US Treasury Market Daily

Revising the 10-year fair value model

- Treasury yields declined 2-3bp amid disappointing data; stay short 3-year Treasuries and hold 10s/30s flatteners
- We revise our 10-year Treasury fair value model, shortening the regression horizon and removing the Fed forward guidance factor. We find this better captures an environment in which the Fed is less reliant on non-traditional policy levers and is actively raising the Federal funds rate
- The long end comes under renewed pressure and cheapens the 30-year bond towards support clustered in the 3.40s. We continue to think the 3.45-3.50% area defines the cheap end of a new multi-month trading range and would look for buying interest to develop near those levels. Resistance comes in at 3.23-3.25%, followed by a more significant area at 3.13-3.15%

Fixed Income Strategy

Jay Barry AC
(1-212) 834-4951
john.f.barry@jpmorgan.com

Jason Hunter AC
(1-212) 270-0034
jason.x.hunter@jpmorgan.com

Phoebe A White
(1-212) 834-3092
phoebe.a.white@jpmorgan.com

Alix Tepper Floman
(1-212) 622-9461
alix.tepper@jpmorgan.com

Luke Y Chang
(1-212) 834-7568
luke.chang@jpmorgan.com

Natalie Matejkova
(1-212) 834-7218
natalie.matejkova@jpmorgan.com

J.P. Morgan Securities LLC

Statistics for various on the run Treasury yields and curve spreads

		Close	1d chg (bp)	WTD chg (bp)	YTD chg (bp)	3m avg	3m low	3m high	3m pctl.
Yields (%)	4wk	2.16	-1.0	0.5	90.2	2.03	1.89	2.20	87%
	13wk	2.32	-0.5	0.1	92.9	2.17	2.00	2.33	97%
	26wk	2.49	0.0	2.7	95.4	2.34	2.21	2.49	100%
	52wk	2.66	0.5	1.8	91.2	2.55	2.41	2.69	88%
	2y	2.84	2.4	3.2	77.9	2.75	2.59	2.91	78%
	3y	2.89	2.5	3.9	81.9	2.82	2.65	2.99	72%
	5y	2.94	2.0	3.2	68.5	2.88	2.70	3.07	64%
	7y	3.03	2.2	3.2	65.9	2.96	2.77	3.17	65%
	10y	3.11	2.4	3.4	72.9	3.01	2.82	3.23	71%
	30y	3.36	2.7	4.1	61.3	3.17	2.97	3.40	89%
Curves (bp)	2s/5s	9.8	-0.4	0.0	-9.4	13.4	9.4	19.5	4%
	5s/10s	17.0	0.3	0.2	4.4	12.7	9.6	17.0	100%
	2s/10s	26.8	-0.1	0.2	-5.0	26.2	19.9	34.5	47%
	5s/30s	41.7	0.7	0.9	-7.2	28.9	22.3	41.7	100%
	10s/30s	24.7	0.4	0.7	-11.6	16.2	12.5	24.7	100%

Source: J.P. Morgan

See page 8 for analyst certification and important disclosures.

Jay Barry
(1-212) 834-4951
john.f.barry@jpmorgan.com

Jason Hunter
(1-212) 270-0034
jason.x.hunter@jpmorgan.com

Phoebe A White
(1-212) 834-3092
phoebe.a.white@jpmorgan.com

Alix Tepper Floman
(1-212) 622-9461
alix.tepper@jpmorgan.com

Market views

Treasury yields declined 2-3bp amid disappointing data. Although initial claims decreased by 2k to 214k from last week, the ISM manufacturing survey fell to 57.7 (consensus: 59.0), near the low end of the range of figures reported over the past year ("US: ISM manufacturing survey steps down in October," Daniel Silver, 11/1/18). Tomorrow, we project a 200k increase in nonfarm payrolls in September, an unchanged unemployment rate, and a 0.1% m/m increase in hourly earnings (**Exhibit 1**). We continue to carry shorts in 3-year Treasuries and hold 10s/30s flatteners.

Exhibit 1: US calendar, 24 hours ahead

Data	Time	Last	Consensus	JPM
Nonfarm payrolls (Oct)	8:30am	134k	200k	200k
Unemployment rate (Oct)	8:30am	3.7%	3.7%	3.7%
Average hourly earnings (Oct)	8:30am	0.3%	0.2%	0.1%
Trade balance (Sep)	8:30am	-$53.2bn	-$53.6bn	-$54.0bn
Factory orders (Sep)	10:00am	2.3%	0.5%	0.5%

