J.P.Morgan

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JPM FX - Derivatives Chartpack Notes

How does the correlation between spot and rates differentials impact FX vol curves?

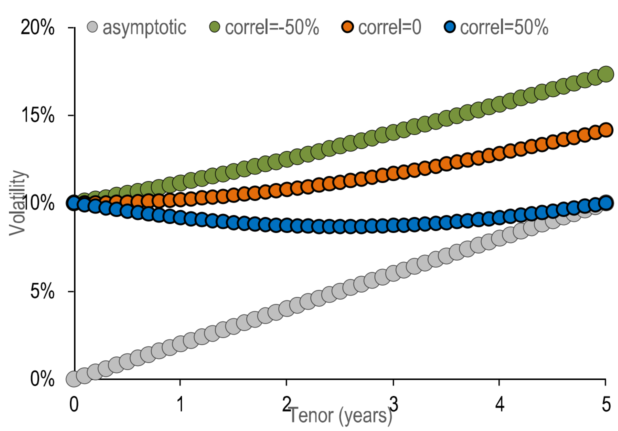
- We present a toy model that allows linking the shape of FX volatility curves to the correlation between spot and rates differentials for different currencies. Results of the analysis are put in relation with historical backtests involving plain vanilla calendar spreads and forward volatility trades.
- We favour a long 6M6M fwd vol on USD/ZAR vs short 6M6M fwd vol on AUD/USD. Flattish vol curve and elevated rates differentials support carry trade plays on EUR/TRY via long-dated vols/spread structures.

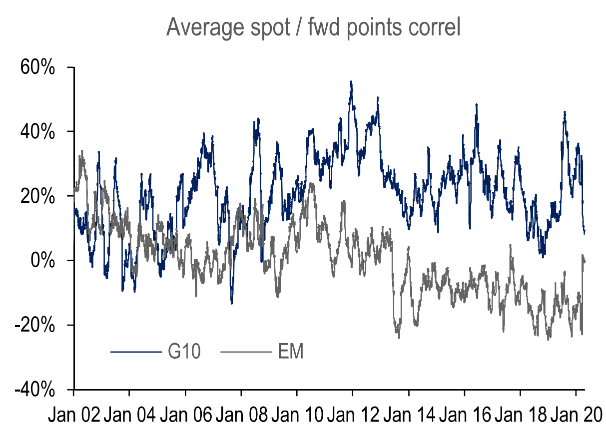
Drivers of the volatility of FX forward contracts across different maturities. We expand on previous research on the interplay between rates and FX skews (*Investigating the interplay between forward points and FX skews*, Feb 2019) and vols (*Assessing the impact of rates correlations on FX vols*, June 2019) dynamics, by focusing on the impact of the correlation between spot and rates differentials on FX vol curves. We analyze the drivers of the volatility of forward contracts for different tenors, from 1M to 5y (keeping in mind the lower liquidity of longer dated volatility instruments). We introduce the following conventions: for a forward contract $F = Sexp(-RD * T)$, where $RD = r_d - r_f$ are rates differentials and T is the maturity (in years), one gets:

$$\sigma_F^2 = \sigma_S^2 + T^2\sigma_{RD}^2 - 2\sigma_S\sigma_{RD}\rho T$$

where σ_S, σ_F are annualized log-normal volatilities for spot and forwards, σ_{RD} is the annualized normal volatility for the rates differential (in % points) and ρ the correlation between spot and rates differentials. One first thing we learn is that, in the simplistic case where σ_{RD}, ρ do not depend on the maturity, the quantity σ_F should scale linearly with T in the limit of large maturities $\sigma_F \sim \sigma_{RD}T$. Otherwise stated, for a fixed-expiry contract, the sensitivity of its volatility on the forward points component is highest at inception and declines as time passes by. Also, **for long-maturities, rates differentials should be the main source of volatility of the forward over the spot volatility** which dominates in the short maturities limit. In the intermediate regime of maturities, the formula above expects a marked sensitivity on the spot/carry correlation parameter ρ. In particular, a negative value of ρ would expect upward sloping curves for all maturities, whereas for positive ρ, curve should be downward sloping up to a maturity $T_c = \sigma_S\rho/\sigma_{DF}$; in this latter regime, forwards should be less volatile than the spot market. A case study (Exhibit 1, LHS), with $\sigma_S = 10\%, \sigma_{RD} = 2\%$, focuses on the maturity-dependence of σ_F for three different values of ρ. The asymptotic limit where σ_F rises linearly with T is also displayed.

