FX Derivatives Research Note

Extracting vol alpha using carry-to-risk signals

- This note aims to re-purpose the traditional carry-to-vol concept to mine for alpha in FX vol investing. Following that path, high carry/vol ratios are considered as potential vol buying opportunities, since they offer an attractive combination of (a) currently low vol that could potentially mean-revert higher and/or (b) elevated carry that partially offsets option time decay, reduces net option holding costs and permits patience in awaiting that mean-reversion.
- Carry-to-vol and period/period change in carry-to-vol trading signals prove to possess meaningful and robust predictive power for EM volatility trading and are able to extract vol alpha.
- Based on the carry-to-vol and period/period change in carry-to-vol framework, the current EM rankings favor EUR/INR and BRL crosses in general, and particularly EUR/BRL as preferred long vol buys. On the short vol side, we favor USD/PLN, USD/KRW and USD/MYR.

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See page 9 for analyst certification and important disclosures.

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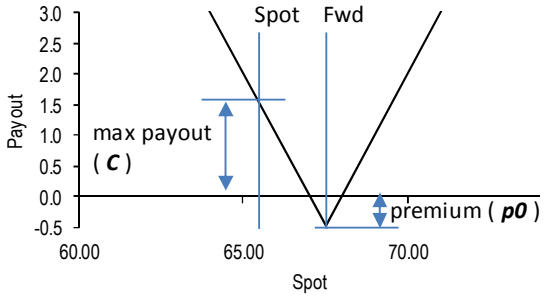
Inverting the carry-to-risk problem

After enduring a torrid time since the onset of the taper tantrum, FX carry trades have revived over the past three months as a mix of Fed dovishness and Chinese data stabilization has sparked a short-covering of deep underweight EM positions in global macro portfolios. It is common to reflexively associate this upturn with a compression in risk premia, and rightly so since FX volatility as measured by JPMorgan's VXY Global index has indeed subsided by more than 2% pt from its peak in early Q1. The causality in most investors' minds runs from vol to carry strategy returns, with a decline in the former indicating a benign shift in risk conditions that brings yield chasers out of the woodwork. This line of reasoning is best exemplified by the widespread use of **carry-to-vol ratios** in constructing carry baskets with the intent of buying assets offering the maximum yield pickup for a given unit of risk; previous JPMorgan research has extensively covered the efficacy of such metrics in extracting yield alpha across asset classes (see *JPMorgan's FX & Commodity Barometer, Normand et al. Sep 2004*).

This note seeks to re-purpose the traditional carry-to-vol concept to mine for alpha in FX vol investing. For directional investors, yield is the asset and volatility a nuisance, hence their ratio a natural lens for screening carry trades. For non-directional vol investors on the other hand, the denominator of that ratio *is* the asset, and interest rates a factor to be considered alongside time decay as a part of the total cost of option ownership. In this inverted view of the world, high carry/vol ratios are to be considered as potential vol *buying* opportunities, since they offer an attractive combination of (a) currently low vol that could potentially mean-revert higher and/or (b) elevated carry that partially offsets option time decay, reduces net option holding costs and permits patience in awaiting that mean-reversion.

Chart 1 illustrates this carry vs. vol trade-off for a stylized vanilla straddle in a high-yielding USD/EM pair. Both the USD call and the USD put are struck at the forward (ATMF strike), hence the USD put/EM call leg of the straddle is in-the-money relative to spot at inception. Option-based expressions of the traditional FX carry trade would involve buying only this leg of the straddle, a classical non-directional approach however needs to eliminate delta exposure by owning the USD call in addition. In this set-up, the straddle buyer pays p_0 for the option at inception in the hope of an outsized spot move one way or the other, but is still able to recoup the interest carry C at expiration if the view were to prove incorrect and spot were to remain unchanged over the life of the option – this is why high interest rates can help offset a part of the cost of owning options. C/p_0 is a measure of the payout / premium ratio of

Chart 1. Stylized payout profile of a vanilla ATMF straddle in a high-yielding USD/EM currency pair



Source: J.P.Morgan

the straddle in static markets and is the definition of carry / vol used in the rest of the note. This ratio tends to vary between 0 and 1 for most currencies, though there is no mathematically hard cap of 1. Note that $C = 0$ for a currency pair that has no yield differential (most of G10), hence no portion of the option premium may be recovered via rate carry.

