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Late-cycle currency investing with FX options

Global FX Strategy
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- Given a universe of pre-determined directional currency moves, how does one construct a systematic efficient option strategy to position for late-cycle FX dynamics? We backtest various trading signals and their combinations (two-factor signals) for selecting baskets of live (non-delta hedged) FX options for late-cycle trading.
- Call/put spread structures show best robustness between the training (2002 - 2013) and test (2013 - present) data set.
- Forward points signals rank high on individual signals ranking and dominate the list of top performers for the two-factor signals. Fwd points signals show up in 9 out of top 10 two-factor signals in call/put spreads structures and in 8 out of top 10 signals for outright calls/puts.
- The best performance in currency selection is achieved with a two-factor signal consisting of monthly changes in 1-y zscore of forward point-to-vol ratio and monthly changes in 1-y zscore of FRIs. The two-factor signal holds well during the quiet periods where other signals tend to bleed P/L and reacts favorably during the stress episodes. Limited downside exposure of call/put spread options structures favorably limits the downside risk.
- The two-factor signal strategy managed to gain ~1500bp USD in P/L during the 2002-18 period. That compares favorably with the (a) smart options benchmark (currency selection based on 1-y zscore of fwd/ATM ratio and 1-y zscore of ATM) which finishes mostly flat, nevertheless a decent achievement, and (b) smart fwds benchmark (currency selection based on 6-mo price momentum and 1-y zscore of FRIs), which shows a few favorable spikes during the stress episodes but fails to hold onto those gains during the quite times. Smart fwds benchmark suffers cumulative ~1000bp USD loss during the 2002-18 period.
- **At current market, the two-factor signal recommends buying (1) 1Y ATM/25D EUR/TRY call spread or USD/TRY call spread, (2) 1Y ATM/25D EUR/BRL call spread or USD/TRY call spread or BRL/JPY put spread, and (3) within G10 1Y ATM/25D NZD/USD put spread, EUR/NZD call spread or NZD/CHF put spread.**

See page 10 for analyst certification and important disclosures.

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The late-cycle focus of global macro portfolios in 2019

The focal point for many macro investors entering 2019 was a long-in-the-tooth US business cycle that demanded greater defensiveness in portfolio construction than perhaps any other year in the post-GFC era. The wave of client enquiries we fielded around late-cycle FX option hedges in early January pointed to a broad-based desire to recession-proof portfolios while protection was still priced cheap, especially with the memory of 2H18's carnage in risk markets still fresh. That narrative appears to have evolved in a more constructive direction judging from the breakneck YTD rallies in equities, commodities and select EM FX, as well as the cratering of FX volatility to multi-year lows presumably due to a lack of option demand in such a benign climate. But with asset pricing running well ahead of current pace of global activity on three-pronged policy optimism around a dovish Fed, China fiscal stimulus and US/China trade détente, risks of a relapse to the less sanguine days of late '18 / early '19 cannot be ruled out (see *The pricing of great expectations when reality bites*, Meggyesi et al., March 1).

Accordingly, this note is penned with a 'prepare-don't-predict' dictum in mind: rather than take active views on recession timing and the associated hedging demand for FX volatility, we explore a systematic *timing-insensitive* framework for perma-hedging late-cycle risks that relies on efficient currency and option structure selection through time. The broad approach is consistent with the factor portfolio literature dedicated to investigating the predictability of the cross-section of asset prices; the key difference is that we are only interested in one extreme decile of the sorted factor portfolios – those that deliver the best defensive performance – as opposed to the long/short methodology applied to the farthest deciles favored in classical factor studies. The exercise can prove useful even for those not given to regular monthly option premium outlays on hedges, since discretionary timing filters can be independently overlaid on rule-based currency selection outputs.

The key results of this study are threefold. First, option structures can efficiently capture adverse episodes while minimizing the decay when portfolio construction is driven by late-cycle timing signals. Notably, call & put spread structures show best robustness and performance consistency. **Second,** among the late-cycle signals, forward points signals ranked consistently high: on individual signals ranking and among the top performers for the two-factor signals. **Third,** the best currency selection was achieved with a two-factor signal that blends a forward point-to-vol ratio signal and an FRI signal. Two-factor signal strategy shows ~1500bp USD in P/L (2002-18).

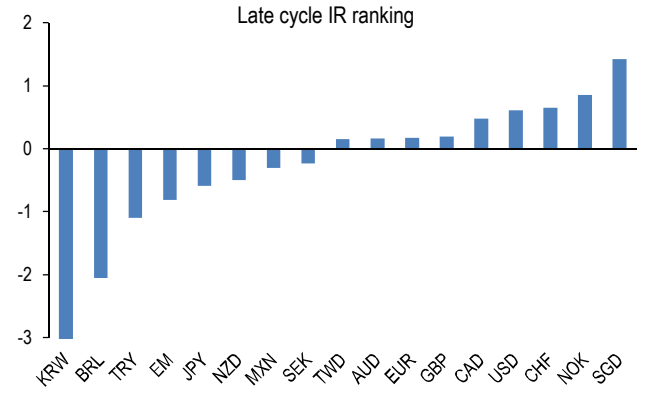
At current market, our composite factor model suggests as optimal hedge selection to be buying (1) 1Y ATM/25D EUR/TRY call spread or USD/TRY call spread, (2) 1Y ATM/25D EUR/BRL call spread or USD/TRY call spread or BRL/JPY put spread and (3) 1Y ATM/25D NZD/USD put spread, EUR/NZD call spread or NZD/CHF put spread.

Methodology

Building on prior JPM research on currency patterns in the late stages of a US expansion (*The best late-cycle trades*, June 14, Normand, and *Is it really coming home? Contingency planning in FX for the next recession*, July 10, Meggyesi) and expanding in scope, robustness we approach late-cycle FX investing using rule-based heuristics to select currency pairs that are then executed via naked (non-delta-hedged) vanilla options. This note extends our earlier study (Systematic late-cycle currency investing with FX options, Nov 21, Sandilya et al.) across currency universe, strikes, tenors and by extent of the robustness analysis.

