shocks below (see our report, A hitchhikers guide to RV on the UST curve).

Curve directionality

One framework that adds to the understanding of the dynamic of the curve is a measure of how frequent the different modes for the curve (bull flattening, bear steepening, bear flattening, and bull steepening) have been in recent history. One can do this by constructing 4 indices, one for each mode, that measure the number of bp moves that can be attributed to that mode in a given historical window versus the sum of absolute moves on the curve over the same period. Those 4 indices can be grouped into short leg (2yT leg in the 2s10s dynamic) driven moves (adding the bear-flattening and bull steepening indices) and belly (10yT in the 2s10s dynamic) driven moves (adding bull flattening and bear steepening moves). This framework is useful to gauge the prevailing modes on the curve and understand the periods when the curve is undergoing a shift in its dynamic.

PCA on global 10y BEs

We run a 2-factor PCA on 10y breakevens across US, UK, AU, JP, EU, and CAD with at least 6 years of history. While central bank policy is certainly a factor for the global inflation market, especially around pivots or other surprises, we find that the first principal component (PC1) explains 85% of the variance in global breaks and is highly correlated with the price of oil. The second principal component of breakevens accounts for 9% of the variance, which results in a total of 94% covered by 2 factors. We find that PC2 correlates well to global financial stress and the Fed's published real rate term premium (see our report, Rates relative value update with PCA).

[1] *European Central Bank, Financial Stability Review, Nov. 2018,* www.ecb.europa.eu/pub/pdf/fsr/ecb.fsr201811.en.pdf

Disclosures

Important Disclosures

BofA Global Research personnel (including the analyst(s) responsible for this report) receive compensation based upon, among other factors, the overall profitability of Bank of America Corporation, including profits derived from investment banking. The analyst(s) responsible for this report may also receive compensation based upon, among other factors, the overall profitability of the Bank's sales and trading businesses relating to the class of securities or financial instruments for which such analyst is responsible.
BofA Securities fixed income analysts regularly interact with sales and trading desk personnel in connection with their research, including to ascertain pricing and liquidity in the fixed income markets.

Other Important Disclosures

Prices are indicative and for information purposes only. Except as otherwise stated in the report, for any recommendation in relation to an equity security, the price referenced is the publicly traded price of the security as of close of business on the day prior to the date of the report or, if the report is published during intraday trading, the price referenced is indicative of the traded price as of the date and time of the report and in relation to a debt security (including equity preferred and CDS), prices are indicative as of the date and time of the report and are from various sources including BofA Securities trading desks.
The date and time of completion of the production of any recommendation in this report shall be the date and time of dissemination of this report as recorded in the report timestamp.