The key difference between the traditional and inverted usage of carry/vol ratios is their assumption regarding the fundamental nature of volatility. The former assumes low vol to be persistent which allows yield to be earned with minimal noise, while the latter treats volatility as inherently mean-reverting and hence best purchased when entry levels are low and carrying costs small. These two diametrically opposite assumptions can be squared by distinguishing between their view horizons: persistence in realized volatility over short periods is consistent with financial literature and empirical experience (periods of low vol followed by periods of low vol etc.), while option-implied volatility tends to mean-revert with longer half-lives. For the same reason, traditional FX carry models tend to employ realized volatility as a risk signal, while option investors tend to focus on implied volatility as the transactable asset.

Can option-based carry/vol ratios extract vol alpha?

We hypothesize that carry-to-vol ratio is a leading indicator of vol and can be used to time entry into contrarian vol trades. Chart 2 and 3 compare G7 and EM VXY with the corresponding VXY weighted aggregate carry-to-vol indices (axis is inverted). The basic observation is that high volatility periods tend to coincide with low carry-to-vol and vice versa. The drop in carry-to-vol was largely coincidental with the sharp jump in VXY G7 around the 2008 GFC, but interestingly preceded the corresponding jump in VXY EM. We attach more weight to the latter, since the magnitude of yield differentials and the trade-off

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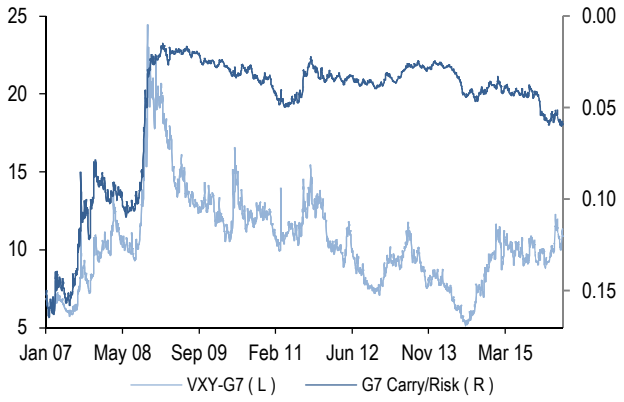
between carry and option prices is more meaningful for EM currencies than for G7. *Prima facie*, carry-to-vol holds promise as a leading indicator for EM vol investments.

We consider the following sets of signals in timing entry into long/short vol trades:

- **Carry-to-vol (CTV)**: Calculated as a ratio of *static* at-expiry payout of an ATMF straddle assuming spot unchanged from inception and the corresponding option premium as discussed in the previous section and illustrated in chart 1. This definition is a close relative of cash-based CTV that is used in the construction of classical carry trade baskets and typically expressed as (FX forward implied yield differential/realized volatility). The numerator in both cases is identical, while the denominator differs in using different measures of volatility – realized for cash and implied (or a transformation thereof – the option premium) for options. The trading rule we test buys vol in currencies where CTV ratios are the highest and sells where they are the lowest.
- **Period/period change in carry-to-vol**: Calculated as a rolling change in CTV ratios on a period/period basis. The intuition is that high frequency option traders could be chasing sources of marginal mean reversion in CTV ratios rather than targeting absolute levels as a vol buying (signal) signal. A crude analogy is that of macro investors responding to changes in short-end interest rates as a proxy for cyclical developments, which we capture in our *Alpha Chartpack* via a suite of interest rate momentum models. Absolute CTV ratios are also liable to become stale/unresponsive to short-horizon moves in the current environment as rates globally are likely-to-stay low for long near multi-year lows, and could miss short-term inflections in option markets. We test for various lookback windows to track CTV momentum, but settle on **two month changes**, roughly mirroring the half-life of implied vol changes. The trading rule we test buys vols in currencies where CTV ratios have improved the most and sells where they have declined the most.

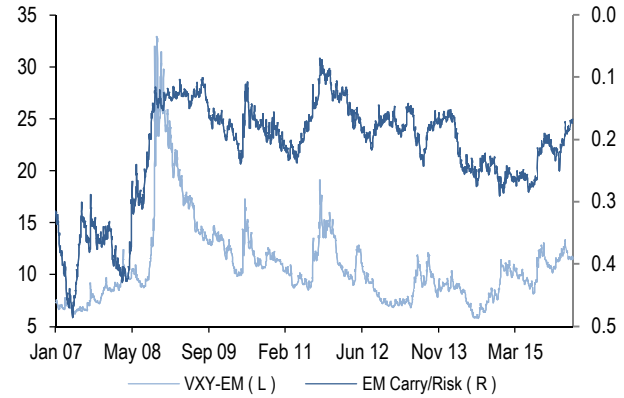
The general backtesting methodology is as follows. A long-short portfolio of 2N option positions, comprising of N equal notional-weighted long and N equal notional-weighted short straddles, is constructed based on CTV signals (we test N = 1,2,3). Each straddle is delta-hedged daily using option-expiry matched forwards/NDFs and smile forward deltas, and the portfolio is rebalanced monthly. Returns are expressed in vol points by dividing bp premia by at-inception option vega.