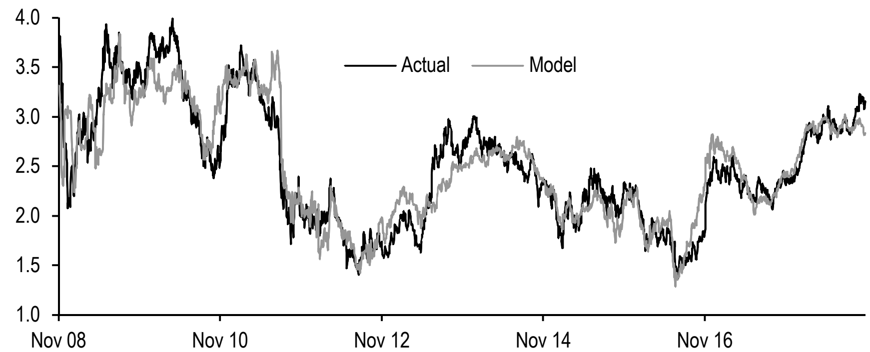
Source: J.P. Morgan, Bloomberg

Revising the 10-year fair value model

Our fair-value framework for 10-year Treasuries combines a number of economic, Fed, and technical variables that we have identified as the main drivers of Treasury yields over the last few years. **Exhibit 2** shows this model has done a reasonably good job of tracking Treasury yields over the last decade. However, the exhibit also shows that over the last six weeks 10-year Treasuries have diverged from fair value. Ten-year Treasuries currently appear more than 25bp cheap to fair value and have not appeared this mispriced since late 2016. While this indicates that Treasuries are approximately 1 standard deviation cheap relative to their drivers, we think now is an appropriate time to make minor adjustments to our framework in order to improve the explanatory value of this model.

Exhibit 2: Our fair-value framework has been highly explanatory in predicting 10-year yields over the past decade, but has diverged more recently

10-year Treasury yields versus model implied fair value*; %



* Fair value model for 10-year yields derived from a regression over the last 10 years. The model predicted value is given by 1.08*5yx5y Inflation swap rate (%) + 0.20* 1y-ahead GDP growth forecast (%) + 0.198* 3mx3m OIS rate (%) – 0.0279* Fed rate fwd guidance (months) + G7 ex-US Avg 3mx3m OIS rate (%) - 0.12*CFTC speculative positions (3-year z-score) – 0.94. R-squared = 84%, Standard error = 0.24%

Source: J.P. Morgan, CFTC, Blue Chip, Federal Reserve

Jay Barry
(1-212) 834-4951
john.f.barry@jpmorgan.com

Jason Hunter
(1-212) 270-0034
jason.x.hunter@jpmorgan.com

Phoebe A White
(1-212) 834-3092
phoebe.a.white@jpmorgan.com

Alix Tepper Floman
(1-212) 622-9461
alix.tepper@jpmorgan.com

First, we reduce the regression period from 10 years down to 5 years, in order to more appropriately portray the market environment. If we separate the decade horizon into two periods, the first five years of the horizon (2008-2013) are distinctly different than the last five years. The 2008-2013 era was characterized by short-term Fed expectations which were well anchored at historically-low levels, thanks to the combination of zero-interest rate policy (ZIRP), ongoing Fed balance sheet expansion, and the use of forward guidance (**Exhibit 3**). However, over the last 5 years, short-term OIS forwards have risen substantially as the Fed has tapered asset purchases and the raised the Fed funds rate by 200bp. Similarly, we think the 10-year horizon overstates the relative importance of growth expectations: **Exhibit 4** shows that the partial sensitivity of Treasury yields to growth expectations has declined from its peak earlier this decade. Intuitively, this makes sense: when the Fed was engaging in QE and forward guidance, growth expectations were relatively more important for Treasury yields than policy rate expectations. **With the Fed in the midst of policy normalization, however, the use of a 10-year regression horizon understates the sensitivity of 10-year yields to short-term Fed expectations, and overstates the relative importance of growth expectations; therefore reducing the window should improve the fit in our model**.

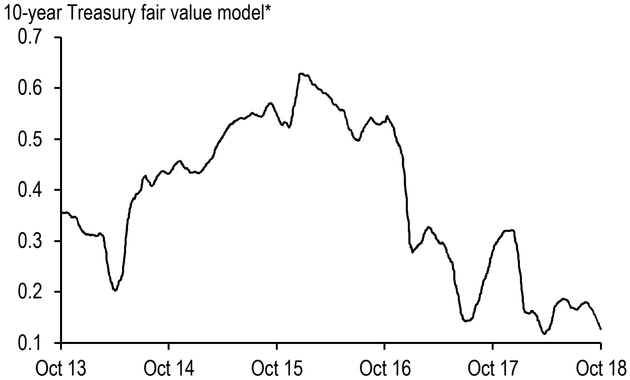
Exhibit 3: Short-term Fed expectations were well-anchored earlier this decade, but have risen sharply over the past number of years as the Fed has transitioned from forward guidance and QE to more traditional policy levers…

3mX3m OIS rates; %

Source: J.P. Morgan

Exhibit 4: …and the partial sensitivity of Treasury yields to growth has come down

Rolling 5-year partial beta with respect to 1-year ahead growth expectations in our 10-year Treasury fair value model*



* See Exhibit 2 for model details

Source: J.P. Morgan, CFTC, Blue Chip, Federal Reserve

Second, as a nod to the changing environment, we remove Fed forward guidance from our framework. The statistical significance of this variable drops meaningfully when we reduce the historical window from a decade to 5 years, and this also makes sense, as the FOMC is no longer using forward guidance (either in a calendar-based or conditional format) in order to anchor the market's expectations. By making both of these revisions, we can better capture an environment in which the Fed is less reliant on non-traditional policy levers and actively raising the Federal funds rate (**Exhibit 5**). **Indeed, the regression fit on our revised model rises from 84% to 91%, and the standard error is cut in half from the previous iteration. However, as the exhibit also shows, even with this improved fit, 10-year Treasuries remain more somewhat cheap to fair value**.