Exhibit 1. NEERs, % change before and during US recessions. Ranking of currencies by their sensitivity to late cycles used as the basis for late-cycle directional FX options trading.
Information ratio = average FX change / standard deviation of FX change over the last 5 recessions. Excerpt from *Is it really coming home? Contingency planning in FX for the next recession*, July 10, Meggyesi.

	USD	CAD	BRL	MXN	JPY	AUD	NZD	KRW	SGD	TWD	EUR	NOK	SEK	CHF	GBP	TRY	EM
Average last 3 recessions																	
Year before recession started	2.1%	3.9%	-91.1%	-3.9%	-4.1%	-0.8%	-0.3%	-6.0%	4.4%	-2.5%	5.1%	2.4%	-3.2%	4.0%	-1.1%	-19.6%	-11.4%
Year after recession started	5.6%	-5.0%	-33.9%	-3.5%	13.4%	-4.4%	-6.5%	-10.2%	2.6%	-0.9%	-0.7%	-3.7%	-3.9%	3.2%	-7.1%	-25.5%	-6.5%
1Y before to 1Y after	7.8%	-1.3%	-94.1%	-7.2%	8.7%	-5.1%	-6.8%	-15.5%	7.2%	-3.4%	4.4%	-1.4%	-6.9%	7.3%	-8.2%	-40.1%	-17.2%
Average 5 recessions																	
Year before recession started	5.0%	2.8%	-86.5%	-1.4%	-5.0%	1.4%	-2.7%	-5.6%	5.1%	0.8%	1.3%	1.6%	-1.1%	2.8%	1.2%	-24.3%	-9.4%
Year after recession started	6.7%	-3.7%	-34.5%	-11.2%	12.0%	-2.5%	-6.0%	-10.4%	3.3%	-1.5%	-1.7%	-1.1%	-3.7%	3.1%	-1.0%	-30.0%	-8.5%
1Y before to 1Y after	12.0%	-1.0%	-91.2%	-12.4%	6.5%	-1.1%	-8.5%	-15.4%	8.6%	-0.7%	-0.4%	0.4%	-4.8%	6.0%	0.2%	-47.1%	-17.1%
Std. dev. over 5 recessions																	
Year before recession started	8.3%	6.0%	42.0%	4.3%	8.4%	8.7%	5.3%	1.8%	3.6%	5.3%	7.8%	1.8%	4.5%	4.4%	6.5%	22.2%	11.4%
Year after recession started	4.5%	7.4%	27.7%	21.7%	15.4%	11.0%	10.2%	14.5%	3.1%	3.1%	3.2%	7.9%	5.8%	5.5%	12.3%	11.1%	6.1%
1Y before to 1Y after	11.9%	5.5%	37.4%	20.8%	16.0%	9.5%	7.8%	14.1%	6.8%	4.9%	6.7%	6.5%	7.1%	3.7%	17.9%	24.0%	14.4%
Information ratio, 5 recessions																	
Year before recession started	0.60	0.47	**-2.06**	-0.31	-0.59	0.16	-0.50	**-3.06**	**1.42**	0.15	0.17	0.85	-0.24	0.64	0.19	**-1.10**	-0.82
Year after recession started	**1.50**	-0.50	**-1.25**	-0.52	0.78	-0.23	-0.58	-0.72	**1.07**	-0.47	-0.52	-0.14	-0.64	0.57	-0.08	**-2.71**	**-1.39**
1Y before to 1Y after	**1.01**	-0.18	**-2.44**	-0.60	0.40	-0.12	**-1.08**	**-1.09**	**1.26**	-0.13	-0.05	0.07	-0.68	**1.62**	0.01	**-1.96**	**-1.19**



Source: J.P.Morgan

Exhibit 1 is an extract from previous JPM research that displays the sensitivity of various currencies to US recessions; statistics that pertain to their behavior in the year prior to recessions (row of numbers highlighted in the table)

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was used as the basis for shortlisting and ranking currency pairs in order of their late-cycle sensitivity. The challenge of running a late-cycle FX option portfolio is the inherent timing uncertainty and consequently the penalty for carrying long option positions (particularly EM options) too early that often offsets gains from eventually favorable market moves. **The problem at hand boils down to the following: given a universe of pre-determined directional currency moves, how does one construct a systematic efficient option strategy to run those views?**

Since we have only one late-cycle episode in our historical sample for which option returns are available, we define success or otherwise of our strategy as its performance relative to a benchmark basket of forwards (designated in the text as "smart fwds benchmark"). The hope is that the defined maximum loss property of purchased options should help in mitigating losses vis-à-vis the control forwards basket in adverse markets (i.e., non late-cycle environments), without necessarily compromising on the degree of participation in favorable moves.

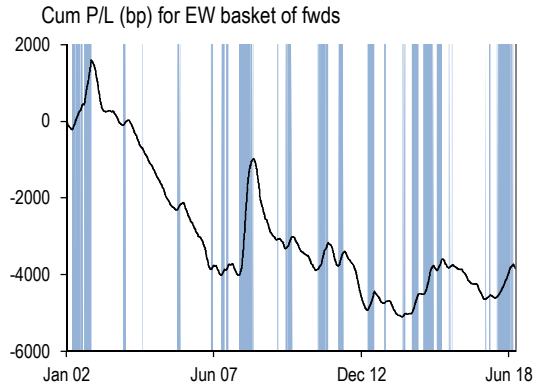
Signals: Starting with a set of FX pairs (both USD pairs and crosses – 34 currency pairs in total) that have a historical track-record of solid performance in late-cycle markets – essentially the high Sharpe Ratio entries from Exhibit 1 – we proceed to sort the universe by a set of conditioning variables as follows: we rank all pairs on a mix of macro, technical and volatility-based indicators one factor at a time and select the top N currency pairs to buy options in (e.g., N = 3 and 7 representing top decile and ventile for the overall currency population, respectively). Directional factors used are: (i) value – deviation of REER from 10 year average; (ii) growth momentum – 3-mo change in FRIs and EASIs, (iii) price momentum – 6-month % change in spot and (iv) rates markets differentials and transformations. Volatility-based factors used are: (i) ATM vol levels and their monthly change, (ii) risk-reversal levels and their monthly change, (iii) forward points relative to ATM vols, and (iv) ATM/realized vol ratio.