Chart 2. G7 VXY and G7 carry-to-vol are largely coincidental, limiting the potential of timing vol trade entry with carry-to-vol



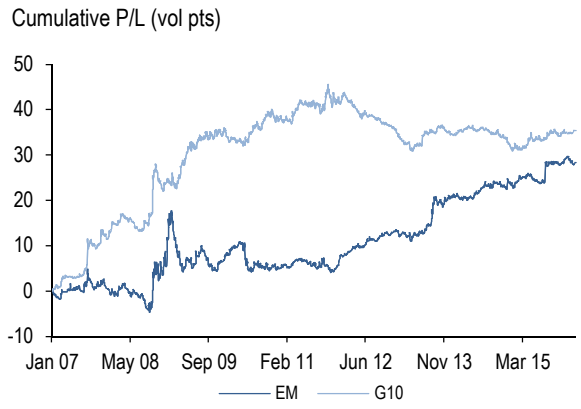
Source: J.P.Morgan and Bloomberg

Chart 3. On the eve of the 2008 crisis EM carry-to-vol dived ahead of the EM VXY's sharp rally.



Source: J.P.Morgan and Bloomberg

Chart 4. Cumulative P/Ls from buying top N carry/risk 6M tenor straddles and selling N lowest carry/risk straddles.
N = 3; 6M tenor options and no TC.



Source: J.P.Morgan

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Results: carry-to-vol based trading signals deliver decent Sharpe ratios

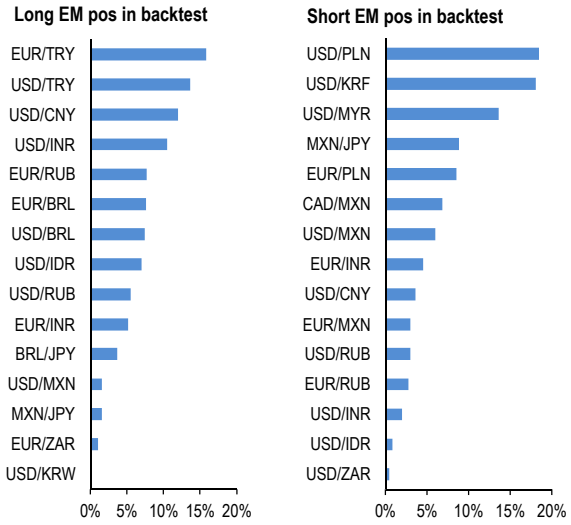
Carry-to-vol and period/period change in carry-to-vol possess meaningful and robust predictive power for volatility, delivering recently 5vols and 7vols in annualized return respectively at Sharpe ratios above 1.0 on our trading rule backtests. The heuristic on the ***level* of CTV ratio** was backtested on 6M straddles over the period 2007 – present, data issues limit extending the study across EM currencies in particular to the pre-2007 period. We backtest both the G10 and EM FX universe, the latter throws up the most material results.

- Chart 4 shows the cumulative P/L of the CTV *level* strategy for G10 and EM. The strong performance of G10 options from 2007 till 2012 came on the back of the long vol outperformance around the GFC and short vol returns thereafter. Returns have dried up since then with the onset of QE and the race to the bottom in DM yields as CTV ratios have dwindled to near historical lows and lost predictive significance.
- In contrast, the performance of the CTV level rule for EM vol was initially weighed down by losses on vol shorts during the period of post-Bear Stearns artificial calm in the run-up to the GFC, but found its footing after and has steadily accrued P/L now for more than 3 years.
- In order to ensure that results are not distorted by recurring selection of the same few currency pairs, we track currency representation in the backtests. Chart 5 shows the top 15 most frequently appearing pairs on the buy- and sell-vol lists for EM FX. Expectedly, usual suspects such as **TRY, BRL, INR** and **RUB** dominate the long entries, while **PLN, KRW, MYR** and **MXN** frequent the short entries; none however tops more than 20% of the selections, indicating reasonable diversification and churn in pair selection.

