Completed 06 Feb 2017 01:51 PM GMT
Disseminated 06 Feb 2017 01:52 PM GMT

J.P.Morgan

European Rates Strategy
06 February 2017

Update on systematic rule based trading strategies

Rules based strategies for trading duration and Euro area rates volatility

- This is an extract from the *Overview* and *European Derivatives* sections of the *Global Fixed Income Markets Weekly*, 3 February publication
- We present a monthly update of our suite of signals for trading duration and volatility
- Our overall duration signal increased short duration exposure this month
- The majority of Euro rates volatility macro-based signal are also pointing towards short gamma positions; the technical signals are flashing neutral
- We highlight that our portfolio in the flagship GFIMS publication is based on more qualitative and discretionary approaches and may not always express views in line with the systematic rule based signals

Rates Strategy
Khagendra Gupta AC
(44-20) 7134-0486
khagendra.x.gupta@jpmorgan.com
Mika Inkinen AC
(44-20) 7742 6565
mika.j.inkinen@jpmorgan.com
Sampath Vijay
(44-20) 7134-1842
sampath.k.vijay@jpmorgan.com
J.P. Morgan Securities plc

See page 6 for analyst certification and important disclosures.

Khagendra Gupta
(44-20) 7134-0486
khagendra.x.gupta@jpmorgan.com

Mika Inkinen
(44-20) 7742 6565
mika.j.inkinen@jpmorgan.com

Update on systematic rule based trading strategies

Duration

We update our regular suite of systematic signals for outright and cross-market fixed income duration trading to complement our qualitative and discretionary approaches[1]. The current signals and past performance are summarized in **Exhibit A1** below. A brief summary of the signals is provided to the right.

Our systematic duration model combines five signals, which seek to capture economic momentum (via manufacturing PMIs and revisions to earnings forecasts in equities), price momentum (via momentum in bond and equity prices), and value (via carry adjusted by volatility). We apply these signals to 10Y total return swaps across 10 developed economies (Euro area, US, Japan, UK, Australia, Canada, Sweden, Switzerland, New Zealand and Norway).

Our overall duration signal increased short duration exposure this month (**Exhibit 1**). At the signal level, much of the change came from the bond price momentum signal turning short duration across most countries in our sample, after turning neutral last month due the rally in the second half of December (the signal is a composite of 1M and 12M momentum, and is neutral if they point in opposite directions). Changes in other momentum signals were relatively small given continued strength in manufacturing PMIs and equity prices, with a further improvement in earnings revision momentum seeing the signal shift modestly further short. By contrast, the combination of a modest steepening in yield curves and decline in vol meant our carry-to-risk signal turned somewhat longer duration. The largest change at the country level among G4 economies was for the US, where the signals shifted from largely neutral to short.

Brief description of the systematic duration signals

Duration signals[2]

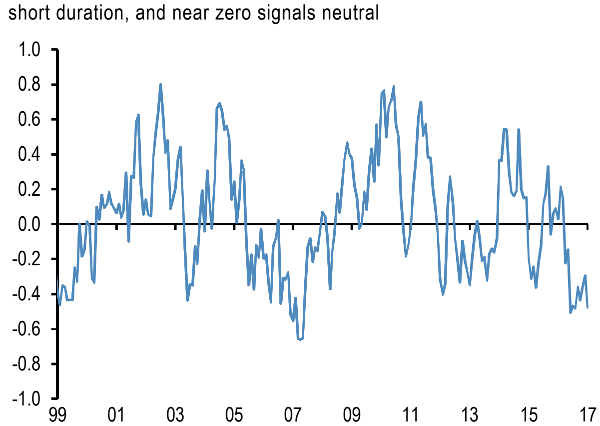
1. **Manufacturing PMI momentum**: Short duration in each country if both local country and global manufacturing PMI increased over past two months, long duration if both fell, and neutral otherwise.
2. **Earnings revision ratio momentum**: Short duration in each country if the local and global IBES equity earnings revision ratio increased over the past three months, long duration if both fell, and neutral otherwise.
3. **Bond price momentum**: Long duration if our total return swap indices are above both 1-month and 12-month average, short if below both 1-month and 12-month average, neutral otherwise.
4. **Equity price momentum**: Long duration in each country if local equity market is below its 6-month average, and short if it is above 6-month average (net of cash).
5. **Carry-to-risk**: Long duration if carry-to-risk (10Y – 3M slope) is above its 10Y average, short duration if below its 10Y average, with position size proportional to how far carry to risk is above or below average.