Currency instruments: We settle on standard option structures of type: (i) outright ATM, 35D, 25D and 10D calls & puts and (ii) ATM/25D and 35D/10D call & put spreads. Options tenors were 3M, 6M and 1Y. A holding period of 3 months was assumed for all options to keep portfolio churn in check. The universe of option structures used follows in line with historically observed direction of various currencies in late-cycle markets:

EM: USD/BRL call, USD/MXN call, USD/KRW call, USD/TRY call, BRL/JPY put, JPY/KRW call, EUR/BRL call, EUR/TRY call, AUD/SGD put, EUR/MXN call, USD/TWD call

Exhibit 2. Major positive P/L episodes of a basket of forwards across the full universe of late-cycle FX pairs (highlighted) are the basis for assessing historical performance of our option-based approach to late-cycle trading

Equally weighted basket of 1Y forwards across the full gamut of late-cycle FX pairs, rolled every 3-mo.



Source: J.P.Morgan

G10: AUD/USD put, NZD/USD put, USD/SEK call, USD/JPY put, AUD/JPY put, NZD/JPY put, CHF/JPY call, NZD/CHF put, NOK/SEK call, GBP/JPY put, EUR/JPY call, EUR/NOK put, EUR/NZD call, AUD/CHF put, EUR/CHF put, GBP/CHF put, EUR/USD put, EUR/SEK call, GBP/USD put, AUD/CAD put, GBP/CAD put, USD/CAD call, USD/CHF put, GBP/AUD call, EUR/GBP put, EUR/AUD call.

Transaction costs: 0.15, 0.2, 0.3, 0.4 and 0.5vol full b/o accounted for USD/G10, liquid, less liquid and illiquid G10 crosses and EM, respectively.

Portfolio construction: The goal is to maximize risk-reward by maximizing P/L during favorable directional move periods (shaded bars in Exhibit 2) while minimizing bleed during directionless markets and/or counter-directional spot moves. **We assess signal performance by analyzing historical returns from holding naked (non-delta hedged) FX options in currency pair(s) selected by the signal analyzed. 2002-2013 – 70% of the data set, represented our training data set while 30% was left out to be used in out-of-sample performance assessment (testing). We allocate 100bucks to the portfolio and distribute those 100bucks across N selected currencies according to 100/N/(option premium of ccy X), i.e., premium-weighted portfolio.** Note that this is different from our prior work, which used equal weighting. **Premium weighting accounts for currency risk and also puts on more similar footing outright calls/puts and call/put spreads, allowing for a comparison.**

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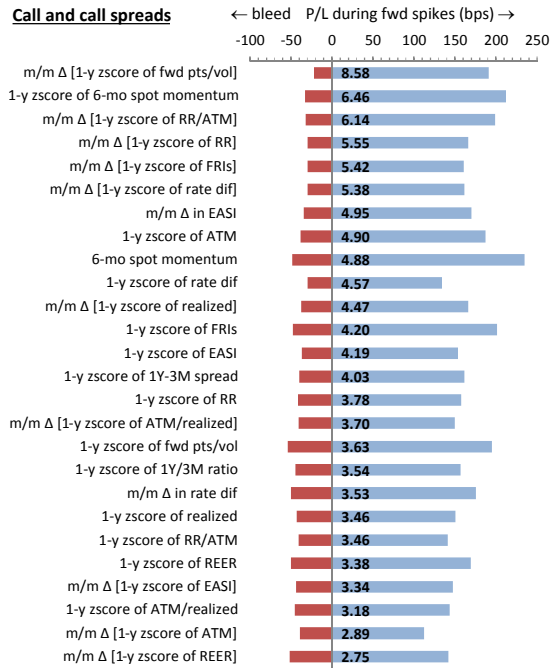
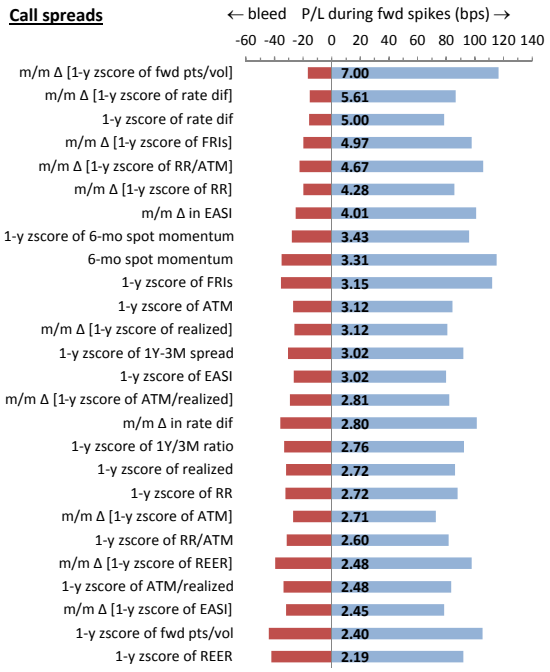
Exhibit 3. The trade-off between bleed during quiet periods and favorable P/Ls during the episodes of spikes in fwds (proxies for late cycle) – performance of outright calls/puts & call/put spreads …

34 currencies universe. The results calculated as an average across Nccys = 1, 3 & 5 (total of 100bucks invested in each cycle, distributed across structures inversly proportional to the option premium – same weighting scheme applied to fwds portflios), tenors = 3M, 6M & 12M, Thresholds for risk off events = 100, 150, 200 & 250bps and option strikes as follows: call spreads: ATM/25D and 35D/10D