Exhibit 1. Toy model case study (spot vol 10%, RD vol=2%). Time series of spot/rates differentials correlation for G10/EM currencies.





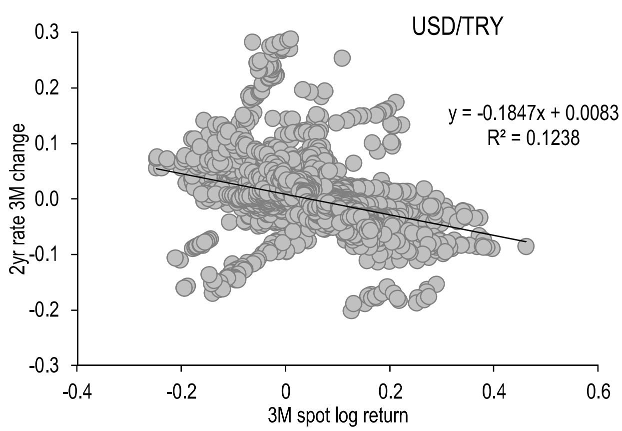
Source: J.P.Morgan

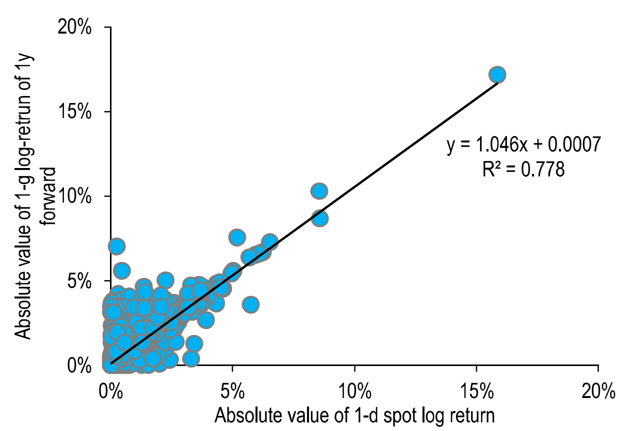
In order to match the results of the proxy analysis above with actual expected dynamics for FX volatility curves, a few assumptions/clarifications are required. First, FX market conventions for ATM volatilities change depending on the currency pair and on the maturity (*Introduction to FX Options*, December 2018): ATMF is standard notion of "At-the-money" for most EM pairs, but for G10 pairs, delta-neutral straddle is the standard convention. While such mismatch is typically non dramatic, as difference of such strikes for G10 is tight on the back of tight rates differentials, we stress the fact that the toy model can possibly refer to strikes which are not exactly matching those the ATM vol curve refers to. Also, the toy model does not take into account serial correlations and flow/liquidity factors that are typically the main driver for the front-end of the curves. For these reasons, we'll assume the rates-based assessment to be meaningful for maturities beyond 6M-1y. Additionally, our analysis implicitly estimating the volatility of rolling maturity, rather than fixed expiry, forwards; this makes trading implications from the analysis relevant especially when dealing with holding periods which are short if compared to the remaining time to maturity of the contracts.

The value of the spot/rates differential correlation plays a crucial role in the shape of the vol curve, as discussed above. No arbitrage arguments call for a widening of forward points when rates differentials widen. Intuitively, a positive correlation between spot and rates differentials should limit the volatility of forward contracts as the effect above is countered by a move of the spot in the direction where the higher yielding currency appreciates. Same reasoning applies when rates differentials tighten. Conversely, **when the correlation is negative, the effect is magnified, and forwards are expected to move more than the spot variable**. The time series of average values of ρ (3M historical correlations) for G10/EM USD pairs (Exhibit 1, RHS) tells a structurally different story in the two spaces. For G10 this value is positive (long-term average =20%), for EM much lower (long-term average =2%) and negative over the past 8 years. While carry investment strategies favor assets where yields are higher or faster rising, in the EM space high or rising rates are often associated with higher default risk. Typically, the dynamics between rates and FX depends on the currency - more granular details on individual currencies investigated will be shared later. To cut the long story short, the lower value of ρ parameter for EM pairs should lead to structurally steeper vol curves.