Jay Barry
(1-212) 834-4951
john.f.barry@jpmorgan.com

Jason Hunter
(1-212) 270-0034
jason.x.hunter@jpmorgan.com

Phoebe A White
(1-212) 834-3092
phoebe.a.white@jpmorgan.com

Alix Tepper Floman
(1-212) 622-9461
alix.tepper@jpmorgan.com

Exhibit 5: Our revised fair framework offers a better regression fit with a lower standard error, and shows that Treasury yields remain cheap relative to fair value

Updated J.P. Morgan 10-year Treasury Fair Value Model*; units as indicated

Variable	Coeffcient	T-stat	Current
Intercept	0.076	0.7	
5yx5y Inflation swap rate; %	0.652	22.8	2.35
1y-ahead Growth Forecast; %	0.144	5.7	2.48
3m3m OIS rate; %	0.348	63.8	2.49
G7 ex-US avg 3mx3m OIS rate; %	0.889	11.8	0.062
CFTC positions; 3yr z-score	-0.056	-13.8	-1.98
R-squared; %			91.2%
Standard Error; bp			12.0
Residual; bp			16.1

* Regression from 10/31/13-10/31/18

Source: J.P. Morgan, CFTC, Blue Chip

Technical highlights

Exhibit 6: The 30-year bond comes under renewed pressure and cheapens toward support in the 3.40s. We continue to think the 3.45-3.50% area defines the cheap end of a new multi-month trading range and would look for buying interest to develop as yields approach that area. Resistance comes in at 3.23-3.25%, followed by more significant levels at 3.13-3.15%

30-year bond, daily bars; %

Source: J.P. Morgan, CQG

The **30-year bond** comes back under pressure as risk markets provide indications that a lasting reversal pattern is potentially starting to take hold. The latest weakness leaves the long end cheapening towards support at the **3.445%** Oct 9 pivot, **3.455%** Aug-Sep equal swings objective, and **3.46%** longer-term monthly trend line (**Exhibit 6**). Ultimately, we think the **3.45-3.50%** area defines range support heading into early 2019. That area also matches levels we suspect would create an extreme oversold condition and set the market up for the same short-term buy signals that triggered in early-Oct. Given that setup and our view, we would view a systematic buy signal as an opportunity to re-enter a tactical long position. The Oct risk-off rally from noted support stalled just shy of the **3.23-3.25%** Sep breakdown area.

Jay Barry
(1-212) 834-4951
john.f.barry@jpmorgan.com

Jason Hunter
(1-212) 270-0034
jason.x.hunter@jpmorgan.com

Phoebe A White
(1-212) 834-3092
phoebe.a.white@jpmorgan.com

Alix Tepper Floman
(1-212) 622-9461
alix.tepper@jpmorgan.com

Look for that area to continue to mark an initial resistance zone for rallies in the weeks ahead. We think the **3.13-3.15%** summer range cheaps will likely define the rich end of the new multi-month trading range.

Technical trade strategies

- **Hold 5s/30s curve flattening trade**
  – Hold 50% flattener from 35.5bp average entry. Use a closing stop above 46bp.
- **Hold 10-year TIPS breakeven widener**
  – Hold 50% widener trade from 210.5bp average entry. Use a stop just below 199bp.
- **Hold a 2-year note short**
  – Hold 50% short from 2.80%. Use a stop just through 2.69%. Exit near 3.10%.

Jay Barry
(1-212) 834-4951
john.f.barry@jpmorgan.com

Jason Hunter
(1-212) 270-0034
jason.x.hunter@jpmorgan.com

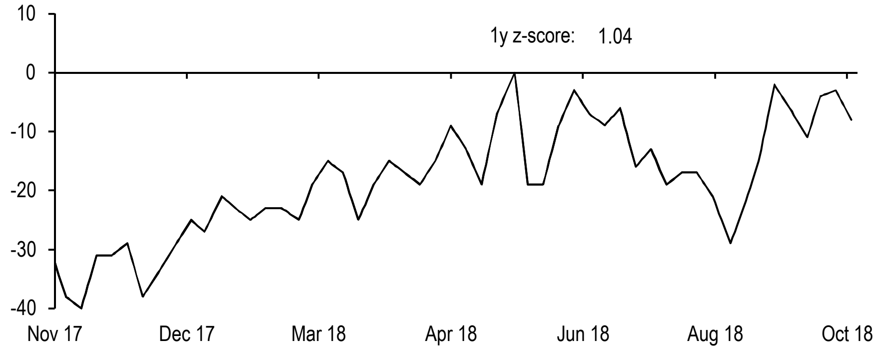
Phoebe A White
(1-212) 834-3092
phoebe.a.white@jpmorgan.com