Cross-market signals

1. **Carry and carry-to-risk**: Overweight countries with high carry (10Y swap rate – 1M Libor rate), and overweight countries where carry is high relative to volatility[3].
2. **Reversal** (change in curve slope): Overweight countries where curve (10Y - 1Y slope) has steepened most, relative to average over past 6M[4].
3. **Real yield**: Overweight markets with high real yields, measured as 10Y swap rate less consensus forecasts of inflation over the next 10Y[5].
4. **Unemployment**: Overweight countries where unemployment has been rising the most (current level less its average over the past 10 months)[6].

Exhibit 1: Our overall duration signal increased short duration exposure

Weighted signal; positive numbers signals long duration, negative numbers short duration, and near zero signals neutral



[1] *Systematic fixed income trading strategies*, M. Inkinen et al, Apr 2015
[2] Signals discussed in more detail in *Simple rules to trade duration*, S. Mac Gorain, October 2012.
[3] See *A cross-market bond carry strategy*, N. Panigirtzoglou, March 2006.
[4] See *Exploiting reversals in cross-market yield spreads*, S. Mac Gorain, March 2012.
[5] See *Rule-based Fixed Income Monthly*, S. Mac Gorain, November 2012.
[6] See *Using unemployment to trade bonds*, S. Mac Gorain, November 2011.

Khagendra Gupta
(44-20) 7134-0486
khagendra.x.gupta@jpmorgan.com

Mika Inkinen
(44-20) 7742 6565
mika.j.inkinen@jpmorgan.com

The sell-off in bond markets in the second half of January, amid constructive economic data and a somewhat more hawkish outcome at the ECB meeting, took DM swap rates back to their mid-December peak (**Exhibit 2**). Our overall duration signal returned 0.1% on the month, with gains from shorts in GBP and EUR swaps only partially offset by losses on longs in NZD swaps.

Cross-market

We also monitor a range of signals that we have found useful for cross-market allocation, and apply these to 10Y interest rate swaps across the same set of countries that we use for our duration signals. These include carry, both outright and adjusted for risk, the change in the curve slope, capturing a tendency of markets that have underperformed to catch up, real yields, and the unemployment rate relative to its 10M average.

On a relative basis, our cross-market signals tend to be quite slow moving. This month, however, the sell-off in bond markets saw a few notable shifts. **First**, the underperformance of NZD swaps since the US election has seen the curve steepen by most among the countries in our sample, meaning NZD swaps now rank second-highest by carry in addition to having by far the highest real yields (**Exhibit 3**). **Second**, despite low outright carry and real yields, risk-adjusted carry in CHF swaps is now second highest after SEK, which remains the highest carrying market (**Exhibit 4**).

In recent months, given the BoJ's introduction of its yield targeting regime, we have recommended a discretionary deviation from the signals by replacing JPY swaps with the next-lowest carrying market. In addition, given the offsetting positions among our real yield and carry-based signals, we have preferred to combine the signals by eliminating these offsets. **This month, this leaves us with longs in SEK, NZD and USD swaps vs. shorts in NOK, EUR and GBP swaps**.