A case study on TRY sheds some additional light on the topic. A scatter plot between 3M changes in rates differentials and 3M spot log returns confirms the negative correlation between rates and spot: typically TRY drops when implied rates (from forward) are rising. The same analysis applied to G10 USD pairs (*What is the impact of rates vols on FX vols?*, May 2019) was finding in all cases a positive correlation.

Exhibit 2. Case study on TRY: change in rates differentials vs. spot returns are negatively correlated. Proxy of daily realized vol higher for 1y forwards than spot.





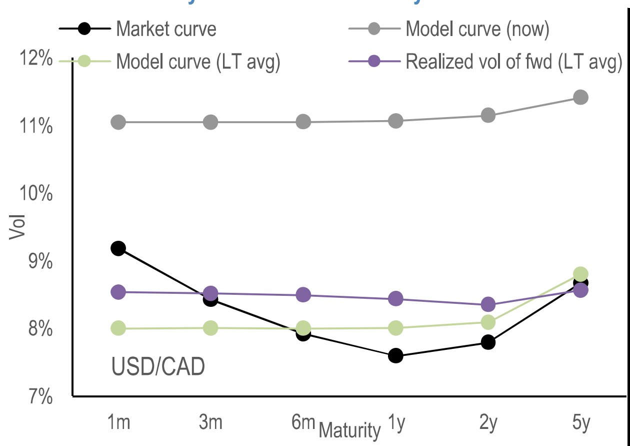
Source: J.P.Morgan

The second chart of Exhibit 2 shows that, for USD/TRY, a proxy of daily volatility is higher for the 1y forward than for spot market. Same analysis on shorter maturity contracts would find a higher R2 and a lower regression slope, indicating a lesser impact from the rates differential volatility and negative spot/forward points correlation. Also, same chart as applied to G10 pairs, on the back of the discussed positive ρ parameter, would find in all cases a lower proxy of daily volatility for the 1y forward if compared to spot. While in this piece we have taken the opposite stance, one could rely on the empirical observations of Exhibit 2 for inferring a proxy of ρ correlation parameter from empirical spot vs. forwards volatilities dynamics.

A proxy model for FX vol curves based on observed spot / rates differentials correlations. In order to build a self-consistent estimate of FX vol curves, we relax some of the earlier assumptions, by letting the quantities σ_{RD}, ρ become T-dependent. In other words, we proxy σ_S and, for each maturity T, σ_{RD}, ρ, with historical estimates over recent periods (3M for σ_S, ρ, 1y for σ_{RD}, in order to reduce estimation noise of the latter). We then plug these estimates into the formula for obtaining a FX vol curve based on recent historical observations. Allowing for T-dependent estimates accounts for the fact that longer dated rates differentials are typically less volatile than front-dated ones, while at the same time granting a degree of self-consistency for the determination of the whole curve, where the ρ spot/rates correlation parameter plays a crucial role. **The model we obtain is a proxy of how FX vol curves should look like were rates the sole driver of FX forwards dynamics.**

This model curve can be naturally compared with market values of implied vols in order to detect term-structure opportunities. As discussed, we proxy the parameter $\sigma_S$via a short-dated estimate of realized vol, although another perfectly acceptable candidate would have been a market value for short-dated vol (for instance, overnight vol). This arbitrariness in the choice of the curve pivot σ_S propagates to the whole curve, especially at the front, and makes us more comfortable in relying on the proxy model for highlighting RV curve dislocations rather than outright mispricing for a given maturity. Given that other factors than rates play out at the front of the vol curve, that short-dated vols are more sensitive to market sentiment, and that >2y vols are typically not very liquid, we'll monitor dislocations on the 1y-6M and 2y-1y segments, via 6M z-scores. These segments will possibly be sensitive to the rates structural effects herein highlighted and less to the flow / time series patterns impacting the front of the curves. Also, for such long-dated vols, the approximation of estimating rolling maturity rather than fixed expiry realized vols will be less severe.