Alix Tepper Floman
(1-212) 622-9461
alix.tepper@jpmorgan.com

Appendix: Position technicals overview

Exhibit A1: J.P. Morgan Treasury Client Survey

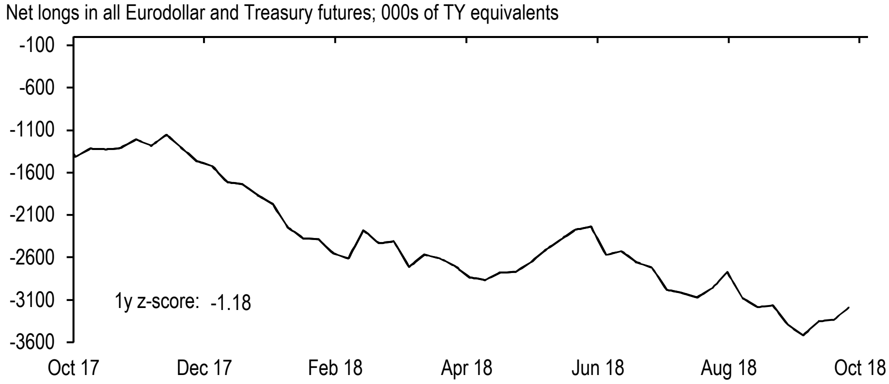
Net longs; %



Source: J.P. Morgan

Exhibit A2: CFTC non-commercial positions

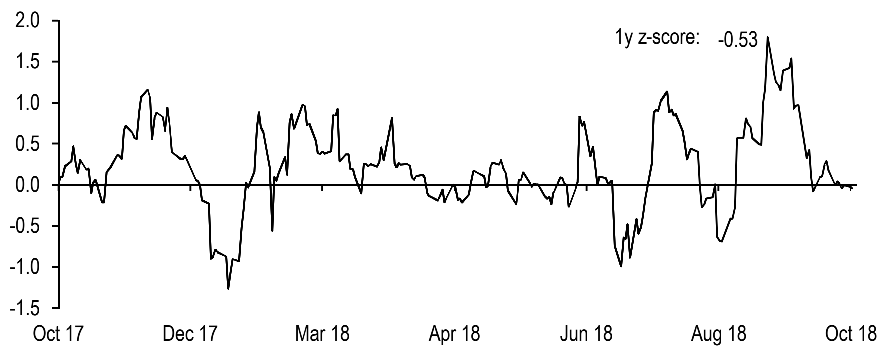
Net longs in all Eurodollar and Treasury futures; 000s of TY equivalents



Source: CFTC

Exhibit A3: CTA exposure to 10-year Treasuries

Partial beta with respect to the J.P. Morgan US 7-10Y bond index in our model for CTA returns*



* Model is a 1-month regression of daily excess returns on the CTA index versus daily excess returns on 1) J.P. Morgan US 7-10Y bond index, 2) J.P. Morgan ex-US Global Bond Index, 3) S&P500 index, 4) J.P. Morgan global cash index, and 5) Goldman Sachs Commodities Index

Source: Bloomberg, SG, J.P. Morgan

Jay Barry
(1-212) 834-4951
john.f.barry@jpmorgan.com

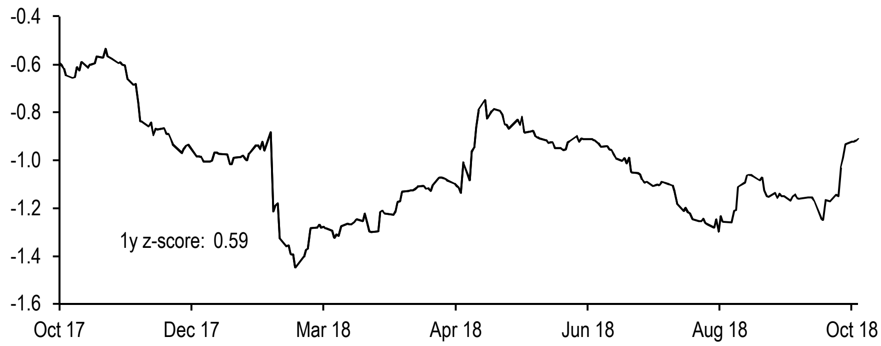
Jason Hunter
(1-212) 270-0034
jason.x.hunter@jpmorgan.com

Phoebe A White
(1-212) 834-3092
phoebe.a.white@jpmorgan.com

Alix Tepper Floman
(1-212) 622-9461
alix.tepper@jpmorgan.com

Exhibit A4: Active Core Bond Fund* Managers' exposure to 10-year Treasuries

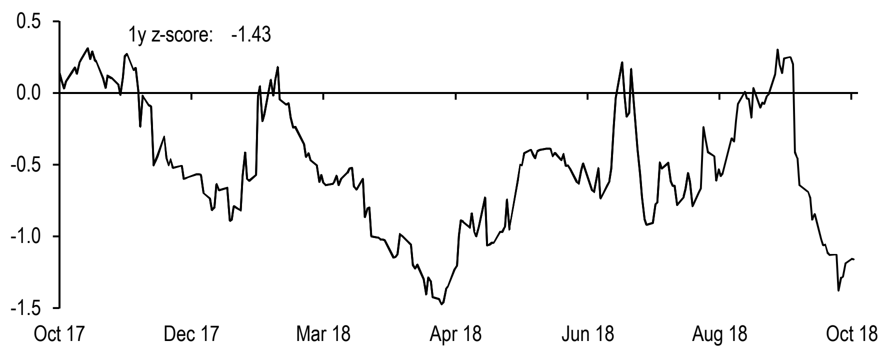
Partial beta with respect to 10-year US Treasury yields in our model for active bond fund excess returns**