The period-over-period *change* in carry-to-vol ratio is constructed as a simple 2-month rolling change of the CTV ratio. The intent is to capture the buildup and drop-off in CTV ratios that precede swings in the vol environment. Chart 6 demonstrates the concept on 6M USD/BRL ATM vol as an example, and shows that the 2mo CTV change tends to lead material moves in vol. We focus exclusively on EM options in light of better CTV-level returns on EM rather than G10 vol.

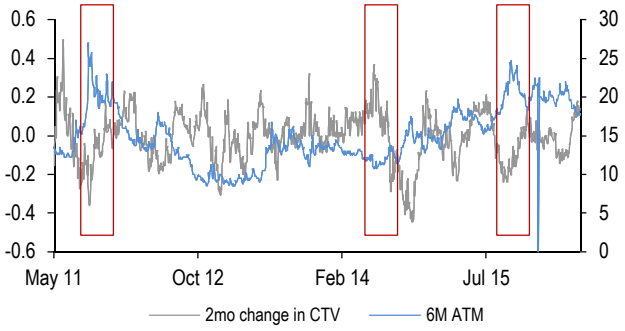
- Chart 7 shows the return stream for the "period/period" heuristic. The portfolio is constructed from buying straddles in top 3 ranked 6M tenor currencies and selling the lowest 3 ranked currencies. Returns from long and short portions of the portfolio are shown alongside the

Chart 5. Occurrence of long and short positions in the EM backtest (top 3 and bottom 3 are monthly selected for vol buy/sell).



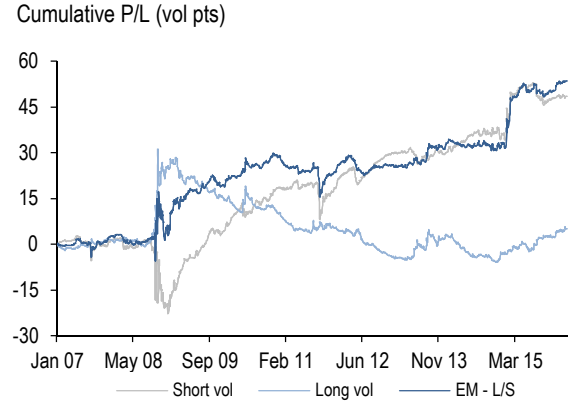
Source: J.P.Morgan

Chart 6. 2mo change leads the vol change in USD/BRL 6M ATM.



Source: J.P.Morgan

Chart 7. Cumulative P/Ls for EM portfolio (in vol pts). L/S designates long-short portfolio. N = 3. No TC.



Source: J.P.Morgan

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long/short portfolio in Chart 7. There is a fair balance of returns from long and short positions around the GFC. The largest quarterly drawdown, 8.6vols, occurred during the EMU crisis peak of Sep 2011.

- Note that relative to the carry-to-vol trading signal, P/Ls from the "period/period" signal are more volatile, but on average and over a long period of time demonstrated similar risk adjusted P/L performance.
- Chart 8, representing occurrence of the individual pairs in the backtest run, shows the backtest to be extensive enough for the trade signal to be considered broadly applicable. The rankings on the long and short list reproduce each other quite closely, demonstrating little pre-disposition for a currency to be persistently a long or a short candidate.

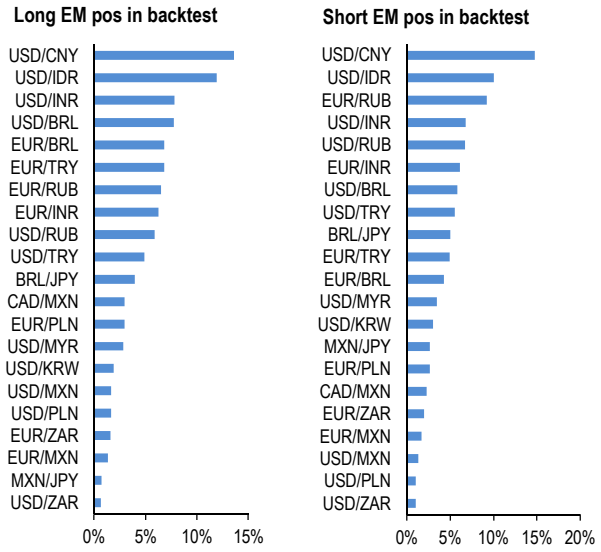
Summary return statistics for the period from 2007-present as well as for the truncated recent period (2012-present) for the two trading signals (carry-to-vol and 2mo change) are shown in Table 1. There is only a marginal distinction in performance difference between the two strategies. Returns are lower for the carry/vol ratio *level* signal, but so is the volatility, thus the resulting Sharpe Ratio is nearly identical to that of the period/period signal for the overall period (2007-present) and reaches a very solid 1.4 (vs. 1.1 for p/p) more recently. Considering different historical periods, the most notable feature is that inclusion of the GFC period increases volatility of returns by about 50%. Also, primarily boosted by that reduction in volatility of returns, Sharpe ratio jumps to above 1.0 for the post-2012 period. On the back of higher average returns in G10, the carry-to-vol strategy exhibits Sharpe Ratio of 0.71, beating 0.52 Sharpe in EM.