Exhibit 3. Case study on USD/CAD. Summary of results on G10 curves.



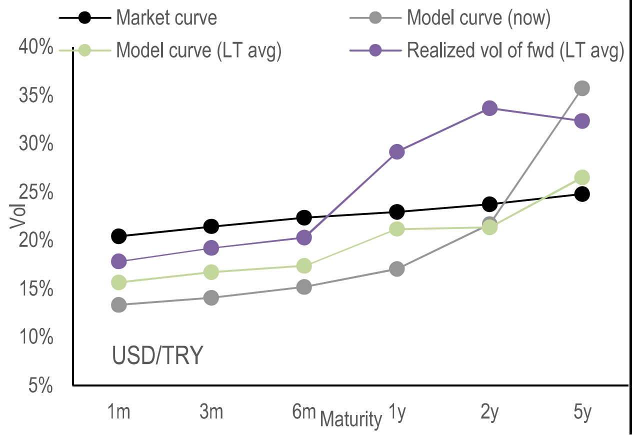
	RD (6M)	Spot Vol	RD vol (6M)	RD spot correl (6M)	RD spot correl (6M) - LT	1y-6m z-score	2y-1y z-score
ccy							
EUR	-0.9%	10.4%	0.7%	10.0%	25.7%	0.9	2.3
GBP	-0.2%	15.5%	0.7%	24.0%	23.4%	0.4	2.6
JPY	-0.8%	13.6%	1.2%	19.1%	10.6%	0.1	-0.7
CHF	-1.2%	9.7%	0.8%	-0.1%	10.9%	0.6	1.9
CAD	-0.2%	11.0%	0.5%	9.9%	22.3%	-0.8	1.0
AUD	0.0%	17.3%	0.7%	18.0%	24.2%	-0.6	1.1
NZD	0.3%	15.4%	1.1%	-2.5%	14.5%	-0.5	0.8
NOK	-0.1%	29.4%	0.8%	6.5%	23.2%	-0.7	-0.9
SEK	-0.4%	14.2%	3.8%	-13.6%	18.0%	1.9	-1.1

Source: J.P.Morgan

We now show the results of the model as applied to a set of G10 and EM curves. As a case study for G10 vols, we focus on USD/CAD (Exhibit 3, LHS). For maturities ranging from 1m to 5y, we show market curve (black line), model curve (grey line), long-term average of model curve (green line) and long term average of 3M realized vol for the forward contracts of different maturities (purple line). Current market curve is very much inverted up until 1y, on the back of Covid-19 and subsequent sharp drop in Oil prices leading up to higher short-dated vols. We note the mismatch in terms of vol levels between market and current model curves, as proxy of σ_S 3M realized vol is 1.4 vols above 1m implied vol. However, what we want to stress is that, with current positive ρ parameter, and low RD volatility (40bps per year), the resulting model curve is very flat, at least up to 1y-2y. Flat vol curve is also consistent with long-term averages of realized vols of forwards. Compared with market curve, this would favor buying 1y over 6m and 2y ones: this result is consistent with a recent vol recommendation, via one-touch calendars (*Express CAD vulnerability via OT calendars and limited downside CAD-RUB at-expiry digitals RV, Jankovic*, Duran-Vara, 23 April).

The summary of results across broader G10 space (Exhibit 3, RHS) shows a current positive correlation parameter in all cases except NZD and SEK, both marginally negative. The analysis finds that the 1y-6m segment on SEK and the 2y-1y segments on EUR, GBP and CHF are too steep.