* The core bond fund index is comprised of the 20 largest (by assets under management) actively-managed US core bond funds
** Model is a 3-month regression of daily excess returns on the bond fund index versus daily changes in 1) 10-year US Treasury yields, 2) 5s/30s Treasury curve, 3) constant-maturity 5-year CDX.IG spread, 4) MBS Libor option-adjusted spread, and 5) 3Mx10Y swaption volatility; Source: Bloomberg, J.P. Morgan

Exhibit A5: Macro Hedge Fund exposure to 10-year Treasuries

Partial beta with respect to the J.P. Morgan US 7-10Y bond index in our model for macro hedge fund returns*

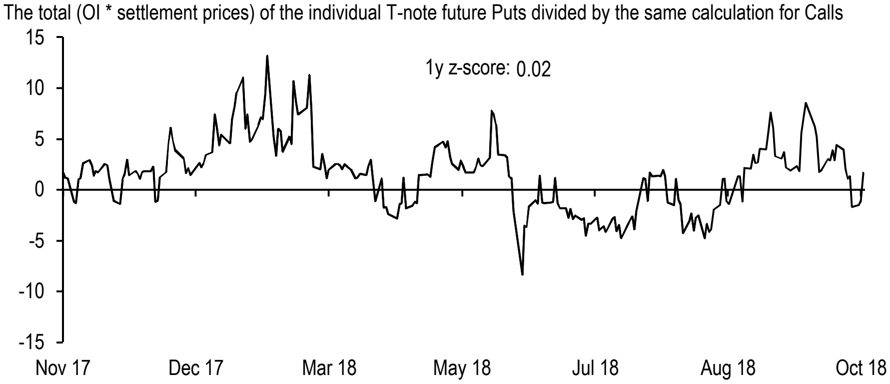


* Model is a six-week regression of daily excess returns on the HFRX Macro/CTA index versus daily excess returns on 1) J.P. Morgan US 7-10Y bond index, 2) J.P. Morgan ex-US Global Bond Index, 3) S&P 500 equity index, 4) MSCI G7 ex-US equity index, 5) J.P. Morgan global cash index, and 6) Goldman Sachs Commodities Index.

Source: Bloomberg, HFR, J.P. Morgan

Exhibit A6: T-note dollar weighed Put/Call ratio

The total (OI * settlement prices) of the individual T-note future Puts divided by the same calculation for Calls



Source: CFTC, Bloomberg, CQG, CME, J.P. Morgan

Jay Barry
(1-212) 834-4951
john.f.barry@jpmorgan.com

Jason Hunter
(1-212) 270-0034
jason.x.hunter@jpmorgan.com

Phoebe A White
(1-212) 834-3092
phoebe.a.white@jpmorgan.com

Alix Tepper Floman
(1-212) 622-9461
alix.tepper@jpmorgan.com

Disclosures

Analyst Certification: The research analyst(s) denoted by an "AC" on the cover of this report certifies (or, where multiple research analysts are primarily responsible for this report, the research analyst denoted by an "AC" on the cover or within the document individually certifies, with respect to each security or issuer that the research analyst covers in this research) that: (1) all of the views expressed in this report accurately reflect his or her personal views about any and all of the subject securities or issuers; and (2) no part of any of the research analyst's compensation was, is, or will be directly or indirectly related to the specific recommendations or views expressed by the research analyst(s) in this report. For all Korea-based research analysts listed on the front cover, they also certify, as per KOFIA requirements, that their analysis was made in good faith and that the views reflect their own opinion, without undue influence or intervention.

Company-Specific Disclosures: Important disclosures, including price charts and credit opinion history tables, are available for compendium reports and all J.P. Morgan–covered companies by visiting https://www.jpmm.com/research/disclosures, calling 1-800-477-0406, or e-mailing research.disclosure.inquiries@jpmorgan.com with your request. J.P. Morgan's Strategy, Technical, and Quantitative Research teams may screen companies not covered by J.P. Morgan. For important disclosures for these companies, please call 1-800-477-0406 or e-mail research.disclosure.inquiries@jpmorgan.com.

Analysts' Compensation: The research analysts responsible for the preparation of this report receive compensation based upon various factors, including the quality and accuracy of research, client feedback, competitive factors, and overall firm revenues.