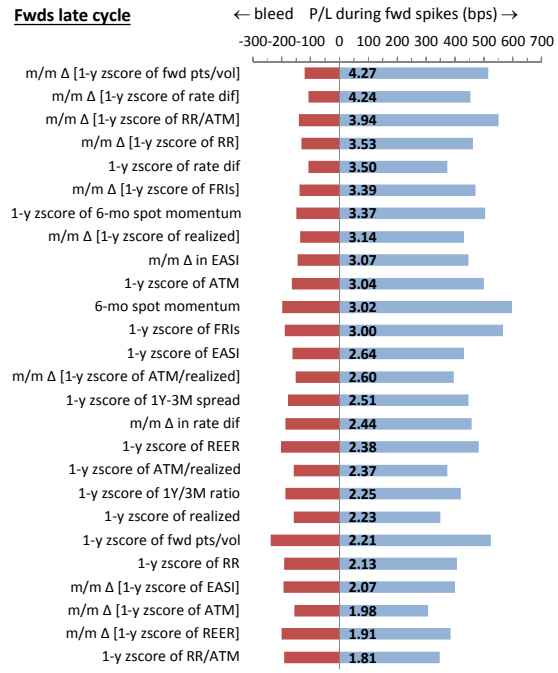
Source: J.P.Morgan

Benchmarking: We use "smart fwd benchmark" (based on 6-mo price momentum and FRI currency selection) and "smart option benchmark" (based on options value – ATM vol zscore – and carry). The fwd benchmark uses risk-based currency weighting.

Performance of individual signals

Exhibits 3 & 4 report the in-sample (2002-13) effectiveness of individual factors in choosing late-cycle candidates. Blue/red bars represent returns under two scenarios. #1 major positive P/L spikes of the equally weighted basket of forwards in magnitude exceeding four thresholds (each threshold is an independent analysis) 100, 150, 200 and 250bps (shaded regions in Exhibit 2; 200bp is ~ 0.5-sigma of positive forward P/Ls). #2 time decay and returns during counter-directional spot moves. **The exhibit represents average P/Ls across three different N ccys in portfolio, three tenors, four thresholds and six FX option structures (as noted in Exhibit 3).** We also note the ratio of the two as a measure of risk/reward; higher the ratio, higher the positive returns vs. losses. Losses typically accrue in sideways or wrong-way markets. The signals are ranked based on the risk-reward ratio. Exhibit 4 also reports

Exhibit 4. … and comparison with performance of portfolio of fwds.



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the performance of the fwd based portfolios against the same set of signals.

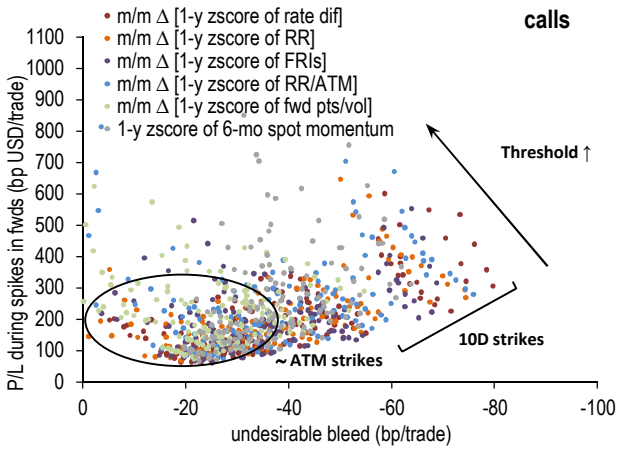
Top individual performers: For identically weighted portfolios, FX option structures risk/reward ratio beat forwards by 30-100%. Among the option structures choices, call & put spreads display more modest risk/reward ratios but due to low upfront premium paid show very low bleed characteristics. 100bucks investment risks losing 15-30bucks vs. gaining 80-120.

Top performing in-sample signals:

- **Forward points-to-vol ratio,** as identified in prior research (*here* and *here*), carry/vol signal has been found to time market's defensive tilt accurately. Within the context of the late-cycle directional trades, the signal identifies low-vol and attractively priced option opportunities, and identifies vulnerabilities to risk-off unwinds that are typically a positive sign for late-cycle trades.
- **Spot momentum**, trending spot can signal a change in macro or technical conditions that leads to increased demand for optionality from directional investors looking to participate in a trend who then push implied vols higher alongside. Note that the spot momentum signal is here defined in the risk-off direction.
- **Skew steepening**, an option markets proxy for emergence of or anticipation of upcoming flow pressures.
- **Forecast revision index**, reflecting change in analysts' expectations. Note that the signal is defined as the risk off ccy FRI net of the counter currency FRI.
- **Rate differential,** change in macro backdrop as captured in interest rates markets. Note that the signal is defined as the risk-off interest rate net of the counter currency interest rate.
- **Call/put spreads performance** (Exhibit 3 - RHS) shows a few distinctive characteristic: a) spot momentum ranking drops as capped upside structures are unable to efficiently utilize strong trends, b) rate differential signal's performance is little changed while c) skew steepening signals performance takes a leg lower with skew steepening and selling of OTM strikes in spread structures being at odds.

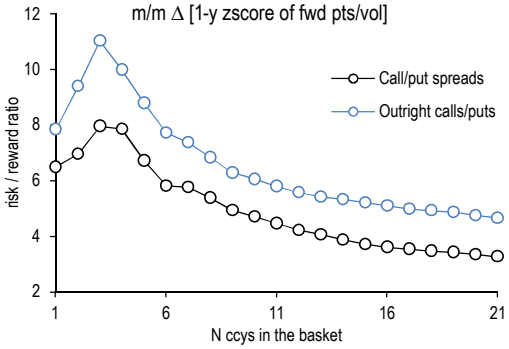
The in-sample scenario analysis in Exhibit 5 shows no warning signs. The top six signals exhibit similar degree of spread across the parameter space (the number of ccys in the portfolio, the tenors, the thresholds and the strikes). A couple of takeaways: The low delta strikes exhibit higher level of bleed, vega tenors display a lower upside P/L

Exhibit 5. In-sample scenario analysis for top 6 signals shows low differentiation across signals, stronger upside but also more bleed for low strikes and no major surprises.
Nccys = 1, 3, 5 & 10, 15, tenors = 3M, 6M & 12M, Thresholds for risk off events = 100, 150, 200 & 250bps and option strikes for outright calls: ATM, 35D, 25D and 10D.