Exhibit 4. Case study on USD/TRY. Summary of results on EM curves.



ccy	RD (6M)	Spot Vol	RD vol (6M)	RD spot correl (6M)	RD spot correl (6M) - LT	1y-6m z-score	2y-1y z-score
TRY	14.8%	12.6%	13.0%	-40.1%	-10.7%	-1.4	-5.9
HUF	0.4%	17.1%	1.1%	18.5%	16.7%	0.1	-0.7
PLN	-0.1%	15.0%	1.0%	37.2%	12.7%	-0.1	0.6
ZAR	3.5%	20.6%	1.2%	-20.2%	-8.9%	-1.3	0.0
RUB	5.0%	32.6%	1.9%	-64.9%	-6.5%	-1.2	-1.5
CNH	0.9%	5.4%	1.3%	33.6%	-13.3%	1.8	2.5
KRW	-1.1%	12.4%	2.3%	29.0%	21.2%	0.3	0.6
BRL	1.8%	17.9%	1.8%	14.9%	16.1%	-2.2	-4.1
MXN	5.3%	28.3%	1.4%	2.2%	-15.0%	-0.7	-1.5

Source: J.P.Morgan

We reprise TRY (Exhibit 4, LHS) for introducing results on EM curves. Current market curve is very flat, which contrast with the long-term behavior of forwards realized vols which is sharply upward sloping. The currently large negative spot/rates differential correlation (-41% for the 6M tenor) justifies an upward sloping model curve, roughly in line as far as shape with forwards long-term average realized vols. At present, the model would favor playing for a steeper curve in the 1y-6m and 2y-1y segments. **More broadly in EM** (Exhibit 4, RHS), **ρ parameter is also negative on RUB (-65%) and ZAR (-21%), supporting steeper vol curves**. Similar conclusions on the interplay between FX spot and forward points were drawn in an earlier research note (*Long-end EM FX vol cheap, curve too flat*, Sandilya, 23 August 2019). The model would currently support steeper curves on BRL and MXN, too, whereas it currently finds CNH curve too steep.

Linking structural features of vol curves with backtests of plain vanillas calendar trades. The following question is that of turning such curve dislocations into trade opportunities. Curves that exhibit the tendency of being very steep, like EM ones, driven by negative spot/rates differentials correlations, are natural candidates for playing long forward vol or conservative vol Carry (short Gamma / long Vega) constructs. In such cases, flattish curves can offer an already attractive entry point for playing the themes, allowing an implementation via plain vanilla or exotic structures (OT calendars as recently proposed are one such example). In the G10 space, where we have that seen rates drivers generally favor flatter curves, a more marked inversion of the curve might be required for playing successfully the short front / long back end of the curves. Otherwise, these cases might offer better potential for enter long front / short back end of the curves when being too steep. **In any case, the reasoning above generally favors RV structures long fwd vol in EM vs. short fwd vol in G10.**

Exhibit 5. 15-yr backtests of straddle calendar trades (-3M / +12M, held until expiry. No trading costs): G10 and EM USD pairs.

	Short 3m			Short 3m / Long 12m				Short 3m			Short 3m / Long 12m		
Pair	Ret	Vol	Sharpe	Ret	Vol	Sharpe	Pair	Ret	Vol	Sharpe	Ret	Vol	Sharpe
EUR-USD	2.8%	4.3%	0.65	1.5%	2.1%	0.69	USD-TRY	7.7%	7.2%	1.07	1.6%	4.1%	0.39
GBP-USD	0.2%	6.3%	0.03	0.1%	3.1%	0.02	USD-HUF	2.7%	5.0%	0.54	1.0%	2.6%	0.38
USD-JPY	1.9%	5.7%	0.34	0.9%	2.8%	0.34	USD-PLN	4.1%	4.8%	0.84	2.2%	2.4%	0.90
USD-CHF	-0.6%	9.0%	-0.06	-0.3%	4.5%	-0.07	USD-ZAR	4.6%	6.4%	0.72	2.2%	3.3%	0.68
USD-CAD	1.7%	3.5%	0.47	0.8%	1.8%	0.48	USD-RUB	4.9%	5.1%	0.96	0.2%	4.3%	0.04
USD-NOK	0.6%	5.0%	0.12	0.4%	2.5%	0.15	USD-CNH	3.3%	3.8%	0.87	1.4%	2.0%	0.71
USD-SEK	1.0%	4.5%	0.21	0.6%	2.2%	0.27	USD-KRW	5.9%	6.2%	0.95	3.0%	3.2%	0.95
AUD-USD	0.9%	7.6%	0.11	0.6%	3.5%	0.16	USD-BRL	6.7%	7.3%	0.91	3.0%	3.7%	0.81
NZD-USD	-0.2%	7.1%	-0.03	0.0%	3.4%	0.01	USD-MXN	6.0%	8.0%	0.74	2.7%	4.0%	0.67