Other Disclosures

J.P. Morgan ("JPM") is the global brand name for J.P. Morgan Securities LLC ("JPMS") and its affiliates worldwide. J.P. Morgan Cazenove is a marketing name for the U.K. investment banking businesses and EMEA cash equities and equity research businesses of JPMorgan Chase & Co. and its subsidiaries.

Options related research: If the information contained herein regards options related research, such information is available only to persons who have received the proper option risk disclosure documents. For a copy of the Option Clearing Corporation's Characteristics and Risks of Standardized Options, please contact your J.P. Morgan Representative or visit the OCC's website at https://www.theocc.com/components/docs/riskstoc.pdf

Private Bank Clients: Where you are a client of the private banking businesses offered by JPMorgan Chase & Co. and its subsidiaries ("J.P. Morgan Private Bank"), research is issued to you by J.P. Morgan Private Bank and not by any other division of J.P. Morgan, including but not limited to the J.P. Morgan corporate and investment bank and its research division.

Legal Entities Disclosures
U.S.: JPMS is a member of NYSE, FINRA, SIPC and the NFA. JPMorgan Chase Bank, N.A. is a member of FDIC. **Canada**: J.P. Morgan Securities Canada Inc. is a registered investment dealer, regulated by the Investment Industry Regulatory Organization of Canada and the Ontario Securities Commission and is the participating member on Canadian exchanges. **U.K.**: JPMorgan Chase N.A., London Branch, is authorised by the Prudential Regulation Authority and is subject to regulation by the Financial Conduct Authority and to limited regulation by the Prudential Regulation Authority. Details about the extent of our regulation by the Prudential Regulation Authority are available from J.P. Morgan on request. J.P. Morgan Securities plc (JPMS plc) is a member of the London Stock Exchange and is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority. Registered in England & Wales No. 2711006. Registered Office 25 Bank Street, London, E14 5JP. **Germany**: This material is distributed in Germany by J.P. Morgan Securities plc, Frankfurt Branch which is regulated by the Bundesanstalt für Finanzdienstleistungsaufsich and also by J.P. Morgan AG (JPM AG) which is a member of the Frankfurt stock exchange and is regulated by the Federal Financial Supervisory Authority (BaFin), JPM AG is a company incorporated in the Federal Republic of Germany with registered office at Taunustor 1, 60310 Frankfurt am Main, the Federal Republic of Germany. **South Africa**: J.P. Morgan Equities South Africa Proprietary Limited is a member of the Johannesburg Securities Exchange and is regulated by the Financial Services Board. **Hong Kong**: J.P. Morgan Securities (Asia Pacific) Limited (CE number AAJ321) is regulated by the Hong Kong Monetary Authority and the Securities and Futures Commission in Hong Kong and/or J.P. Morgan Broking (Hong Kong) Limited (CE number AAB027) is regulated by the Securities and Futures Commission in Hong Kong. **Korea**: This material is issued and distributed in Korea by or through J.P. Morgan Securities (Far East) Limited, Seoul Branch, which is a member of the Korea Exchange(KRX) and is regulated by the Financial Services Commission (FSC) and the Financial Supervisory Service (FSS). **Australia**: J.P. Morgan Securities Australia Limited (JPMSAL) (ABN 61 003 245 234/AFS Licence No: 238066) is regulated by ASIC and is a Market, Clearing and Settlement Participant of ASX Limited and CHI-X. **Taiwan**: J.P. Morgan Securities (Taiwan) Limited is a participant of the Taiwan Stock Exchange (company-type) and regulated by the Taiwan Securities and Futures Bureau. **India:** J.P. Morgan India Private Limited (Corporate Identity Number - U67120MH1992FTC068724), having its registered office at J.P. Morgan Tower, Off. C.S.T. Road, Kalina, Santacruz - East, Mumbai – 400098, is registered with Securities and Exchange Board of India (SEBI) as a 'Research Analyst' having registration number INH000001873. J.P. Morgan India Private Limited is also registered with SEBI as a member of the National Stock Exchange of India Limited (SEBI Registration Number - INB 230675231/INF 230675231/INE 230675231), the Bombay Stock Exchange Limited (SEBI Registration Number - INB 010675237/INF 010675237) and as a Merchant Banker (SEBI Registration Number - MB/INM000002970). Telephone: 91-22-6157 3000, Facsimile: 91-22-6157 3990 and Website: www.jpmipl.com. For non local research reports, this material is not distributed in India by J.P. Morgan India Private Limited. **Thailand**: This material is issued and distributed in Thailand by JPMorgan Securities (Thailand) Ltd., which is a member of the Stock Exchange of Thailand and is regulated by the Ministry of Finance and the Securities and Exchange Commission and its registered address is 3rd Floor, 20 North Sathorn Road, Silom, Bangrak, Bangkok 10500. **Indonesia**: PT J.P. Morgan Sekuritas Indonesia is a member of the Indonesia Stock Exchange and is regulated by the OJK a.k.a. BAPEPAM LK. **Philippines**: J.P. Morgan Securities Philippines Inc. is a Trading Participant of the Philippine Stock Exchange and a member of the Securities Clearing Corporation of the Philippines and the Securities Investor Protection Fund. It is regulated by the Securities and Exchange Commission. **Brazil**: Banco J.P. Morgan S.A. is regulated by the Comissao de Valores Mobiliarios (CVM) and by the Central Bank of Brazil. **Mexico**: J.P. Morgan Casa de Bolsa, S.A. de C.V., J.P. Morgan Grupo Financiero is a member of the Mexican Stock Exchange and authorized to act as a broker dealer by the National Banking and Securities Exchange