The two trading signals complement each other; current recommendations

Independently, the two suggested trading signals are able to deliver solid returns, 25+ vols cumulative since 2007 in case of the carry-to-vol signal and 50+vols in case of the "period/period" signal with a solid Sharpe Ratio (Table 1). In fact one could argue that period/period signal is preferred as it delivers better returns. However, "period/period" signal loses its edge at risk adjusted basis as P/L gains come at cost of increased volatility. The signals are complementary, with the carry/vol ratio historically delivering more consistent performance and the 2mo change signal delivering more volatile but larger P/L.

The rolling weekly correlation of returns between the CTV level and 2-month change heuristics over our sample period is near zero. To take advantage of potential diversification benefits, we construct a 50:50 portfolio of the two strategies. The returns of the portfolio equal the

Chart 8. Frequency of occurrence of pairs in long and short positions in the EM backtest (3 long/ 3short, selected monthly).



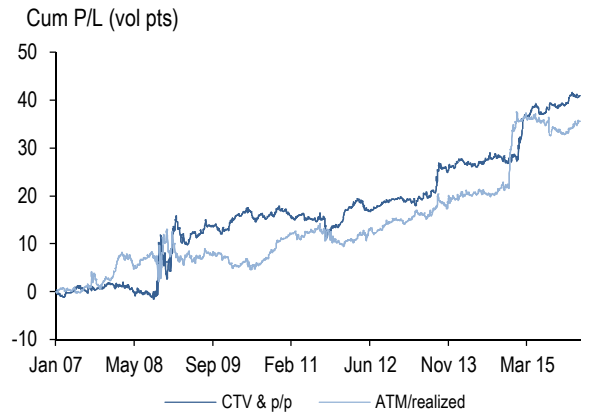
Source: J.P.Morgan

Table 1. Return statistics from carry/vol ratio and period/period changes in carry/vol.

	carry/vol ratio		2mo change in carry/vol	
	Overall	since 2012	Overall	since 2012
avg return (ann., vol pts)	3.0	5.3	5.6	7.0
StDev of ret (ann., vol pts)	5.7	3.7	9.6	6.3
Sharpe Ratio	0.52	1.41	0.59	1.11
Max monthly drawdown	7.9	1.5	7.9	3.0
Max quarterly drawdown	12.7	2.4	8.6	6.4

Source: J.P.Morgan

Chart 9. 50:50 L/S portfolio of carry-to-vol and period/period CTV shows comparable performance to the ATM/realized L/S trading signal. No TC. EM currencies universe.
ATM/realized signal buys 3 lowest and sells 3 highest currencies. Calculated as a ratio of 6M ATM and 1-month trailing realized vol.



Source: J.P.Morgan

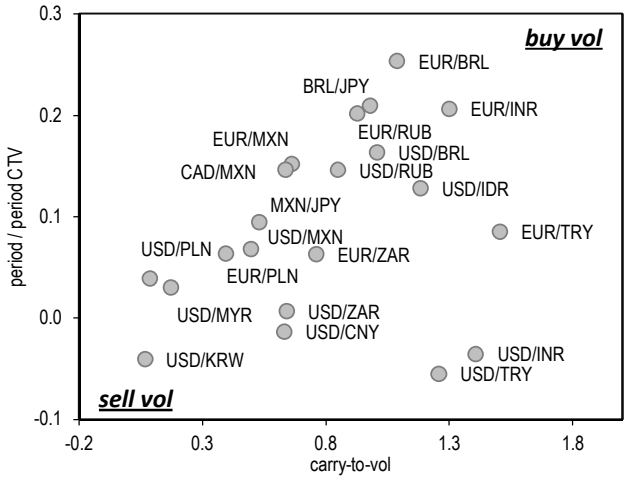
average of CTV and p/p series (to 4.3vols annualized from 3.0/5.6 for CTV and p/p, respectively), but the corresponding Sharpe Ratio increases to 0.76 (to 1.40 for 2012-present), up from 0.52/0.59 individually.