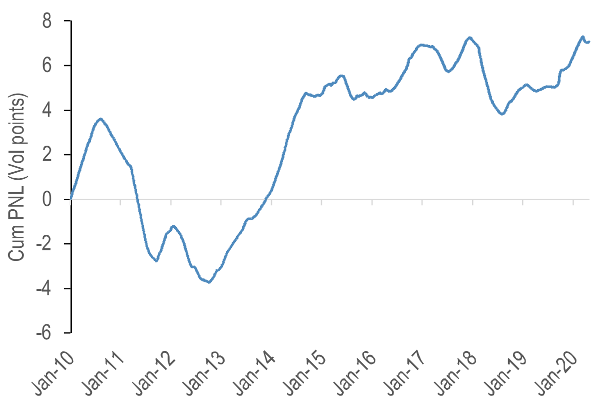
Source: J.P.Morgan

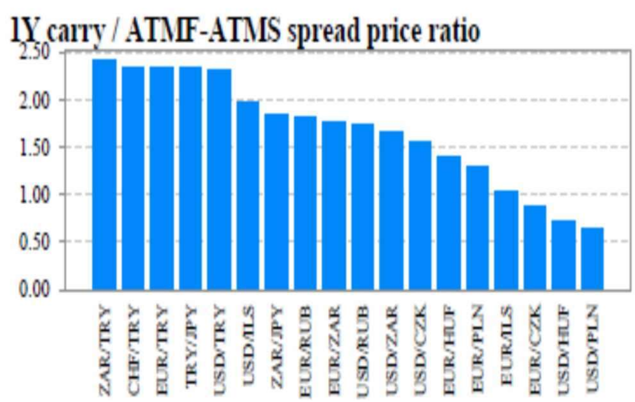
Other than FX/rates dynamics, another possible factor leading to different structural features on vol curves is that of central bank intervention, as discussed in previous research pieces (for instance *Front-end USD/CNH vol a high conviction short*, Sandilya, 5 February). When central banks have an interest in controlling spot fluctuations, as it often happens within the EM space, the Gamma-end of the curve is capped whereas the Vega end of the curve has more room to move, leading to steeper curves. Both rates and CBs factors can serve up well for explaining the empirical observation that short front / long back end calendar spread trades perform better in EM than G10 (Exhibit 5). In the charts, we compare the short 3M / long 12M calendar spreads of straddles, traded daily, held until expiry of the short leg (15yr of data). As the comparison of the strategies / currency groups is done for illustrative purposes only, we report results corresponding to the zero trading costs limit.

Current vol curve opportunities. Curves that exhibit the tendency of being very steep (notably TRY, RUB and ZAR – see Exhibit 4), driven by negative spot/rates differentials correlations, are natural candidates for playing long forward vol. For that reason, it is particularly interesting to look at the current shape of the USD/ZAR vol term structure. With USD/ZAR 6M at-the-money volatility at 18.6 vol points and the 6M x 6M volatility at 17.0 vol points, ZAR screens in our *FX Derivatives Analytics Chart-pack* as a top 3 6M x 6M FVA buy opportunity, given the inverted volatility curve. Hence, **a 6M x 6M FVA in USD/ZAR could form the long fwd vol leg of a RV play**, in order to hedge for a continuation of the risk-on sentiment and lower FX vols. For finding a good short fwd vol candidate, we screen for high beta currencies (in order to provide a good hedge) where the curve is flat / upward sloping, which have positive spot/rates differentials correlations (Exhibits 3 and 4), and where the macro picture is favorable. **AUD seems to meet all such conditions as a good short fwd vol candidate**.