Commission. **Singapore:** This material is issued and distributed in Singapore by or through J.P. Morgan Securities Singapore Private Limited (JPMSS) [MCI (P) 099/04/2018 and Co. Reg. No.: 199405335R], which is a member of the Singapore Exchange Securities Trading Limited and/or JPMorgan Chase Bank, N.A., Singapore branch (JPMCB Singapore) [MCI (P) 046/09/2018], both of which are regulated by the Monetary Authority of Singapore. This material is issued and distributed in Singapore only to accredited investors, expert investors and institutional investors, as defined in Section 4A of the Securities and Futures Act, Cap. 289 (SFA). This material is not intended to be issued or distributed to any retail investors or any other investors that do not fall into the classes of "accredited investors," "expert investors" or "institutional investors," as defined under Section 4A of the SFA. Recipients of this document are to contact JPMSS or JPMCB Singapore in respect of any matters arising from, or in connection with, the document. **Japan**: JPMorgan Securities Japan Co., Ltd. and JPMorgan Chase Bank, N.A., Tokyo Branch are regulated by the Financial Services Agency in Japan. **Malaysia**: This material is issued and distributed in Malaysia by JPMorgan Securities (Malaysia) Sdn Bhd (18146-X) which is a Participating Organization of Bursa Malaysia Berhad and a holder of Capital Markets Services License issued by the Securities Commission in Malaysia. **Pakistan**: J. P. Morgan Pakistan Broking (Pvt.) Ltd is a member of the Karachi Stock Exchange and regulated by the Securities and Exchange Commission of Pakistan. **Saudi Arabia**: J.P. Morgan Saudi Arabia Ltd. is authorized by the Capital Market Authority of the Kingdom of Saudi Arabia (CMA) to carry out dealing as an agent, arranging, advising and custody, with respect to securities business under licence number 35-07079 and its registered address is at 8th Floor, Al-Faisaliyah Tower, King Fahad Road, P.O. Box 51907, Riyadh 11553, Kingdom of Saudi Arabia. **Dubai**: JPMorgan Chase Bank, N.A., Dubai Branch is regulated by the Dubai Financial Services Authority (DFSA) and its registered address is Dubai International Financial Centre - Building 3, Level 7, PO Box 506551, Dubai, UAE.