This report may refer to fixed income securities or other financial instruments that may not be offered or sold in one or more states or jurisdictions, or to certain categories of investors, including retail investors. Readers of this report are advised that any discussion, recommendation or other mention of such instruments is not a solicitation or offer to transact in such instruments. Investors should contact their BofA Securities representative or Merrill Global Wealth Management financial advisor for information relating to such instruments.
Rule 144A securities may be offered or sold only to persons in the U.S. who are Qualified Institutional Buyers within the meaning of Rule 144A under the Securities Act of 1933, as amended.
SECURITIES OR OTHER FINANCIAL INSTRUMENTS DISCUSSED HEREIN MAY BE RATED BELOW INVESTMENT GRADE AND SHOULD THEREFORE ONLY BE CONSIDERED FOR INCLUSION IN ACCOUNTS QUALIFIED FOR SPECULATIVE INVESTMENT.
Recipients who are not institutional investors or market professionals should seek the advice of their independent financial advisor before considering information in this report in connection with any investment decision, or for a necessary explanation of its contents.
The securities or other financial instruments discussed in this report may be traded over-the-counter. Retail sales and/or distribution of this report may be made only in states where these instruments are exempt from registration or have been qualified for sale.
Officers of BofAS or one or more of its affiliates (other than research analysts) may have a financial interest in securities of the issuer(s) or in related investments.
This report, and the securities or other financial instruments discussed herein, may not be eligible for distribution or sale in all countries or to certain categories of investors, including retail investors.
Refer to BofA Global Research policies relating to conflicts of interest.
"BofA Securities" includes BofA Securities, Inc. ("BofAS") and its affiliates. Investors should contact their BofA Securities representative or Merrill Global Wealth Management financial advisor if they have questions concerning this report or concerning the appropriateness of any investment idea described herein for such investor. "BofA Securities" is a global brand for BofA Global Research.
Information relating to Non-US affiliates of BofA Securities and Distribution of Affiliate Research Reports:
BofAS and/or Merrill Lynch, Pierce, Fenner & Smith Incorporated ("MLPF&S") may in the future distribute, information of the following non-US affiliates in the US (short name: legal name, regulator): Merrill Lynch (South Africa): Merrill Lynch South Africa (Pty) Ltd., regulated by The Financial Service Board; MLI (UK): Merrill Lynch International, regulated by the Financial Conduct Authority (FCA) and the Prudential Regulation Authority (PRA); BofASE (France): BofA Securities Europe SA is authorized by the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers (AMF). BofA Securities Europe SA ("BofASE") with registered address at 51, rue La Boétie, 75008 Paris is registered under no 842 602 690 RCS Paris. In accordance with the provisions of French Code Monétaire et Financier (Monetary and Financial Code), BofASE is an établissement de crédit et d'investissement (credit and investment institution) that is authorised and supervised by the European Central Bank and the Autorité de Contrôle Prudentiel et de Résolution (ACPR) and regulated by the ACPR and the Autorité des Marchés Financiers. BofASE's share capital can be found at www.bofaml.com/BofASEdisclaimer; BofA Europe (Milan): Bank of America Europe Designated Activity Company, Milan Branch, regulated by the Bank of Italy, the European Central Bank (ECB) and the Central Bank of Ireland (CBI); BofA Europe (Frankfurt): Bank of America Europe Designated Activity Company, Frankfurt Branch regulated by BaFin, the ECB and the CBI; BofA Europe (Madrid): Bank of America Europe Designated Activity Company, Sucursal en España, regulated by the Bank of Spain, the ECB and the CBI; Merrill Lynch (Australia): Merrill Lynch Equities (Australia) Limited, regulated by the Australian Securities and Investments Commission; Merrill Lynch (Hong Kong): Merrill Lynch (Asia Pacific) Limited, regulated by the Hong Kong Securities and Futures Commission (HKSFC); Merrill Lynch (Singapore): Merrill Lynch (Singapore) Pte Ltd, regulated by the Monetary Authority of Singapore (MAS); Merrill Lynch (Canada): Merrill Lynch Canada Inc, regulated by the Canadian Investment Regulatory Organization; Merrill Lynch (Mexico): Merrill Lynch Mexico, SA de CV, Casa de Bolsa, regulated by the Comisión Nacional Bancaria y de Valores; Merrill Lynch (Argentina): Merrill Lynch Argentina SA, regulated by Comisión Nacional de Valores; BofAS Japan: BofA Securities Japan Co., Ltd., regulated by the Financial Services Agency; Merrill Lynch (Seoul): Merrill Lynch International, LLC Seoul Branch, regulated by the Financial Supervisory Service; Merrill Lynch (Taiwan): Merrill Lynch Securities (Taiwan) Ltd., regulated by the Securities and Futures Bureau; BofAS India: BofA Securities India Limited, regulated by the Securities and Exchange Board of India (SEBI); Merrill Lynch (Israel): Merrill Lynch Israel Limited, regulated by Israel Securities Authority; Merrill Lynch (DIFC): Merrill Lynch International (DIFC Branch), regulated by the Dubai Financial Services Authority (DFSA); Merrill Lynch (Brazil): Merrill Lynch S.A. Corretora de Títulos e Valores Mobiliários, regulated by Comissão de Valores Mobiliários; Merrill Lynch KSA Company: Merrill Lynch Kingdom of Saudi Arabia Company, regulated by the Capital Market Authority.
This information: has been approved for publication and is distributed in the United Kingdom (UK) to professional clients and eligible counterparties (as each is defined in the rules of the FCA and the PRA) by MLI (UK), which is authorized by the PRA and regulated by the FCA and the PRA - details about the extent of our regulation by the FCA and PRA are available from us on request; has been approved for publication and is distributed in the European Economic Area (EEA) by BofASE (France), which is authorized by the ACPR and regulated by the ACPR and the AMF; has been considered and distributed in Japan by BofAS Japan, a registered securities dealer under the Financial Instruments and Exchange Act in Japan, or its permitted affiliates; is issued and distributed in Hong Kong by Merrill Lynch (Hong Kong) which is regulated by HKSFC; is issued and distributed in Taiwan by Merrill Lynch (Taiwan); is issued and distributed in India by BofAS India; and is issued and distributed in Singapore to institutional investors and/or accredited investors (each as defined under the Financial Advisers Regulations) by Merrill Lynch (Singapore) (Company Registration No 198602883D). Merrill Lynch (Singapore) is regulated by MAS. Merrill Lynch Equities (Australia) Limited (ABN 65 006 276 795), AFS License 235132 (MLEA) distributes this information in Australia only to 'Wholesale' clients as defined by s.761G of the Corporations Act 2001. With the exception of Bank of America N.A., Australia Branch, neither MLEA nor any of its affiliates involved in preparing this information is an Authorised Deposit-Taking Institution under the Banking Act 1959 nor regulated by the Australian Prudential Regulation Authority. No approval is required for publication or distribution of this information in Brazil and its local distribution is by Merrill Lynch (Brazil) in accordance with applicable regulations. Merrill Lynch (DIFC) is authorized and regulated by the DFSA. Information prepared and issued by Merrill Lynch (DIFC) is done so in accordance with the requirements of the DFSA conduct of business rules. BofA Europe (Frankfurt) distributes this information in Germany and is regulated by BaFin, the ECB and the CBI. BofA Securities entities, including BofA Europe and BofASE (France), may outsource/delegate the marketing and/or provision of certain research services or aspects of research services to other branches or members of the BofA Securities group. You may be contacted by a different BofA Securities entity acting for and on behalf of your service provider where permitted by applicable law. This does not change your service provider. Please refer to the Electronic Communications Disclaimers for further information.
This information has been prepared and issued by BofAS and/or one or more of its non-US affiliates. The author(s) of this information may not be licensed to carry on regulated activities in your jurisdiction and, if not licensed, do not hold themselves out as being able to do so. BofAS and/or MLPF&S is the distributor of this information in the US and accepts full responsibility for information distributed to BofAS and/or MLPF&S clients in the US by its non-US affiliates. Any US person receiving this information and wishing to effect any transaction in any security discussed herein should do so through BofAS and/or MLPF&S and not such foreign affiliates. Hong Kong recipients of this information should contact Merrill Lynch (Asia Pacific) Limited in