AUD/USD 6M at-the-money volatility currently stands at 12.2 % and the 6M x 6M volatility at 11.5 % – thus a rather flat curve for this market environment. The macro picture is also favorable, our antipodean strategists see AUD at 0.65 by year-end, which represents a 1% appreciation from spot levels – even after the impressive 4.5% rally in AUD during the last 3 weeks. The argument behind this bullish outlook (see *AUD: Thinking through the drivers of recent out-performance*) is that key commodity prices for Australia's export basket (e.g. iron ore, coal) have remained elevated throughout the extreme volatility of the past month. Also, RBA's approach to unconventional monetary policy looks light, relative to the actions of other central banks (such as Fed and BoE). On top of that, Australia's out-performance in terms of its management of the COVID-19 outbreak seems remarkable - our Asian insurance analysts place Australia only third to South Korea and China in terms of progress on the global infection curve. Finally, Australia can likely stabilize the government debt to GDP ratio around 60%, while still running modest budget deficits (2.1% of GDP projected for 2020).

Exhibit 6. Favorable historical performance at 6M holding for a long USD/ZAR 6Mx6M FVAs vs. short AUD/USD 6Mx6M FVAs (positions held 6M, no trading costs). Current opportunities in the CEEMEA carry trade space via ATMF-ATMS constructs.





Source: J.P.Morgan

In contrast, our EM team maintains an UW in ZAR, while our year-end forecast for ZAR is set at 20.0 (6.4% down from current spot levels). This is because the COVID-19 crisis has exposed South Africa's existing vulnerabilities and transformed chronic problems of growth and public debt sustainability into a more acute liquidity problem (see *South Africa: Chronic problems become acute*). South Africa's initial conditions coming into the crisis were uniquely weak among major EM peers: the economy was already in recession with potential growth on a downward trajectory; social and economic reform was proving intractable; and a large fiscal deficit raised questions over debt sustainability. Only last week our South Africa's economists *revised the 2020 main government deficit projection* to an astonishing 16% of GDP. Debt/GDP is also set to widen to 71% by year-end. Furthermore, the policy options SA authorities may be contemplating (including CB bond purchases, measures to mobilize domestic savings pools, external assistance via FX swap lines, or an IMF program), are linked to important financial and political risks – such as capital outflows, uncertainty over a new monetary expansion regime, or stress in the bond market – and thus FX volatility.

Beyond the macro angle, **a RV play long forward vol on ZAR vs. short forward vol on AUD is also supported from a historical PnL standpoint**. Exhibit 6 shows that the historical performance of the trade, using 6M x 6M FVAs, during the past 10 years has been favorable (entering daily a new position held 6M, spreading unit of Vega notional over 6M and adjusting daily notionals accordingly, no trading costs for illustrative purposes). However, the low liquidity of FVAs in the current market conditions means that one should look at implementing the trade via delta-hedged straddles, in Gamma-neutral notionals. We point out that overstretched valuations of AUD and other G10 long-dated riskies might open the way for adjusting the strikes in order to optimize the structure to current market pricing.

We suggest:

- *Enter a short 6m @ 18.65 vols (choice) / long 1y @ 17.4/18.1 vols (indic) straddles on USD/ZAR (Gamma-neutral notionals), long 6m @ 12.2 vols (choice) / short 1y @ 11.6/12.1 vols (indic) straddles on AUD/USD (Gamma-neutral notionals. Keep both legs delta-hedged.*

The relative flatness of TRY vol curve can open the way for different constructs. Delta-hedged calendar trades (Exhibit 5, RHS) have exhibited a positive long-term performance and could work as a pure vol implementation of the flattish vol curve theme. Carry trades via vols would also benefit from the flat vol curves. On EUR/TRY, more appealing than USD/TRY due to comparable vol levels coupled with wider rates differentials, OTM EUR puts / TRY calls exhibit a positive roll-up of premia in the 3y to 2y segment, thanks to the wide level of the riskies, cheapening the cost of the long carry position. Otherwise, EUR/TRY, and TRY crosses in general, screen favourably for playing the carry theme via spread structures, again thanks to the substantial skew-led discount (Exhibit 6, RHS, from *FX Derivatives Analytics Chartpack*, Sandilya, 27 April).

We suggest:

- *Buy a 1y ATMF / sell a 1y 40delta EUR put / TRY call @ EUR 4.55% (strikes 8.8207 / 8.2433 respectively, spot ref. 7.5769)*

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