Our cross-market signals started the year somewhat better after struggling in 2H16. Our **real yield** signal returned 1.2% in January, recouping some of the losses in 2H that left overall performance in 2016 at -1.2%, arising mainly from underperformance of SEK swaps vs. AUD swaps. Our **carry** and **carry-to-risk** signals, by contrast, were largely flat and returned -0.1% each, after returning 3.1% in 2016 despite struggling in the second half of the year. After eliminating offsetting positions as explained above, last month left us with longs in NZD and USD swaps vs. EUR and NOK swaps, which returned +0.6%. Since we began to combine the signals

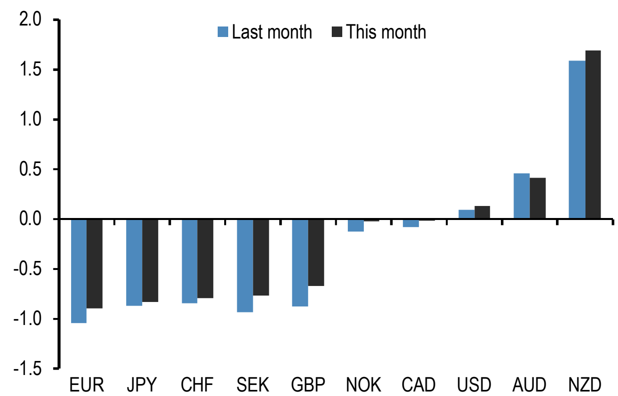
Exhibit 2: The sell-off in rates in the second half of January took DM swap rates back to their mid-December peak

Average 10Y swap rate*; %

* Simple average of USD, EUR, JPY, GBP, AUD, CAD, SEK, CHF, NOK and NZD swap rates.
Source: J.P. Morgan

Exhibit 3: NZD swaps remain the highest real yielding market in addition to being one of the highest carrying markets

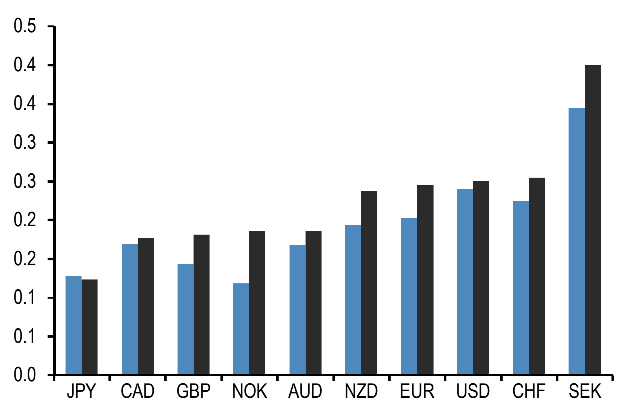
Countries ranked by real yield (10Y nominal swap rate less consensus forecast for inflation over the next 10Y);%



Source: J.P. Morgan

Exhibit 4: Despite low outright carry and real yields, risk-adjusted carry in CHF swaps looks attractive

Countries ranked by carry-to-risk (10Y - 1M rate scaled by volatility);unitless



Source: J.P. Morgan

Khagendra Gupta
(44-20) 7134-0486
khagendra.x.gupta@jpmorgan.com

Mika Inkinen
(44-20) 7742 6565
mika.j.inkinen@jpmorgan.com

in mid-2016, the cumulative performance of the combined trades since mid-2016 +0.3% compared to -1.0% and -0.4% for the carry and carry-to-risk signals, and -3.5% for the real yield signal.

Euro rates volatility

In an earlier research note[7], we had extensively discussed several rule based short gamma strategies based on macro and technical signals. In this section, we update our suite of systematic signals for outright volatility trading. We highlight that we do not develop our volatility views based on these rule based signals. Our views are developed based on macro and qualitative analysis and may not necessarily be in line with these rules based signals.

Our systematic volatility trading rules are classified into two categories: *1)* Based on macro signals (PMIs, market liquidity, momentum in vol returns, etc); *2)* Based on technical signals (ECB regime, implied/delivered vol ratio, richness/cheapness of implieds based on its history). **Exhibit 5** summarizes these signals and what these signals pointed to at start of this month.