respect of any matters relating to dealing in securities or provision of specific advice on securities or any other matters arising from, or in connection with, this information. Singapore recipients of this information should contact Merrill Lynch (Singapore) Pte Ltd in respect of any matters arising from, or in connection with, this information. For clients that are not accredited investors, expert investors or institutional investors Merrill Lynch (Singapore) Pte Ltd accepts full responsibility for the contents of this information distributed to such clients in Singapore.

General Investment Related Disclosures:

Taiwan Readers: Neither the information nor any opinion expressed herein constitutes an offer or a solicitation of an offer to transact in any securities or other financial instrument. No part of this report may be used or reproduced or quoted in any manner whatsoever in Taiwan by the press or any other person without the express written consent of BofA Securities.

This document provides general information only, and has been prepared for, and is intended for general distribution to, BofA Securities clients. Neither the information nor any opinion expressed constitutes an offer or an invitation to make an offer, to buy or sell any securities or other financial instrument or any derivative related to such securities or instruments (e.g., options, futures, warrants, and contracts for differences). This document is not intended to provide personal investment advice and it does not take into account the specific investment objectives, financial situation and the particular needs of, and is not directed to, any specific person(s). This document and its content do not constitute, and should not be considered to constitute, investment advice for purposes of ERISA, the US tax code, the Investment Advisers Act or otherwise. Investors should seek financial advice regarding the appropriateness of investing in financial instruments and implementing investment strategies discussed or recommended in this document and should understand that statements regarding future prospects may not be realized. Any decision to purchase or subscribe for securities in any offering must be based solely on existing public information on such security or the information in the prospectus or other offering document issued in connection with such offering, and not on this document.

Securities and other financial instruments referred to herein, or recommended, offered or sold by BofA Securities, are not insured by the Federal Deposit Insurance Corporation and are not deposits or other obligations of any insured depository institution (including, Bank of America, N.A.). Investments in general and, derivatives, in particular, involve numerous risks, including, among others, market risk, counterparty default risk and liquidity risk. No security, financial instrument or derivative is suitable for all investors. Digital assets are extremely speculative, volatile and are largely unregulated. In some cases, securities and other financial instruments may be difficult to value or sell and reliable information about the value or risks related to the security or financial instrument may be difficult to obtain. Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment. Past performance is not necessarily a guide to future performance. Levels and basis for taxation may change.

BofA Securities is aware that the implementation of the ideas expressed in this report may depend upon an investor's ability to "short" securities or other financial instruments and that such action may be limited by regulations prohibiting or restricting "shortselling" in many jurisdictions. Investors are urged to seek advice regarding the applicability of such regulations prior to executing any short idea contained in this report.

This report may contain a trading idea or recommendation which highlights a specific identified near-term catalyst or event impacting a security, issuer, industry sector or the market generally that presents a transaction opportunity, but does not have any impact on the analyst's particular "Overweight" or "Underweight" rating (which is based on a three month trade horizon). Trading ideas and recommendations may differ directionally from the analyst's rating on a security or issuer because they reflect the impact of a near-term catalyst or event.

Foreign currency rates of exchange may adversely affect the value, price or income of any security or financial instrument mentioned in this report. Investors in such securities and instruments effectively assume currency risk.

