05 September 2019

# JPM FX - Derivatives Chartpack Notes

## Practical recipes for reducing options time decay

- The recent awakening from a multi-year bearish trend puts FX volatilities again under markets' spotlight. However, while several risk factors impacted a re-pricing of implied volatilities, realized vols for USD-crosses remained largely unscathed, implying that not all long option trades equally benefited from the latest market moves.
- In this short note, we review some general features regarding the time decay associated with long volatility positions. We will investigate the interplay between different market parameters, guiding in the choice of best possible candidates for minimizing time decay while offering a positive sensitivity to the key vol parameter.
- We highlight a few candidate trades that currently screen as appealing based on the previous analyses: amongst them, EUR/TRY and EUR/MXN 1y puts screen favourably as EM Carry trades in a long vol format that could further benefit from a dovish ECB. EUR/SGD puts offer value as cheap long Vega trades.

FX volatilities moved back under the market spotlight after the sharp repricing higher between end of July and early August. Yet, as commented last week, FX realized vols were just barely impacted (at least across the USD vol universe). While it's certainly the case that suitably timed long-Gamma positions can significantly boost returns during proper market meltdowns, they are the positions most impacted by time-decay in the long-run. Also, by agreeing that vol levels remain historically low, if not outright cheap, as for instance suggested by a macro valuation based on cyclical factors (*BRL back end vols are a buy as VXY-EM vol curve flattened to short-lived levels*, Jankovic, 16 August), one might wonder how to enter a pure volatility trade, exclusively positioned for a further move on implied vol levels, but rather insensitive to actual spot dynamics and/or realized vols patterns. The latter case would come in handy, especially for hedging purposes and for diversification within a portfolio of "risk-on" strategies.

Far from offering an all-inclusive review on the topic, the pragmatic goal of this piece is to list a number of recipes for minimizing the negative time decay associated with long volatility positions, by reprising previous research (see for instance *EM vol has peaked for now,* Sandilya, Sep 18, and *Long Carry, Long Vega and short Gamma makes Jack a happy boy*, Ravagli, 26 July). The focus will be mostly on plain vanillas, although some conclusions could be applied to exotics and L/S trades too.

We fear that, despite our best efforts for keeping the technical aspects to a minimum, the formula for the theta of a long call option position as computed in the Black-Scholes model cannot be escaped:

$$\vartheta_{BS}^{Call} = -\mathrm{e}^{-q\tau}\frac{S\varphi(d_1)\sigma}{2\sqrt{\tau}} - rK\mathrm{e}^{-r\tau}\Phi(d_2) + qS\mathrm{e}^{-q\tau}\Phi(d_1)$$

Where $S$ is spot value, $q, r$ foreign/domestic interest rates, $K$ the strike, $\tau$ the time to maturity (i.e., $T-t$), $\sigma$ market volatility, $\varphi, \Phi$ the density/cumulative Gaussian distributions; $d_1 = \frac{\ln\left(\frac{S}{K}\right)+(r-q+\sigma^2/2)\tau}{\sigma\sqrt{\tau}}, d_2 = d_1 - \sigma\sqrt{\tau}$. A similar expression can be obtained for puts. In the following, we will review some well-known features regarding options time decay. We will highlight the sensitivity to the main market parameters (maturity, volatility, vol curve, Carry, skew, strike), and come up with a set of option trades based on the analysis.