The macro signals are broadly unchanged since we published the research note in early November. The recent pick up in 10Y implieds has led to a positive momentum in vol returns from buying gamma and hence this signal indicates to go long. On the other hand, both liquidity and the metric are indicating towards a short gamma view. On the technical side, we remain in ECB QE and rates on-hold regime, which are indicative of short gamma positions. However, looking at the two other signals, ratio of implieds to delivered volatility is less than 125% and 3Mx10Y implieds is close to the middle of its last 1Y range which suggests a neutral stance in both the cases.

Exhibit 6 shows the performance of these rule based strategies over the past few months and since Euro inception. Most of the macro indicators and the ECB regime indicator already highlighted a short gamma position at the beginning of January. Consequently, they have resulted in positive P&L as implieds declined during the month of January and delivered vol remained below inception implieds.

Exhibit 5: We refresh our signals for systematic rule based trading Euro rates vol

Summary of various trading signals with a brief description and their current indications

	Strategy	Rule	Current positioning
1	Momentum in vol returns	Go long vol if 1M momentum in return from selling vol is negative; otherwise stay short	Long
2	Carry	Go long vol when swap RAC is below 30th percentile and rising; otherwise stay short	Short
3	Macro shock	Go long vol if 3M change in PMI is more than 1SD below average of changes; otherwise stay short	Short
4	Liquidity	Turn neutral on vol if the HH ratio is above 0.02; otherwise short vol	Short
	Combining 1 - 4	Apply equal weights to each strategy	Short
5	ECB regime	Buy vol during easing regimes; sell vol during on-hold and hiking regimes; requires ex-ante knowledge of ECB regime	Short
6	Ratio of implied to delivered volatility	Go long vol if ratio <66%; go short if ratio > 125%; otherwise stay neutral	Neutral
7	Fading extremes in implied	Buy vol when z-score below -1.5; sell when 1Y Zscore is above 1.5; otherwise stay neutral	Neutral
8	Combining 6) and 8)	Only buy low (sell high) when in an easing (on-hold/hiking) regime and Zscore < -1.5 (> 1.5)	Neutral

Exhibit 6: Recent performance of 3Mx10Y gamma based on various rule based signals

Returns as of 1 Feb 2017; bp of notional

	Holding period returns*							
	1M	3M	6M	12M	5Y	10Y	Since 2000	IR since 2000
Always short	11	3	-3	141	103	105	94	0.98
Vol momentum	5	-63	-138	-136	203	252	180	1.90
Carry	11	3	-60	71	184	233	159	1.68
Liquidity	5	23	17	68	113	114	102	1.44
PMI	11	3	-3	141	135	177	147	1.54
Combined	8	-9	-46	36	159	194	147	2.45
ECB regime	11	2	-9	20	48	124	101	0.9
Ratio of imp to deliv vol	-	-59	-95	82	77	136	94	0.8
Fading extremes in implied	22	71	0	-6	47	-17	-37	-0.3

* Holding period returns for 1M - 12M; annualized returns for 12M and longer

[7] See *Systematic short gamma strategies to trade Euro rates vol* by Khagendra Gupta and Mika Inkinen, 15 November 2016.

Exhibit A1: Current systematic model signals and recent performance

Signals and returns as at 1 Feb 2017.

Duration — Current signal by country

	Weight	Euro area	Japan	UK	US	Australia	Canada	Sweden	Switzerland	New Zealand	Norway	Combined
PMI momentum	15%	-1	-1	-1	-1	0	-1	-1	0	-1	-1	-0.8
Revision ratio momentum	15%	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-0.9
Bond price momentum	20%	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-0.9
Equity price momentum	15%	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-0.8
Carry to Risk	35%	0.0	-1.0	-0.7	0.5	1.3	0.2	0.9	0.4	0.0	0.6	0.2
Combined		-0.7	-1.0	-0.7	-0.5	0.1	-0.6	-0.3	-0.4	-0.3	-0.4	-0.5
Previous month		*-0.5*	*-0.7*	*-0.7*	*-0.1*	*0.0*	*-0.4*	*-0.3*	*-0.7*	*0.4*	*0.0*	*-0.3*

NB: Positive numbers signal a duration long, negative numbers a duration short, and 0 neutral. Combined signal can be thought of as a scalar relative to a risk budget - e.g. a coefficient of -0.2 would signal a short of 20% of risk limit.