Do carry-to-vol ratios contain additional predictive power over and above traditional metrics such as implied / realized ratios? To answer this, chart 9 plots historical returns of our 50:50 CTV portfolio and compares it with those from a traditional long/short vol benchmark which buys options pricing the least ATM – realized vol premia and sells options containing the largest premium. Here, risk premium is calculated as a ratio of 6M ATM straddles and 1-month trailing realized vol. The performance of the two strategies is very comparable but shows a significant level of short term divergence demonstrating that the heuristics extract returns differently. In fact, correlation of weekly returns is slightly negative, at -0.16 (-0.37 for daily returns). Due to the higher efficiency of extracting short vol returns with the CTV based strategy and better ability in extracting long vol returns with the ATM/premium signal, the P/L series exhibit sporadic opposite dynamics.

The abovementioned complementarity between CTV and p/p in screening for L/S trades can be captured by a two-by-two matrix as in Chart 10, with the best buy and best sell candidates located in the diagonal corners, as highlighted in the chart.

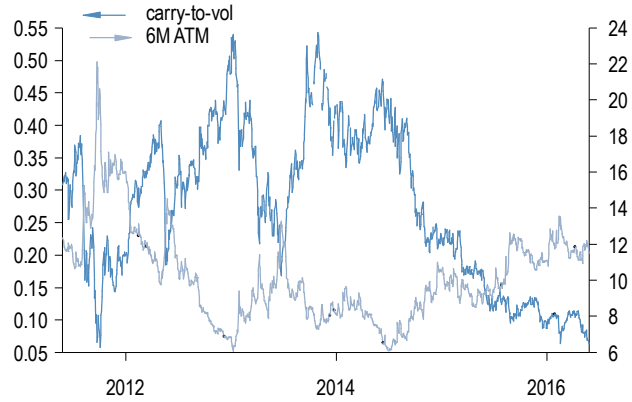
The current EM rankings for long vol, as shown in Chart 10, show preference for **EUR/INR** and BRL crosses in general, and particularly **EUR/BRL as preferred buys.** USD/BRL and BRL/JPY screen favorably as well. Favoring BRL vols is a sound proposition as implieds have dropped to their lowest levels since last August on the back of recent BCB intervention. Political and economic uncertainty remains high and the attractive vol levels make BRL one of our EM long vol favorites especially relative to its Latam peers (as e.g. discussed in BRL vs. CLP RV - see *FX Derivatives*). On the short vol side, we find some of the usual favorites such as **USD/PLN, USD/KRW** and **USD/MYR**. Following the uncertainty around Polish MPC policy course that loomed in Q1 and uncertain franc conversion developments, Polish Zloty risk premium has been elevated, though slightly less so more recently. USD/MYR we hold in our model portfolio as a short vol trade as USD/MYR has commanded one of the highest risk premiums in EM universe over last few weeks, thus it is not a surprise that we find it at the lower left side of the two-by-two recommendation matrix.

Chart 10.Two-by-two trade ranking matrix.



Source: J.P.Morgan

Chart 11. Carry-to-vol is near five year lows and ATM vol has been elevated since Q3 2015 for USD / KRW 6M options.



Source: J.P.Morgan

Appendix: Robust performance against currency universe and tenor selection

To determine robustness of the trading signal, the following analyses have been conducted: i) top 4 pairs (2 from long and 2 from short side) have been excluded and backtest repeated, ii) the number of top/bottom selections have been varied, iii) option tenor has been varied.