Source: J.P.Morgan

Exhibit 6. In-sample scenario analysis for fwp pts signal on call/put spreads as function of # of currencies selected into the portfolio.
Average across tenors (3M, 6M, 12M) and thresholds for risk off events = 100, 150, 200 & 250bps. Outright vanilla strikes: ATM, 35D, 25D and 10D. Call/put spreads option strikes: ATM/25D & 35D/10D.



Source: J.P.Morgan

performance, weighed by a higher upfront premium. Higher threshold means that risk-offs are more narrowly defined thus more explosive and delivering more P/L. Exhibit 6 shows an analysis for fwp pts signal on call & put spreads as a function of the number of currencies selected into the portfolio. The bottom line is that a basket consisting of top decile outperforms. The 2-4 currencies optimum as per Exhibit 6 for fwds pts signal should not be taken too literally. Some of the other highly ranked signals show strictly monotonically declining performance with increase in the # of currencies in the portfolio basket (i.e., peak at # of currencies = 1). A peak occurring outside of the first

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decile would be a strong warning sign. In the multi-factor study below we do a deep dive the currency deciles.

Multi-factor signals performance & robustness

In order to shift the needle further in the direction of minimizing time decay while maximizing returns, we explore multi-factor signals (i.e., multiple signals simultaneously used in selecting currencies). The idea is that multi-factor selection criteria could be able to marry low decay signals (that possibly haven't been too great in timing the spikes) with the signals that accurately time spikes. On net, the aim is to have less decay while reducing high P/L misses. The constructs are nonlinear and also admittedly typically less robust (thus more thorough robustness analysis). **Multi-signal construction:** While there are myriads of ways to combine multiple signals into a score (and none without pitfalls of selection ambiguities and/or spurious selection of underdogs) **we rely on Q-score**, which is more typical in stocks selection. If Xi, Yi, Zi, etc., are the values of the signals X, Y and Z for the ith currency in a universe of N currencies (i.e., i = 1 to N), then a) normalize each conditioning variable for the ith currency across the currency universe as $x_i = [X_i - avg(X_1, X_2, \dots X_N)]/, stDev(X_1, X_2, \dots X_N)$, and equivalently for signal Y and Z and b) combine the X, Y and Z signals in a multi factor signal $w_1 x_1 + w_1 y_1 + w_1 z_1$ where the default for $w_1 = w_1 = w_1 = 1/3$. For a two-factor signal the weights would be 1/2. The normalization step sets different signals on the same footing and assures that no signal dominates purely on its intrinsic non-signaling properties, e.g., magnitude or range. The portfolio and signal selection parameters (i.e., currency baskets, tenors, strikes, thresholds) in our backtest remain same.

Exhibit 7 ranks top 10 two-factor signals based on the risk/reward criteria (P/L during risk offs vs. the bleed during calm periods). We show risk/reward across various portfolio baskets (3 currencies, 7, 10, 14, etc, representing the six reference decile baskets). The ratio measure should be approximately monotonically declining, in order to demonstrate the value of the currency selection signal. Poorly performing signal would have tendency to show a poor differentiation between the deciles or even worse, a better performance of the bottom deciles, which would indicate that the signal is selecting underperforming currencies. While there are 325 combinations of the original individual signals, some are unsuitable. For example we exclude the two-factor signals of the following type: m/m change in rate differential, crossed with rate differential, i.e., two times the same signal but different transformation. Such signals are perfectly legitimate but our preference is for having the signals crosses between fundamentally different

Exhibit 7. Top 10 two-factor composite trading signals based on risk/reward ratio. 9/10 and 8/10 involve fwd pts signal in call/put spreads and outright calls/puts, respectively.
Average across tenors (3M, 6M, 12M) and thresholds for risk off events = 100, 150, 200 & 250bps. Outright vanilla strikes: ATM, 35D, 25D and 10D. Call/put spreads option strikes: ATM/25D & 35D/10D.Deciles: 1st – 3 ccys, 2nd – 7, 3ed – 10, 4th – 14, 6th – 21 and 10th – 34 currency in portfolio basket.

In-sample	# currencies deciles					
Top 10 two-factor signals (based on risk/reward)	**1st**	**2nd**	**3ed**	**4th**	**6th**	**10th**
Call/put spreads						
m/m Δ [1-y zscore of fwd pts/vol] / m/mΔ [1-y zscore of FRIs]	10.9	5.5	4.5	3.9	3.5	3.0
m/m Δ [1-y zscore of fwd pts/vol] / 1-y zscore of EASI	7.1	5.3	4.5	4.0	3.5	3.0
m/m Δ [1-y zscore of fwd pts/vol] / 1-y zscore of FRIs	6.7	5.5	4.8	4.1	3.7	3.0
m/m Δ [1-y zscore of ATM] / m/mΔ [1-y zscore of fwd pts/vol]	6.7	5.5	4.6	3.8	3.2	3.0
m/m Δ [1-y zscore of rate dif] / m/m Δ [1-y zscore of fwd pts/vol]	6.1	5.1	4.4	3.7	3.3	3.0
1-y zscore of 1Y/3M ratio / m/m Δ [1-y zscore of fwd pts/vol]	5.5	4.2	4.0	3.5	3.2	3.0
m/m Δ [1-y zscore of realized] / m/m Δ [1-y zscore of fwd pts/vol]	5.4	4.6	4.4	3.8	3.3	3.0
m/m Δ [1-y zscore of fwd pts/vol] / m/mΔ [1-y zscore of EASI]	5.3	4.1	3.8	3.4	3.1	3.0
1-y zscore of 1Y-3M spread / m/m Δ [1-y zscore of fwd pts/vol]	5.2	4.2	4.0	3.5	3.2	3.0
m/m Δ [1-y zscore of rate dif] / 1-y zscore of FRIs	5.2	4.9	4.3	3.6	3.3	3.0
Outright calls/puts						
m/m Δ [1-y zscore of rate dif] / m/m Δ [1-y zscore of fwd pts/vol]	11.2	7.3	5.9	5.1	4.6	4.2
m/m Δ [1-y zscore of fwd pts/vol] / m/mΔ [1-y zscore of FRIs]	11.2	7.0	5.9	5.3	4.7	4.2
1-y zscore of 6-mo spot momentum / m/m Δ [1-y zscore of fwd pts/vol]	9.8	6.1	5.6	5.3	4.9	4.2
m/m Δ [1-y zscore of fwd pts/vol] / 1-y zscore of FRIs	7.8	6.6	6.3	5.7	5.0	4.2
6-mo spot momentum/ m/m Δ [1-y zscore of fwd pts/vol]	7.7	6.4	6.0	5.6	5.2	4.2
1-y zscore of 6-mo spot momentum / 1-y zscore of REER	7.6	7.2	6.1	5.4	4.6	4.2
6-mo spot momentum/ m/m Δ [1-y zscore of FRIs]	7.2	5.8	5.2	5.0	4.7	4.2
m/m Δ [1-y zscore of realized] / m/m Δ [1-y zscore of fwd pts/vol]	7.2	6.5	6.0	5.1	4.5	4.2
m/m Δ [1-y zscore of fwd pts/vol] / m/mΔ in rate dif	7.2	5.7	5.2	4.9	4.6	4.2
m/m Δ [1-y zscore of fwd pts/vol] / 1-y zscore of EASI	7.1	6.8	6.2	5.5	4.7	4.2