Choice of maturity. A direct implication from the formula above is that for large maturities, the negative impact from the passing of time is largely reduced (going to zero in the limit of infinite time to maturity). This is of course well-known by market participants, and justifies referring to long-Expiries as the Vega segment of the

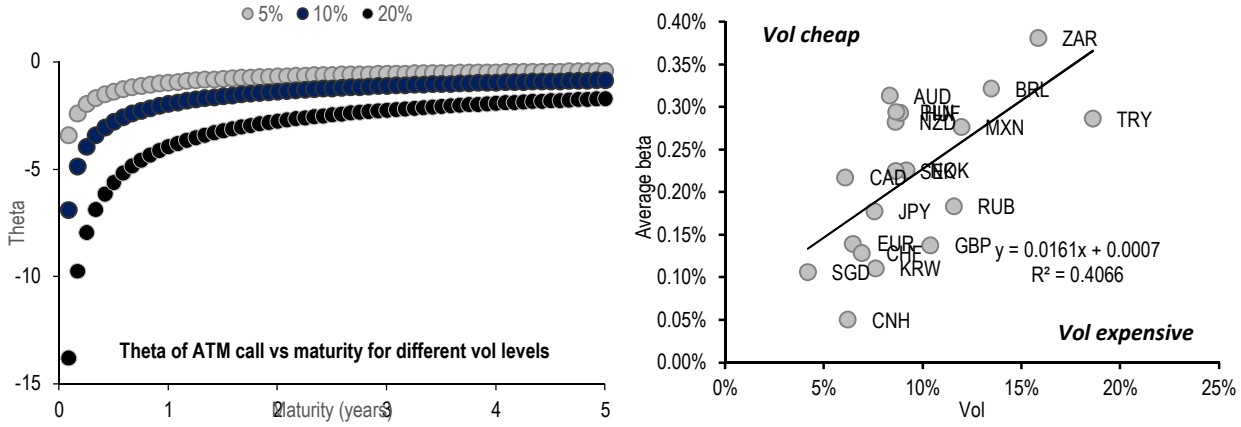
curves, allowing a "pure" exposure to volatility. The price one would have to pay would be a correspondingly reduced Gamma sensitivity.

A very practical and intuitive consequence of the above would recommend systematically buying long-dated vols and then re-striking the trades (i.e., unwinding positions and buying later expiries) when time decay starts to kick-in. We acknowledge that, typically, the most liquid FX options maturities range around 3M and that maturities above 2y gradually exit the "high-liquidity / plain-vanillas" space. Putting aside sporadic, high-liquidity opportunities in the long-dated vols space, buying vols in the 1y to 2y range should strike a reasonable compromise between tight trading costs associated with the front-end of the curve with a modest time decay associated with the longer-end of the curve.

Exhibit 1 (LHS) shows the non-linear features of time-decay for a fixed strike, ATMF option (for zero interest rates and flat vol curve) as a function of time to maturity, for different vol levels. We can see how the impact of time decay is particularly harmful after a critical level is reached, around 1 year in this case.

**Exhibit 1. Time decay as a function of options maturity - Beta over vol analysis favouring buying vol on USD/CAD**

Average Beta reflects sensitivity to a set of global risk factors is monitored in our beta-to-vol ratios framework: *Beta-over-vol ratios*, Ravagli, Jankovic, 27 March.




Source: J.P. Morgan

Impact of volatility level. Similarly as for the maturity sensitivity, the impact of vol levels on the formula above is straightforward. Putting aside non-linearities, due to the sensitivity of $d_1, d_2$ on vols, this effect is due to the proportionality to $\sigma$ of the first (unequivocally negative) term of the Theta equation. Higher vols imply higher, more negative time decay (Exhibit 1, LHS), although it remains true that, for a fixed level of vol, time decay still goes to zero in the limit of large maturities. When choosing between different options, all for the same maturity, those with lower volatility offer a more contained time decay (for the same unit of invested notional).

Of course, one should recall that, at the end of the day, options are a "derivative" market and so volatility itself should be interpreted as a barometer for the risk the underlying asset faces. The interpretation by which the formation of vol levels for each asset is directly related to the expected sensitivity to a set of global risk factors is monitored in our beta-to-vol ratios (Exhibit 1 RHS, *Beta-over-vol ratios*, Ravagli, Jankovic, 27 March): the analysis should guide towards choosing long option positions on assets where vol is low yet betas to a set of risk factors are elevated. Based on the right-hand chart above, USD/CAD vol might fulfill these criteria.