Carry-to-vol trading signal robustness testing

- Chart 12 makes comparison between the backtest run on a truncated currency population and the original set. The most dominant pairs were excluded, e.g. in EM: EUR/TRY, USD/TRY, USD/KRW and USD/PLN. The chart shows annual P/Ls. Both EM and G10 have demonstrated a solid level of robustness. Looking more closely, EM returns got redistributed across different time periods and the truncated population backtest

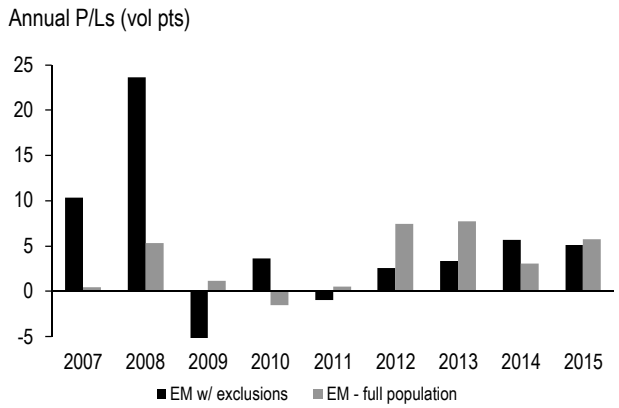
displayed more volatility, especially around GFC. More recently, e.g. in 2015, P/Ls show more consistency, giving confidence that the trade selection criteria can be applied generally within EM. Same exercise was repeated for G10. The most dominant pairs were excluded: AUD/USD, AUD/JPY, EUR/JPY and GBP/USD. The impact was more severe thank in EM, with 2008 and 2009 seeing 7vols and 3vols annual P/L shortfall, respectively. G10 backtest performance is more dominated by the top ranked currencies. Exclusion of AUD reduced the returns of the long vol part of the portfolio during the turbulent GFC years. On the other hand, exclusion of EUR, one of top ranked shorts, had a positive outcome for the returns in 2012-2014, when sovereign crisis weighed down on EUR/JPY short positions. The more recent returns marginally outperformed the original backtest run.

- We also analyze performance of the trading strategy when varying the number of pairs included into portfolio. Chart 13 shows the results of the analysis conducted on EM pairs. The portfolio consisting of 1 long/1 short pair outperformed the base case (3 long/3 short currencies) but exhibits higher level of volatility. Recent performance was quite comparable (N = 3 slightly outperforming N=1), with cumulative returns over the 5 year period reaching around 20-25vol pts, or 4-5vol pts annually. The corresponding analysis conducted in G10 has demonstrated similar behavior, the portfolio constructed of only one long and one short currency outperforming the base case portfolio (3 long/3 short). The results reinforce the notion that returns are concentrated in a few top performers and that diversifying a portfolio too much can hurt returns.
- The robustness to tenor selection demonstrates very modest sensitivity. The option and the trade signal tenors were matched. We test against 1Y tenor but do not consider 3M tenor since 3M options are more weighed down by time decay. As shown in Chart 14 for EM portfolio, there is little performance difference between 6M and 1Y. In G10, 6M tenor outperformed 1Y tenor during GFC due to a smaller impact from short vol pairs drawdowns. Moreover, gamma P/L contributes more in 6M than in 1Y tenor. However, outside the 2008-2009 period the difference between 6M and 1Y tenor performance is insignificant.

Robustness testing for the trading signal based on period/period change in carry-to-vol

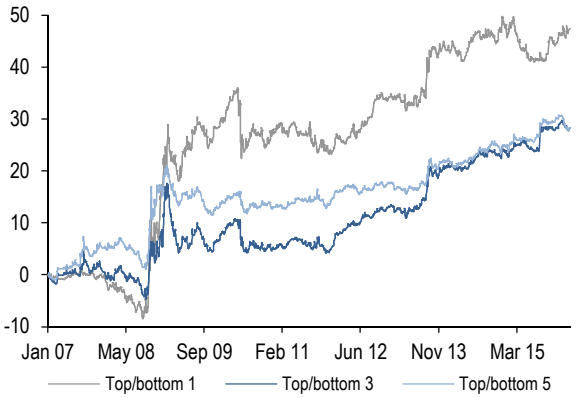
We follow same path of analysis as before and test the trading signal with respect to how generally applicable it is, as well as with respect to the portfolio size. We find the performance to be adequately robust.

Chart 12. Carry/vol robustness test: full EM population vs. the one excluding the dominant pairs: EUR/TRY, USD/TRY, USD/KRW and USD/PLN.