BofAS or one of its affiliates is a regular issuer of traded financial instruments linked to securities that may have been recommended in this report. BofAS or one of its affiliates may, at any time, hold a trading position (long or short) in the securities and financial instruments discussed in this report.

BofA Securities, through business units other than BofA Global Research, may have issued and may in the future issue trading ideas or recommendations that are inconsistent with, and reach different conclusions from, the information presented herein. Such ideas or recommendations may reflect different time frames, assumptions, views and analytical methods of the persons who prepared them, and BofA Securities is under no obligation to ensure that such other trading ideas or recommendations are brought to the attention of any recipient of this information.

In the event that the recipient received this information pursuant to a contract between the recipient and BofAS for the provision of research services for a separate fee, and in connection therewith BofAS may be deemed to be acting as an investment adviser, such status relates, if at all, solely to the person with whom BofAS has contracted directly and does not extend beyond the delivery of this report (unless otherwise agreed specifically in writing by BofAS). If such recipient uses the services of BofAS in connection with the sale or purchase of a security referred to herein, BofAS may act as principal for its own account or as agent for another person. BofAS is and continues to act solely as a broker-dealer in connection with the execution of any transactions, including transactions in any securities referred to herein.

Copyright and General Information:

Materials prepared by BofA Global Research personnel are based on public information. Facts and views presented in this material have not been reviewed by, and may not reflect information known to, professionals in other business areas of BofA Securities, including investment banking personnel. BofA Securities has established information barriers between BofA Global Research and certain business groups. As a result, BofA Securities does not disclose certain client relationships with, or compensation received from, such issuers. To the extent this material discusses any legal proceeding or issues, it has not been prepared as nor is it intended to express any legal conclusion, opinion or advice. Investors should consult their own legal advisers as to issues of law relating to the subject matter of this material. BofA Global Research personnel's knowledge of legal proceedings in which any BofA Securities entity and/or its directors, officers and employees may be plaintiffs, defendants, co-defendants or co-plaintiffs with or involving issuers mentioned in this material is based on public information. Facts and views presented in this material that relate to any such proceedings have not been reviewed by, discussed with, and may not reflect information known to, professionals in other business areas of BofA Securities in connection with the legal proceedings or matters relevant to such proceedings.

This information has been prepared independently of any issuer of securities mentioned herein and not in connection with any proposed offering of securities or as agent of any issuer of any securities. None of BofAS any of its affiliates or their research analysts has any authority whatsoever to make any representation or warranty on behalf of the issuer(s). BofA Global Research policy prohibits research personnel from disclosing a recommendation, investment rating, or investment thesis for review by an issuer prior to the publication of a research report containing such rating, recommendation or investment thesis.

Any information relating to the tax status of financial instruments discussed herein is not intended to provide tax advice or to be used by anyone to provide tax advice. Investors are urged to seek tax advice based on their particular circumstances from an independent tax professional.

The information herein (other than disclosure information relating to BofA Securities and its affiliates) was obtained from various sources and we do not guarantee its accuracy. This information may contain links to third-party websites. BofA Securities is not responsible for the content of any third-party website or any linked content contained in a third-party website. Content contained on such third-party websites is not part of this information and is not incorporated by reference. The inclusion of a link does not imply any endorsement by or any affiliation with BofA Securities. Access to any third-party website is at your own risk, and you should always review the terms and privacy policies at third-party websites before submitting any personal information to them. BofA Securities is not responsible for such terms and privacy policies and expressly disclaims any liability for them.

All opinions, projections and estimates constitute the judgment of the author as of the date of publication and are subject to change without notice. Prices also are subject to change without notice. BofA Securities is under no obligation to update this information and BofA Securities ability to publish information on the subject issuer(s) in the future is subject to applicable quiet periods. You should therefore assume that BofA Securities will not update any fact, circumstance or opinion contained herein.

Certain outstanding reports or investment opinions relating to securities, financial instruments and/or issuers may no longer be current. Always refer to the most recent research report relating to an issuer prior to making an investment decision.

In some cases, an issuer may be classified as Restricted or may be Under Review or Extended Review. In each case, investors should consider any investment opinion relating to such issuer (or its security and/or financial instruments) to be suspended or withdrawn and should not rely on the analyses and investment opinion(s) pertaining to such issuer (or its securities and/or financial instruments) nor should the analyses or opinion(s) be considered a solicitation of any kind. Sales persons and financial advisors affiliated with BofAS or any of its affiliates may not solicit purchases of securities or financial instruments that are Restricted or Under Review and may only solicit securities under Extended Review in accordance with firm policies.

Neither BofA Securities nor any officer or employee of BofA Securities accepts any liability whatsoever for any direct, indirect or consequential damages or losses arising from any use of this information.