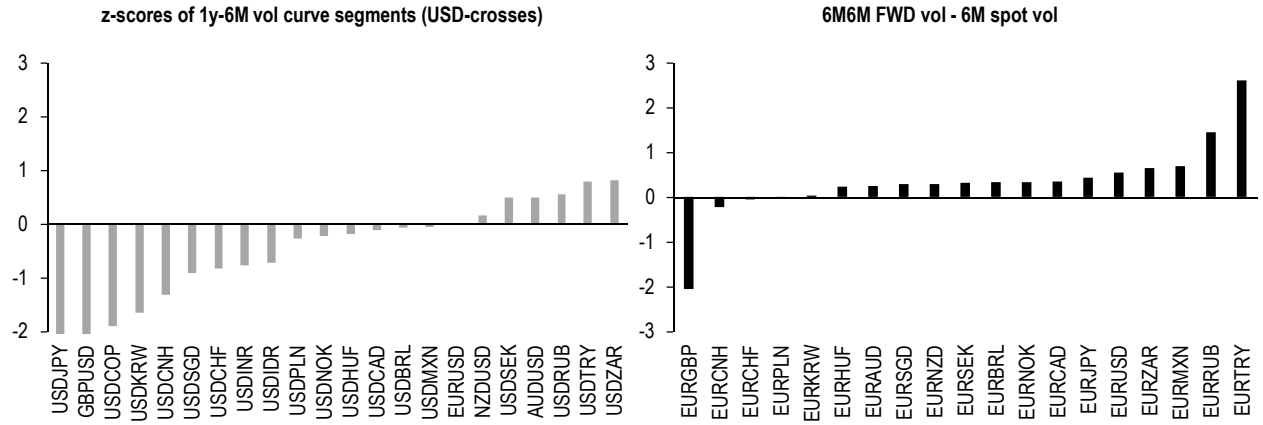
Sensitivity on vol curve. The formula we have referred to above for the time decay is the one directly obtained from the Black-Scholes model. In practice, the volatility market does not fully adhere to the BS assumptions, mostly because volatility is not constant across strikes (i.e., vol smile) and maturities (i.e., vol curve). A vol-curve adjustment for the time decay can be obtained as below:

$$\vartheta_{VC} = \vartheta_{BS} + Vega_{BS}\frac{\partial \sigma}{\partial t}$$

Basically, the "static" time decay (i.e., the Black-Scholes Theta) is corrected by a factor which is proportional to the Vega of the option, and which depends on the slope of the volatility curve $\sigma(\tau)$, $\frac{\partial \sigma}{\partial t} = -\frac{\partial \sigma}{\partial \tau}$ (we recall $\tau =$

$T-t$): sharply upward sloping curves are associated with stronger time decays. For the sake of clarity, we simply estimate $\frac{\partial\sigma}{\partial t}$ via the scaling of ATM vol different maturities: the (much more complicated) case where smile parameters follow a non-trivial scaling (i.e., the vol curve dynamics depends on the moneyness) will not be treated in this short piece.

**Exhibit 2. Z-scores on vol curves point to flat curves for USD/JPY, GBP/USD. EUR/GBP and EUR/CNH are the two cases where forward vols for EUR-crosses offer a discount vs. spot vols**




Source: J.P. Morgan

To conclude, here the recipe is simple: flat or even inverted vol curves allow an easier to manage time decay. Similar conclusions apply when considering calendar spreads or FVAs as long-vol trades with low time-decay. Exhibit 2 displays shows two indicators related to shape of the vol curve we monitor on a weekly basis (see for instance, *FX Options trading screeners*, Ravagli, 4 September.). At present, GBP-crosses offer discounts when trading forward vols vs. spot vols given the Brexit risk-premium as priced on the front-end of the curve.