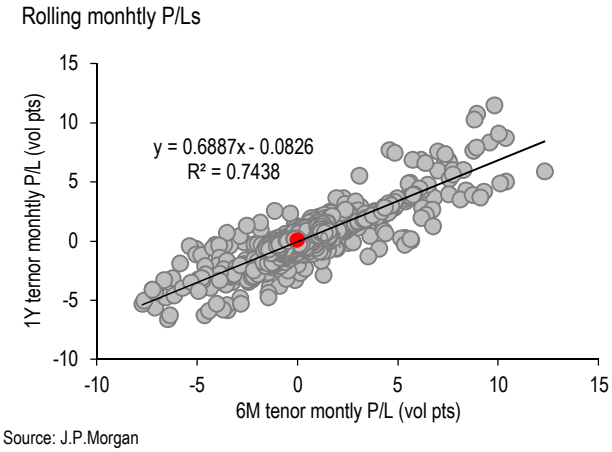
Source: J.P.Morgan

Chart 13. Robust EM performance with regard to the number of pairs selected into portfolio each month for carry/vol signal.



Source: J.P.Morgan

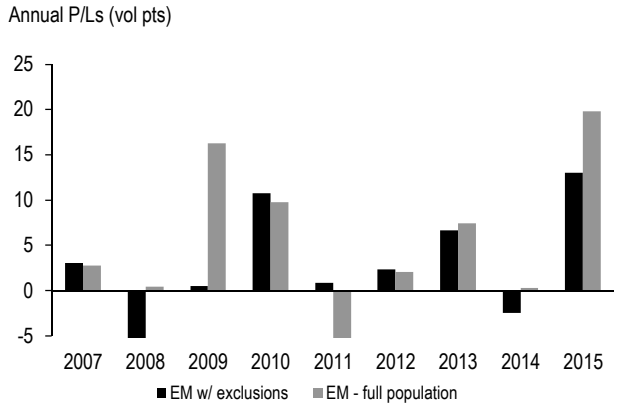
Chart 14. Tenor selection robustness for carry/vol: comparison of the strategy performance in EM for different tenors of straddles.



Source: J.P.Morgan

- Similarly to the carry/vol trading signal analysis, the returns got redistributed across different time periods, as Chart 15 shows for EM. The backtest ran on truncated currency population (the most dominant pairs have been excluded: USD/CNY, USD/IDR, USD/INR and USD/RUB) displayed more volatility of returns, with the largest deviation from the base run for GFC period.
- The more recent performance is more correlated with the base case, installing confidence in the approach and that the trade selection criteria can be applied generally within EM. However, the analysis raises the question if introducing a threshold for the trigger signal may be able to further improve the performance.
- The lookback window with two month changes to track CTV momentum roughly mirrors the half-life of implied vol changes. Table 2 shows sensitivity of the backtest on lookback window selection. The trading rule uses two month window.
- Robustness of the trading strategy on portfolio size has shown satisfactory result, Chart 16, but the analysis indicates a preference for some moderate diversification (e.g. 3long/3short or more pairs). The most concerning aspect being that too narrow portfolio (e.g. consisting of 1 long/1 short) has inconsistent performance over time, with prolonged periods of diminishing returns. That underperformance is consistent with the long position under delivering and the short position only offsetting the long leg time decay. We conclude that the performance of the trading signal is not accurate enough, so having more currencies in the portfolio improves the likelihood of capturing positive P/L.

Chart 15. Robustness test: full EM population vs. the one excluding the dominant pairs: USD/CNY, USD/IDR, USD/INR and USD/RUB.



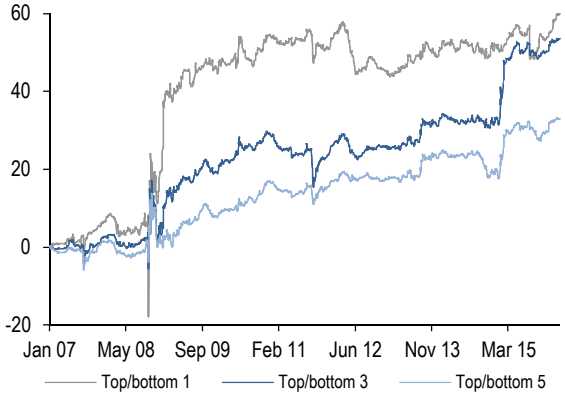
Source: J.P.Morgan

Table 2. Performance statistics as function of the lookback window.

2007-2016	3 mo	2 mo	1.5 mo
annualized returns	2.7	5.6	3.0
StDev	9.1	9.6	9.6
S.R.	0.30	0.59	0.31

Source: J.P.Morgan

Chart 16. Robust performance with regard to the number of pairs selected into portfolio each month.



Source: J.P.Morgan

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