Out-of-sample	# currencies deciles					
	1st	**2nd**	**3ed**	**4th**	**6th**	**10th**
Call/put spreads						
m/m Δ [1-y zscore of fwd pts/vol] / m/mΔ [1-y zscore of FRIs]	7.8	6.8	5.6	4.9	4.7	5.1
m/m Δ [1-y zscore of fwd pts/vol] / 1-y zscore of EASI	7.0	7.0	6.3	5.6	6.1	5.1
m/m Δ [1-y zscore of fwd pts/vol] / 1-y zscore of FRIs	6.1	4.4	4.4	4.7	5.0	5.1
m/m Δ [1-y zscore of ATM] / m/mΔ [1-y zscore of fwd pts/vol]	23.1	7.8	6.4	5.9	5.7	5.1
m/m Δ [1-y zscore of rate dif] / m/m Δ [1-y zscore of fwd pts/vol]	5.6	4.9	4.6	4.7	4.7	5.1
1-y zscore of 1Y/3M ratio / m/m Δ [1-y zscore of fwd pts/vol]	11.6	7.3	7.0	5.9	5.1	5.1
m/m Δ [1-y zscore of realized] / m/m Δ [1-y zscore of fwd pts/vol]	7.4	5.4	5.5	5.8	5.4	5.1
m/m Δ [1-y zscore of fwd pts/vol] / m/mΔ [1-y zscore of EASI]	12.4	9.4	6.6	6.0	5.2	5.1
1-y zscore of 1Y-3M spread / m/m Δ [1-y zscore of fwd pts/vol]	11.3	7.6	6.3	5.6	5.1	5.1
m/m Δ [1-y zscore of rate dif] / 1-y zscore of FRIs	8.0	6.7	6.1	5.5	5.1	5.1
Outright calls/puts						
m/m Δ [1-y zscore of rate dif] / m/m Δ [1-y zscore of fwd pts/vol]	2.3	2.1	2.1	2.1	2.0	2.0
m/m Δ [1-y zscore of fwd pts/vol] / m/mΔ [1-y zscore of FRIs]	3.8	2.9	2.4	2.2	2.0	2.0
1-y zscore of 6-mo spot momentum / m/m Δ [1-y zscore of fwd pts/vol]	2.4	2.2	2.0	1.8	1.8	2.0
m/m Δ [1-y zscore of fwd pts/vol] / 1-y zscore of FRIs	2.8	2.3	2.2	2.1	2.0	2.0
6-mo spot momentum/ m/m Δ [1-y zscore of fwd pts/vol]	3.7	3.0	2.5	2.2	2.0	2.0
1-y zscore of 6-mo spot momentum / 1-y zscore of REER	4.0	1.6	1.4	1.3	1.4	2.0
6-mo spot momentum/ m/m Δ [1-y zscore of FRIs]	6.5	4.5	3.4	2.6	2.1	2.0
m/m Δ [1-y zscore of realized] / m/m Δ [1-y zscore of fwd pts/vol]	2.9	2.2	2.2	2.3	2.2	2.0
m/m Δ [1-y zscore of fwd pts/vol] / m/mΔ in rate dif	2.5	2.3	2.2	2.1	2.1	2.0
m/m Δ [1-y zscore of fwd pts/vol] / 1-y zscore of EASI	3.2	3.0	2.7	2.4	2.4	2.0

Source: J.P.Morgan

signals, e.g., fwd pts and FRIs.

A few observations about the two-factor signals:

- Fwd points signals show up in 9 out of top 10 two-factor signals in call/put spreads structures and in 8 out of top 10 signals for outright calls/puts. Note that fwd pts signal was also one of the top signals in Exhibit 3, the individual signals performance study.

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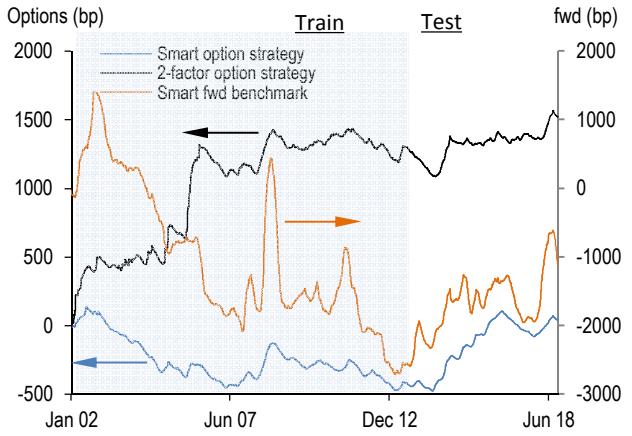
Exhibit 8. 2-factor call/spread option strategy wins in the horse race against the "smart option strategy' and fwd benchmark.