Sensitivity on Carry. The impact of interest rates, which is normally overlooked as negligible for short maturities, can lead to significant effects when maturities and either domestic or foreign interest rates are large. We will consider here the case where the foreign interest rate $q$ is large, but results are rather symmetric between calls and puts if the opposite case of large $r$ holds. As before, by assuming all other parameters (strike, vol, maturity etc.) as fixed, by neglecting non-linearities embedded in the $\varphi, \Phi$ functions, and by grouping the $e^{-q\tau}$ term common to the first and third term, the multiplicative $q$ factor in front of the third term would balance the negative time decay as coming from the first term: increasing values of $q$ should grant for a less negative and ultimately positive time-decay, although a precise estimate of this critical value $q_c$ would involve assessing the non-linearities above, a task which goes beyond the scope of this note.

What should be stressed is the analysis above confirms that playing for an appreciation of the higher-yielding currency via options should automatically balance the negative time decay long vol positions are naturally exposed to. This is a very important feature that will be relied upon when looking for actual ideas, especially when EM and high-yielding currency are concerned. The following section on the skew sensitivity should shed some additional light on the matter.

Impact of skew. The impact of an option skew on its time decay is at least twofold, corresponding to two different notions of what "skew" is intended for. The first one relates to the market (or implied) skew definition, directly associated with the pricing of risk-reversals.

When buying vol on the high-yielding currency (i.e., calls when $q > r$ and puts when $r > q$), the above considerations on vol and carry should naturally favor elevated implied skews: given the typical interplay between skew and carry levels, with high-yielding calls trading at a discount vs. puts, elevated skews should offer a more substantial discount. Conversely, for the cases where one wants to go long a low-yielding currency, low skews should be favored. An earlier study investigated possible mismatches in the skew vs carry (and vol) space (*Investigating the interplay between forward points and FX skews*, Ravagli, 22 February). While one could carry out the analysis at the time series level, below we will reprise the cross-sectional analysis as performed across different currencies, with today's data (Exhibit 3).