Country and Region Specific Disclosures
U.K. and European Economic Area (EEA): Unless specified to the contrary, issued and approved for distribution in the U.K. and the EEA by JPMS plc. Investment research issued by JPMS plc has been prepared in accordance with JPMS plc's policies for managing conflicts of interest arising as a result of publication and distribution of investment research. Many European regulators require a firm to establish, implement and maintain such a policy. Further information about J.P. Morgan's conflict of interest policy and a description of the effective internal organisations and administrative arrangements set up for the prevention and avoidance of conflicts of interest is set out at the following link https://www.jpmorgan.com/jpmpdf/1320742677360.pdf. This report has been issued in the U.K. only to persons of a kind described in Article 19 (5), 38, 47 and 49 of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005 (all such persons being referred to as "relevant persons"). This document must not be acted on or relied on by persons who are not relevant persons. Any investment or investment activity to which this document relates is only available to relevant persons and will be engaged in only with relevant persons. In other EEA countries, the report has been issued to persons regarded as professional investors (or equivalent) in their home jurisdiction. **Australia:** This material is issued and distributed by JPMSAL in Australia to "wholesale clients" only. This material does not take into account the specific investment objectives, financial situation or particular needs of the recipient. The recipient of this material must not distribute it to any third party or outside Australia without the prior written consent of JPMSAL. For the purposes of this paragraph the term "wholesale client" has the meaning given in section 761G of the Corporations Act 2001. J.P. Morgan's research coverage universe spans listed securities across the ASX All Ordinaries index, securities listed on offshore markets, unlisted issuers and investment products which Research management deem to be relevant to the investor base from time to time. J.P. Morgan seeks to cover companies of relevance to the domestic and international investor base across all GIC sectors, as well as across a range of market capitalisation sizes. **Germany:** This material is distributed in Germany by J.P. Morgan Securities plc, Frankfurt Branch which is regulated by the Bundesanstalt für Finanzdienstleistungsaufsicht. **Hong Kong:** The 1% ownership disclosure as of the previous month end satisfies the requirements under Paragraph 16.5(a) of the Hong Kong Code of Conduct for Persons Licensed by or Registered with the Securities and Futures Commission. (For research published within the first ten days of the month, the disclosure may be based on the month end data from two months prior.) J.P. Morgan Broking (Hong Kong) Limited is the liquidity provider/market maker for derivative warrants, callable bull bear contracts and stock options listed on the Stock Exchange of Hong Kong Limited. An updated list can be found on HKEx website: http://www.hkex.com.hk. **Korea:** This report may have been edited or contributed to from time to time by affiliates of J.P. Morgan Securities (Far East) Limited, Seoul Branch. **Singapore:** As at the date of this report, JPMSS is a designated market maker for certain structured warrants listed on the Singapore Exchange where the underlying securities may be the securities discussed in this report. Arising from its role as designated market maker for such structured warrants, JPMSS may conduct hedging activities in respect of such underlying securities and hold or have an interest in such underlying securities as a result. The updated list of structured warrants for which JPMSS acts as designated market maker may be found on the website of the Singapore Exchange Limited: http://www.sgx.com. In addition, JPMSS and/or its affiliates may also have an interest or holding in any of the securities discussed in this report – please see the Important Disclosures section above. For securities where the holding is 1% or greater, the holding may be found in the Important Disclosures section above. For all other securities mentioned in this report, JPMSS and/or its affiliates may have a holding of less than 1% in such securities and may trade them in ways different from those discussed in this report. Employees of JPMSS and/or its affiliates not involved in the preparation of this report may have investments in the securities (or derivatives of such securities) mentioned in this report and may trade them in ways different from those discussed in this report. **Taiwan**: Research relating to equity securities is issued and distributed in Taiwan by J.P. Morgan Securities (Taiwan) Limited, subject to the license scope and the applicable laws and the regulations in Taiwan. According to Paragraph 2, Article 7-1 of Operational Regulations Governing Securities Firms Recommending Trades in Securities to Customers (as amended or supplemented) and/or other applicable laws or regulations, please note that the recipient of this material is not permitted to engage in any activities in connection with the material which may give rise to conflicts of interests, unless otherwise disclosed in the "Important Disclosures" in this material. **India:** For private circulation only, not for sale. **Pakistan:** For private circulation only, not for sale. **New Zealand:** This material is issued and distributed by JPMSAL in New Zealand only to persons whose principal business is the investment of money or who, in the course of and for the purposes of their business, habitually invest money. JPMSAL does not issue or distribute this material to members of "the public" as determined in accordance with section 3 of the Securities Act 1978. The recipient of this material must not distribute it to any third party or outside New Zealand without the prior written consent of JPMSAL. **Canada:** The information contained herein is not, and under no circumstances is to be construed as, a prospectus, an advertisement, a public offering, an offer to sell securities described herein, or solicitation of an offer to buy securities described herein, in Canada or any province or territory thereof. Any offer or sale of the securities described herein in Canada will be made only under an exemption from the requirements to file a prospectus with the relevant Canadian securities regulators and only by a dealer properly registered under applicable securities laws or, alternatively, pursuant to an exemption from the dealer registration requirement in the relevant province or territory of Canada in which such offer or sale is made. The information contained herein is under no circumstances to be construed as investment advice in any province or territory of Canada and is not tailored to the needs of the recipient. To the extent that the information contained herein references securities of an issuer incorporated, formed or created under the laws of Canada or a province or territory of Canada, any trades in such securities must be conducted through a dealer registered in Canada. No securities commission or similar regulatory authority in Canada has reviewed or in any way passed judgment upon these materials, the information contained herein or the merits of the securities described herein, and any representation to the contrary is an offence.

Jay Barry
(1-212) 834-4951
john.f.barry@jpmorgan.com

Jason Hunter
(1-212) 270-0034
jason.x.hunter@jpmorgan.com

Phoebe A White
(1-212) 834-3092
phoebe.a.white@jpmorgan.com

Alix Tepper Floman
(1-212) 622-9461
alix.tepper@jpmorgan.com

Dubai: This report has been issued to persons regarded as professional clients as defined under the DFSA rules. **Brazil**: Ombudsman J.P. Morgan: 0800-7700847 / ouvidoria.jp.morgan@jpmorgan.com.

General: Additional information is available upon request. Information has been obtained from sources believed to be reliable but JPMorgan Chase & Co. or its affiliates and/or subsidiaries (collectively J.P. Morgan) do not warrant its completeness or accuracy except with respect to any disclosures relative to JPMS and/or its affiliates and the analyst's involvement with the issuer that is the subject of the research. All pricing is indicative as of the close of market for the securities discussed, unless otherwise stated. Opinions and estimates constitute our judgment as of the date of this material and are subject to change without notice. Past performance is not indicative of future results. This material is not intended as an offer or solicitation for the purchase or sale of any financial instrument. The opinions and recommendations herein do not take into account individual client circumstances, objectives, or needs and are not intended as recommendations of particular securities, financial instruments or strategies to particular clients. The recipient of this report must make its own independent decisions regarding any securities or financial instruments mentioned herein. JPMS distributes in the U.S. research published by non-U.S. affiliates and accepts responsibility for its contents. Periodic updates may be provided on companies/industries based on company specific developments or announcements, market conditions or any other publicly available information. Clients should contact analysts and execute transactions through a J.P. Morgan subsidiary or affiliate in their home jurisdiction unless governing law permits otherwise.

"Other Disclosures" last revised October 20, 2018.