2-factor strategy = m/m z-score of fwpd pts/ATM ratio & m/m z-score of FRI. "smart option strategy" = zscore of ATM & zscore of fwds pts/ATM. fwd bencmark = price momentum (6M) & zscore of FRIs. Nccys = 3 tenors = 3M, 6M & 12M and option strikes: ATM/25D & 35D/10D.



Source: J.P.Morgan

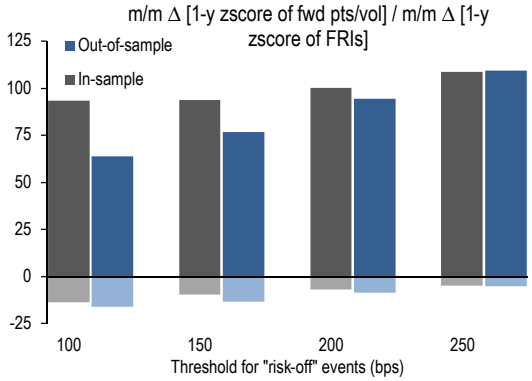
- FRI signals make a solid imprint within the top 10 outright calls & puts. The signals demonstrate high level of out-of-sample robustness in case of call & put spreads (Exhibit 7 – lower).
- With a few exceptions the strong performance translated well to the out-of-sample case, demonstrating a genuine value of the framework.

The two-factor call & spread option strategy (based on: m/m z-score of fwpd pts/ATM ratio & m/m z-score of FRI) wins in the horse race against the "smart options strategy benchmark" (based on zscore of ATM & zscore of fwds pts/ATM) and fwd bencmark (based on zscore of fwds pts/ATM ratio & zscore of FRIs) – Exhibit 8. The 2-factor strategy shows the P/L gently upsloping, a result of an efficient minimization of the quiet times bleed and maintaining of sensitivity to risk-off events. The limited downside exposure characteristics of the call & put spread options structures is a contributor to minimizing the bleed, as well. Next, we take a deep dive into the multi-factor signal performance with respect to the tenor selection, the "risk-off" events threshold, the strikes selection and the portfolio basket size (Exhibit 9, 10 and 11). Again, the focuses on the two-factor signal based on m/m change in 1-analysis y zscore of fwd pts/vol and m/m change in 1-y zscore of FRI and except for Exhibit 11 analyzes call & put spread structures specifically. The results can be generalized to the other top ranked two-factor signals.

Importantly, the main trends translate well from the in-sample to the out of sample. Risk/rewards ratios remain fairly consistent despite the in-sample period having an

Exhibit 9. Scenario analysis for call/put spread options as function of "risk-off" thresholds.

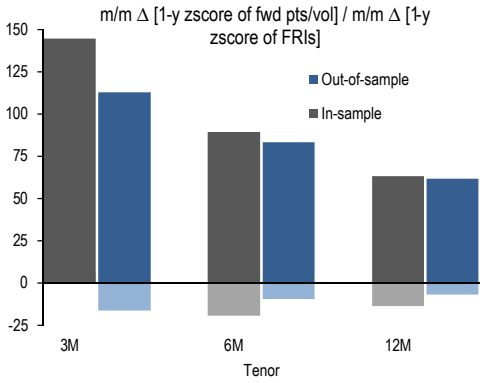
Nccys = 3 tenors = 3M, 6M & 12M and option strikes for call spreads: ATM/25D & 35D/10D.



Source: J.P.Morgan

Exhibit 10. Scenario analysis for call/put spread options as function of option tenors shows 3M tenor outperforming.

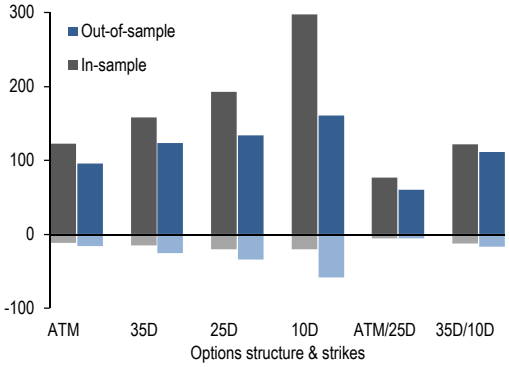
Nccys = 3, Thresholds for risk off events = 100, 150, 200 & 250bps and option strikes for call spreads: ATM/25D & 35D/10D.



Source: J.P.Morgan

Exhibit 11. Scenario analysis for top m/m 1-y zscore fwd pts – m/m 1-y zscore FRI as function of options and strikes.

Average across tenors (3M, 6M, 12M), thresholds for risk off events = 100, 150, 200 & 250bps and Nccys = 3.



Source: J.P.Morgan

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advantage of including the GFC period. The tenor analysis makes it clear that the in-sample results overstate the 3M outperformance and that investors should rather focus on 6M to 1Y tenors.

The in-sample low delta options outperformance needs to be considered with the GFC in mind. More modest "risk-offs" are more likely to exhibit behavior more similar to the out-of-sample, which is characterized by more decay and only marginally better positive P/L, thus a worse risk/reward. With the portfolio always buying 100bucks of premium, more option notional is owned with low premium (low delta) options. The call & put spread structures leverage that backdrop and offer better consistency between in- and out-of sample at a very attractive low decay.

Current Recommendations

We analyzed the late-cycle FX systematic trading using live (non-delta hedged) FX options to express directional risk-off view. We find that call & put spread structures show best robustness between the training (2002-13) and test (2013 - present) data set.

The best performance in currency selection is achieved with a two-factor signal consisting of monthly changes in 1-y zscore of forward point-to-vol ratio and monthly changes in 1-y zscore of FRIs. The two-factor signal holds well during the quiet periods where other signals tend to bleed P/L and reacts favorably during the stress episodes. Limited downside exposure of call/put spread options structures favorably limits the downside risk.