**Exhibit 3. Skew vs carry and vol – cross sectional analysis four USD and JPY crosses**

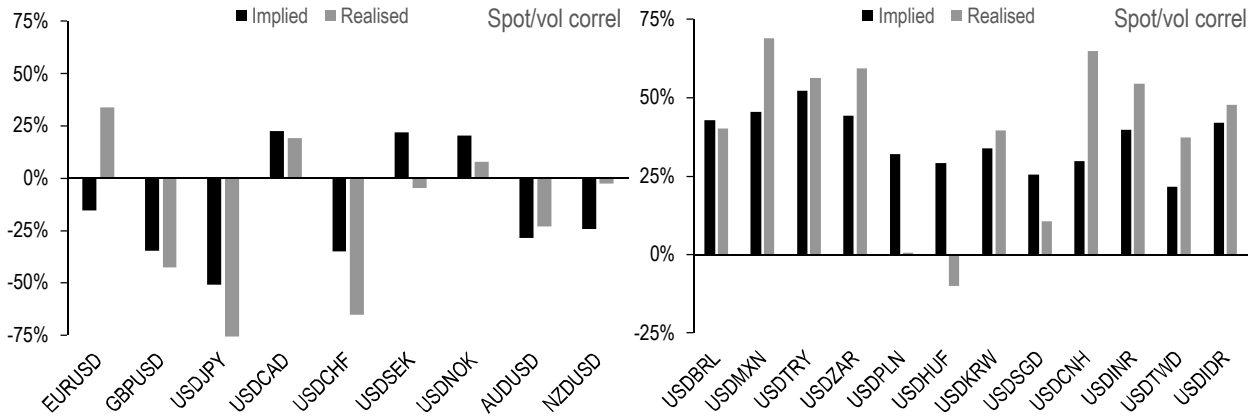
| *Model for long-USD skews* | | | | | *Model for long-JPY skews* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Vol | Carry USD | Skew market | Skew model | | Vol | Carry JPY | Skew market | Skew model |
| EUR | 5.94 | 2.7% | 0.25 | -0.03 | EUR | 8.01 | 0.2% | 1.86 | 1.61 |
| GBP | 12.94 | 1.4% | 1.96 | 1.28 | GBP | 14.58 | -1.1% | 3.22 | 2.99 |
| AUD | 7.53 | 1.0% | 0.95 | 0.58 | AUD | 10.31 | -1.5% | 2.39 | 2.18 |
| NZD | 7.86 | 1.0% | 0.85 | 0.63 | NZD | 10.44 | -1.6% | 2.16 | 2.21 |
| JPY | 7.49 | 2.5% | -1.91 | 0.25 | USD | 7.48 | -2.5% | 1.92 | 1.69 |
| NOK | 8.59 | 0.6% | 0.72 | 0.80 | NOK | 10.11 | -1.9% | 2.01 | 2.17 |
| SEK | 7.93 | 2.3% | 0.56 | 0.35 | SEK | 10.04 | -0.2% | 1.97 | 2.04 |
| CAD | 5.53 | 0.5% | 0.48 | 0.38 | CAD | 8.91 | -2.0% | 2.05 | 1.94 |
| CHF | 6.29 | 3.3% | -1.09 | -0.09 | CHF | 6.01 | 0.8% | 0.75 | 1.18 |
| BRL | 13.38 | -2.6% | 2.22 | 2.20 | BRL | 15.66 | -5.0% | 3.55 | 3.48 |
| MXN | 11.15 | -5.9% | 2.26 | 2.54 | MXN | 12.55 | -8.4% | 3.80 | 3.10 |
| PLN | 7.87 | 0.6% | 1.14 | 0.69 | PLN | 13.45 | -1.9% | 1.82 | 2.82 |
| HUF | 8.13 | 2.1% | 1.17 | 0.42 | HUF | 23.52 | -0.4% | 5.21 | 4.71 |
| ZAR | 14.95 | -4.5% | 2.45 | 2.83 | ZAR | 16.49 | -7.0% | 2.95 | 3.78 |
| TRY | 16.32 | -12.9% | 4.77 | 4.78 | TRY | 23.52 | -15.4% | 5.65 | 5.74 |
| KRW | 7.48 | 1.0% | 1.03 | 0.56 | KRW | 10.95 | -1.5% | 1.97 | 2.30 |
| SGD | 4.07 | 0.4% | 0.43 | 0.18 | SGD | 7.94 | -2.1% | 1.95 | 1.75 |
| CNH | 6.05 | -0.8% | 0.90 | 0.73 | CNH | 10.35 | -3.3% | 2.78 | 2.31 |

Source: J.P. Morgan

At present, a few carry-friendly opportunities for USD-crosses could be USD/JPY and USD/CHF calls, USD/CNH puts and, for JPY-crosses, CHF/JPY puts, MXN/JPY and CNH/JPY calls.

The second natural implication regards the notion of realized skew, or spot/volatility correlation. Assume that one is long the high-yielding currency via vols. The best scenario is the one where the currency appreciates and its vol rises. In practice, given the spot/vol correlation and the sign of the skew, in most cases the rise of the vol would correspond to a drop in the currency: in such cases, a modest realized spot/vol correlation would help as the positive Vega-PnL due to the Vega not being countered by a negative Delta-PnL. Conversely, for cases where one goes long the low-yielding currency via options, an elevated spot/vol correlation could be desired.

**Exhibit 4. 3M implied and realized spot/vol correlations for a set of G10 and EM USD-pairs**




Source: J.P. Morgan

In Exhibit 4, we show implied and realized spot/vol correlations for a set of G10 and EM USD-crosses. In the G10 space, USD/JPY and USD/CHF puts and NZD/USD calls would be favored. In the EM space, where USD-skews are currently "realizing" (based on the most recent estimate of historical skew), USD/HUF and USD/PLN puts would be supported.