	Returns*, %								IR since 1998
	1M	3M	6M	YTD	12M	5Y	10Y	Since 1998	
PMI momentum	0.4	3.8	3.6	0.4	5.6	2.2	3.5	2.7	0.68
Revision ratio momentum	0.5	0.5	2.2	0.5	-2.8	1.2	4.5	3.3	0.77
Bond price momentum	0.0	0.7	-1.4	0.0	3.0	2.1	3.0	2.6	0.56
Equity price momentum	0.4	0.0	2.4	0.4	0.7	0.1	3.0	3.8	0.73
Carry to Risk	0.0	0.5	2.4	0.0	0.2	1.3	1.7	2.2	0.55
Combined	0.1	0.7	1.3	0.1	0.8	1.0	2.2	2.1	1.26

* Holding period returns for 1M - 12M; annualized for 12M and longer.

Cross-market — Current basket

	First pair		Second pair	
	Long	**Short**	**Long**	**Short**
Carry	SEK	JPY	NZD	NOK
Carry to Risk	SEK	JPY	CHF	CAD
Change in slope	NZD	JPY	AUD	CHF
Real yield	NZD	EUR	AUD	JPY
Unemployment change	NZD	EUR	AUD	USD

	Returns*, %								IR since 1996**
	1M	3M	6M	YTD	12M	5Y	10Y	Since 1996**	
Carry	-0.1	-2.1	-2.3	-0.1	1.6	-0.4	1.4	2.7	0.66
Carry to Risk	-0.1	-2.1	-2.0	-0.1	2.3	-1.1	1.4	2.3	0.61
Change in slope	0.8	-2.6	-1.9	0.8	-3.2	-3.1	-0.3	1.8	0.46
Real yield	1.2	-2.0	-3.5	1.2	-1.0	0.8	1.8	1.4	0.44
Unemployment change	0.0	-3.3	-3.3	0.0	-7.1	-0.7	-0.5	0.5	0.13

* Holding period returns for 1M - 12M; annualized for 12M and longer; using two long-short pairs for each signal

** Except for the real yield signal, which starts in 2004.

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://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 http://www.optionsclearing.com/publications/risks/riskstoc.pdf

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. **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. **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 Australia Limited (JPMAL) (ABN 52 002 888 011/AFS Licence No: 238188) is regulated by ASIC and 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) and Bombay Stock Exchange Limited (SEBI Registration Number - INB 010675237/INF 010675237). 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 Securities 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) 193/03/2016 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) 089/09/2016], 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

Khagendra Gupta
(44-20) 7134-0486
khagendra.x.gupta@jpmorgan.com

Mika Inkinen
(44-20) 7742 6565
mika.j.inkinen@jpmorgan.com

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/1320678075935.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. **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. **Japan:** There is a risk that a loss may occur due to a change in the price of the shares in the case of share trading, and that a loss may occur due to the exchange rate in the case of foreign share trading. In the case of share trading, JPMorgan Securities Japan Co., Ltd., will be receiving a brokerage fee and consumption tax (shouhizei) calculated by multiplying the executed price by the commission rate which was individually agreed between JPMorgan Securities Japan Co., Ltd., and the customer in advance. Financial Instruments Firms: JPMorgan Securities Japan Co., Ltd., Kanto Local Finance Bureau (kinsho) No. 82 Participating Association / Japan Securities Dealers Association, The Financial Futures Association of Japan, Type II Financial Instruments Firms Association and Japan Investment Advisers Association. **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.sg. 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**: This material is issued and distributed in Taiwan by J.P. Morgan Securities (Taiwan) Limited. 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. **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 January 07, 2017.