The two-factor signal strategy manages to gain ~1500bp USD in P/L during the 2002-2018 period. That compares favorably with the (a) smart options benchmark (currency selection based on 1-y zscore of fwd/ATM ratio and 1-y zscore of ATM), which finishes mostly flat, nevertheless a decent achievement, and (b) smart fwds benchmark (currency selection based on 6-mo price momentum and 1-y zscore of FRIs), which shows a few favorable spikes during the stress episodes but fails to hold onto those gains during the quite times. Smart fwds benchmark suffers cumulative ~1000bp USD loss during the 2002 – 2018 period.

Exhibit 12. The 2-factor signal favors TRY and BRL structures as the best late cycle positions.

CCY	OT	Rank
EUR-TRY	Call	1
USD-TRY	Call	2
EUR-BRL	Call	3
USD-BRL	Call	4
BRL-JPY	Put	5
NZD-USD	Put	6
EUR-NZD	Call	7
NZD-CHF	Put	8
GBP-USD	Put	9
EUR-SEK	Call	10
EUR-MXN	Call	11
USD-TWD	Call	12
USD-JPY	Put	13
EUR-GBP	Put	14
GBP-CHF	Put	15
USD-CAD	Call	16
NZD-CAD	Put	17
USD-MXN	Call	18
NZD-JPY	Put	19
GBP-JPY	Put	20
USD-KRW	Call	21
USD-SEK	Call	22
EUR-USD	Put	23
EUR-CHF	Put	24
AUD-USD	Put	25
GBP-CAD	Put	26
AUD-CHF	Put	27
NOK-SEK	Call	28
EUR-AUD	Call	29
GBP-AUD	Call	30
JPY-KRW	Call	31
AUD-JPY	Put	32
AUD-CAD	Put	33
AUD-SGD	Put	34

Source: J.P.Morgan

At current market, the fwdPts/ATM – FRI composite signal suggests buying (1) 1Y ATM/25D EUR/TRY call spread or USD/TRY call spread, (2) 1Y ATM/25D EUR/BRL call spread or USD/TRY call spread or BRL/JPY put spread, and (3) within G10 1Y ATM/25D NZD/USD put spread, EUR/NZD call spread or NZD/CHF put spread (Exhibit 12).

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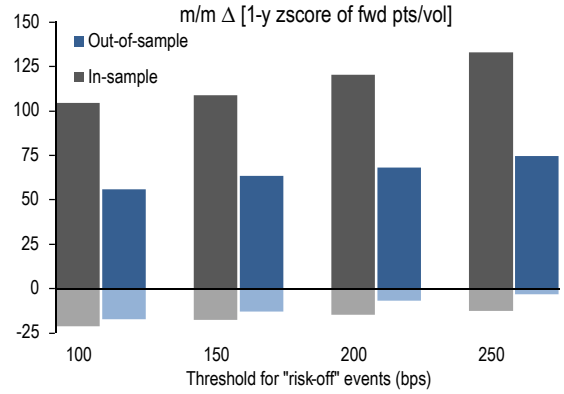
Appendix: Performance robustness of single factor signals

We take a deep dive into the performance of individual signals with respect to the tenor selection, the "risk-off" events thresholds and the strike slection in a similar fashion as done in the case of the multi-factor signals. Recall that in-sample is based on 2002-13 (70% of the data) and out-of-sample 2013-18. The main trends translate well from the in-sample to the out-of sample. As in the multi-factor case the risk/rewards ratios remain fairly consistent despite the in-sample period having an advantage of including the GFC period. Also, the tenor analysis makes it clear that the in-sample somewhat overstates the 3M outperformance.

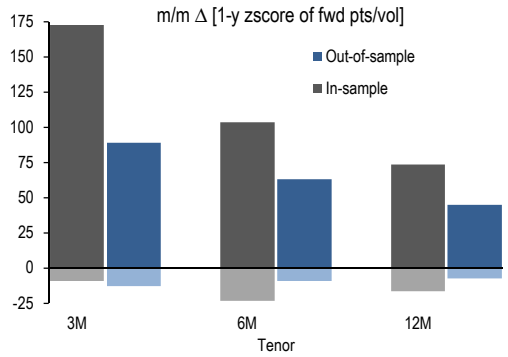
Again, the low delta options in-sample outperformance needs to be considered with the GFC in mind. More modest "risk-offs" are more likely to exhibit behavior similar to the out-of-sample, thus more bleed and consequently a modestly worse risk/reward.

Exhibit 14. Scenario analysis for fwp pts signal on call/put spreads as function of "risk-off" thresholds.
Nccys = 1, 3, 5, tenors = 3M, 6M & 12M and option strikes for call spreads: ATM/25D & 35D/10D.



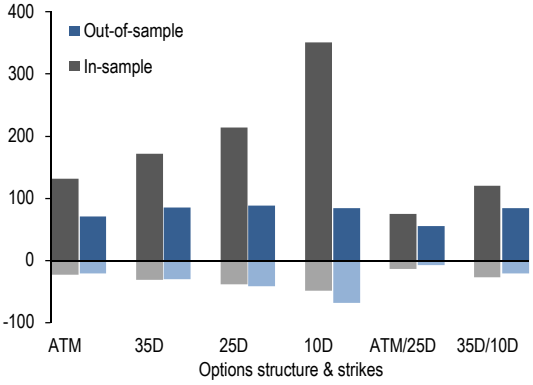
Source: J.P.Morgan

Exhibit 15. Scenario analysis for fwp pts signal on call/put spreads as function of option tenors shows 3M tenor outperforming.
Nccys = 1, 3, 5, Thresholds for risk off events = 100, 150, 200 & 250bps and option strikes for call spreads: ATM/25D & 35D/10D.



Source: J.P.Morgan

Exhibit 16. Scenario analysis for top 6 signals as function of options and strikes.
Average across tenors (3M, 6M, 12M), thresholds for risk off events = 100, 150, 200 & 250bps and Nccys (1,3 and 5).



Source: J.P.Morgan

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