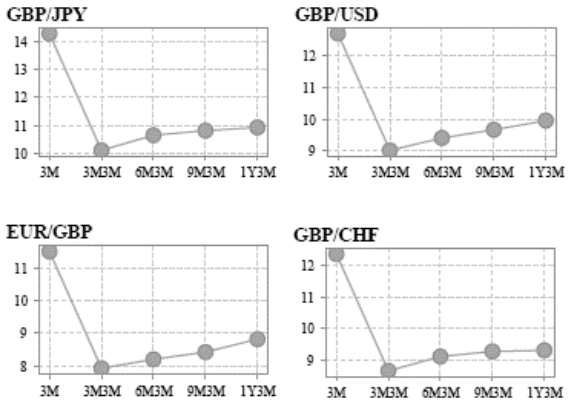
Choice of strike/moneyness. Having already opted for calls vs. puts based on the interplay between carry, skew and vol levels, it remains for the choice of the actual strikes or moneyness/deltas to be assessed. We overview a few possible different constraints. We first look for the strike such that the exposure to vol is maximized vs exposure to spot moves: max of $\frac{\partial O/\partial \sigma}{\partial O/\partial S} = Vega/Delta$. Result is $d_1 = 0 \rightarrow K = F * \exp(\sigma^2 T/2)$. This condition holds for both calls and puts. For low vols and short maturities, the condition above suggests choosing strikes not far from ATMF. This might prove relatively onerous from a premium standpoint.

The second option considers a plain reduction of time decay regardless of sensitivity to spot, which favours simply going sufficiently out-of-the-money so that premia are low. We recall that the maximum loss suffered by a long volatility position corresponds to the premium, which correspondingly sets the upper bound in terms of time-decay as well. A more general condition would entail defining targets for $\Delta S, \Delta\sigma, \Delta t$ under certain scenarios one wants to play and optimize strikes accordingly. We will refer to the low-premium, OTM option as the base case scenario when looking for actual trades.

Candidate trade ideas. We now look for candidate trade ideas which rank favourably based on the screeners introduced earlier. We start by carrying out a brute force analysis of options premia for different currency pairs (liquid USD, EUR and JPY crosses) over different maturities. Strikes are assumed to be fixed, corresponding, for both puts and calls, to 0.15 deltas for the 1y maturity: low deltas strikes are preferred, as detailed in the section above. Options are ranked based on the % change in premium from 1y to 5y (which is indicative of time decay), although we stress that, especially for EM currencies, liquidity can be poor beyond 1y-2y.

**Exhibit 5. USD-, EUR- and JPY-crosses offering the most appealing time decays (% premia are displayed in the table). Fwd vol opportunity on GBP/USD and GBP-x in case where Brexit deadline is delayed**

| Pair | Type | 3m | 6m | 1y | 2y | 3y | 5y | 1y-5y % diff |
|---|---|---|---|---|---|---|---|---|
| EUR-INR | Put | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | 0.5 | -17% |
| EUR-TRY | Put | 0.8 | 1.1 | 1.3 | 1.4 | 1.2 | 1.2 | -8% |
| USD-INR | Put | 0.2 | 0.4 | 0.5 | 0.6 | 0.6 | 0.5 | 14% |
| COP-JPY | Put | 0.1 | 0.4 | 0.9 | 1.4 | 1.4 | 1.1 | 21% |
| USD-TRY | Put | 0.5 | 0.8 | 1.2 | 1.4 | 1.5 | 1.5 | 25% |
| BRL-JPY | Call | 0.2 | 0.5 | 1.0 | 1.4 | 1.4 | 1.3 | 31% |
| ZAR-JPY | Call | 0.2 | 0.6 | 1.2 | 1.8 | 2.0 | 1.7 | 42% |
| RUB-JPY | Call | 0.2 | 0.5 | 0.8 | 1.2 | 1.4 | 1.2 | 53% |
| EUR-ZAR | Put | 0.3 | 0.6 | 1.0 | 1.4 | 1.6 | 1.6 | 57% |
| MXN-JPY | Call | 0.3 | 0.6 | 1.0 | 1.3 | 1.3 | 1.5 | 61% |
| EUR-COP | Put | 0.2 | 0.5 | 0.8 | 1.2 | 1.4 | 1.3 | 61% |
| EUR-RUB | Put | 0.3 | 0.6 | 0.8 | 1.0 | 1.0 | 1.4 | 74% |




Source: J.P. Morgan

Results for a set of liquid USD-, EUR-, and JPY-crosses are displayed in Exhibit 5 (LHS). Top ranked candidates exhibit lowest decay. Across the USD-crosses, EUR/USD puts pass several tests for offering a contained time decay for long-expiry options. Liquidity remains decent up to long maturities. Vols are undervalued based on the beta to vol analysis. Flattish vol curves combined with positive carry (for EUR/USD puts) help reducing the premium roll-down, especially between 1y and 9M. While the latest estimate of realized spot/volatility correlation (33%) would support a higher EUR/USD in case of a rise of vol levels, a longer-dated estimate of that correlation (-30% with data from 2009 on) would typically favor puts ahead of vol spikes.

Low interest rates grant that several EUR-puts pass the time-decay constraint, like EUR/SGD and EUR/NOK puts, offering attractive hedges in case of a new round of ECB QE programs. In both cases, realized spot/vol correlations (at 45%, 34% respectively) are relatively contained, limiting the directional exposure. On EUR/NOK, the strategy team still finds potential for a gradual drop of the pair over the next year (*Key Currency Views: Still playing it safe*, Chandan et al, 16 August). For both crosses, the time decay is reduced especially between 2y and 1y maturities. For EUR/TRY puts, forward points would almost perfectly neutralize time decay between 5y and 6M. For JPY-crosses, thanks to the wide and positive rates differentials, MXN/JPY calls offer a smooth time decay, especially in the (possibly not very liquid) 2y-5y segment of the curve. A contained current estimate of spot/vol realized correlation (-24%), if sustained in the future, would rule out large drops of the spot market in case if vols were to rise. Elevated implied skew, based on Exhibit 3, would also offer some value when buying MXN calls. We are already long 2y EUR/INR puts (one of the top contenders in Exhibit 5).

Consider:

- *1Y EUR/TRY 15 delta put @140 bps EUR, spot ref 6.2522, vol 17.2 as a long Carry play in a long vol format*
- *1Y EUR/SGD 15 delta put @ 50 bps EUR, spot ref 1.5296, vol 5.6 as a cheap long vol play*

- *1Y 15 delta EUR/MXN put or MXN/JPY call @105 bps EUR and @134 bps JPY, spot ref 21.805 and 5.3712, (vol 12.0 and 14.7) respectively as a Latam and trade risk hedge at times when MXN vols are trailing BRL vols by ~1.5pts making MXN long vol exposure a better value hedge.*

Given the huge premium for the late October Brexit deadline, leading to an inverted vol curve beyond 2M (Exhibit 5, RHS), GBP crosses (especially GBP/USD and EUR/GBP puts, GBP/JPY calls) would "roll-down" softly in the 3M-6M segment of the curves, offering room to play a further rise of the late October risk premium. Conversely, an eye-catching element of forward vol pricing is that the option market seems to expect a rapid improvement of market conditions past the October deadline. This appears to be consistent with expectations of a benign outcome, but does not price in uncertainty of a UK general election and postponement of the deadline to the beginning of 2020, while also lacking risk premium for low probability, but nevertheless still non-negligible adverse withdrawal outcome in October that could throw GBP into a state of chaos and push the entire vol curve materially higher than where forwards are presently priced. The risk-reward of betting on a slippage of the deadline or an adverse outcome in Oct via 3M3M or 4M4M FVAs looks quite attractive in our view and offers a substantial discount vs the current level of 3M vol.

Consider:

- *3M3M GBP/USD FVA @9/10 vols indic*

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