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Global Quantitative & Derivatives Strategy
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Pick your best FX hedges

A scorecard approach for selecting FX hedging instruments

- **The value of using FX options for hedging multi-asset portfolios and as part of corporate hedging programmes has been extensively covered in previous J.P. Morgan research pieces. In this study, we aim at tackling a different topic, namely, whether it is possible to dynamically choose between hedging instruments as market conditions change, for different currency pairs.**
- **On EUR/USD, the cost of carry EUR-based companies need to pay on their forward hedges has risen to multi-year highs. Similarly, the current depressed level of volatility makes vol-based hedges attractive. Elevated cost of carry is usually a structural consideration when hedging EMFX risk as well. However, the interplay between different pricing parameters might vary with time, and strongly depend on the FX pair considered. This motivates the goal of systematizing the selection process into a rule-based one.**
- **We will monitor a set of derivatives instruments financial institutions and corporates commonly trade as part of their FX hedging programmes. We will introduce a scorecard-based dynamic selection process which allows choosing across the different instruments based on the pricing of relevant market parameters.**
- **Average long-term scorecard-based allocations to forwards, over time and across currencies, are around 35%: the rest would be attributed to volatility instruments. The scorecard-based allocation allows reducing hedging cost vs. forwards by around 110 bps per year, when averaging over all currencies herein considered.**
- **At present, allocation to forwards is well below long-term averages for G10 currencies. For EUR/USD, wide forward points, low vol and negative sign of market skew currently favor allocating around 95% to option-based hedges and just 5% to forwards.**
- **For EM, in a few cases the current allocation to forwards is well above long-term averages. This can be understood via the latest price momentum indicators flagging a bearish environment for EMFX and by tight EM-USD rates differentials.**

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Lorenzo Ravagli, PhD AC
(44-20) 7742-7947
lorenzo.ravagli@jpmorgan.com
J.P. Morgan Securities plc

Dobromir Tzotchev, PhD
(44-20) 7134-5331
dobromir.tzotchev@jpmorgan.com
J.P. Morgan Securities plc

Marko Kolanovic, PhD
(1-212) 622-3677
marko.kolanovic@jpmorgan.com
J.P. Morgan Securities LLC

Global FX Strategy

Ladislav Jankovic AC
(1-212) 834-9618
ladislav.jankovic@jpmchase.com
J.P. Morgan Securities LLC

Arindam Sandilya AC
(65) 6882-7759
arindam.x.sandilya@jpmorgan.com
JPMorgan Chase Bank, N.A., Singapore Branch

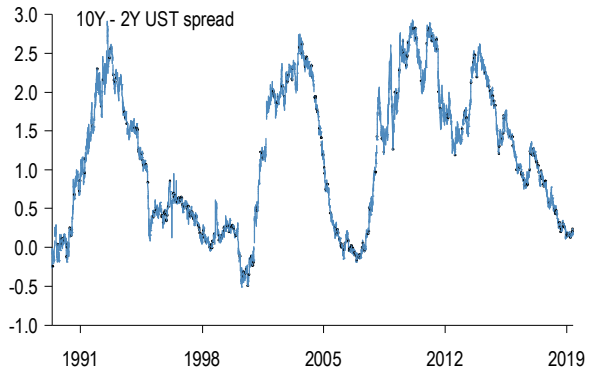
See page 12 for analyst certification and important disclosures, including non-US analyst disclosures.

Lorenzo Ravagli, PhD
(44-20) 7742-7947
lorenzo.ravagli@jpmorgan.com

The endless quest for optimal FX hedges

The need for adding hedging solutions to financial portfolios goes almost as far back in time as financial investments themselves. When considering foreign currencies-denominated Equity or Bond investments, FX forwards represent the bread and butter of hedging FX exposures. Considering bonds specifically, Forwards-based hedging solutions are typically effective when the yield of the bonds is well above the rate implied by the (shorter-dated) forwards: the current flat US rates curve means that a good portion of the Carry is eroded when applying the FX forward hedge (Exhibit 1).

Exhibit 1. Flattening US rates curve means forward-based hedging erodes a high fraction of bonds yield



Source: J.P.Morgan

The interest from investors and corporates in option-based FX hedging solutions has increased over recent periods. The widening of rates differential between USD and EUR to a multi-year high and the drop of FX vol levels made vol-based solutions comparatively attractive over forwards, at least for EUR-based companies. This backdrop was already highlighted in a research piece published last year (*Currency hedging with options*, Sandilya, 4 April 2018) emphasizing the long-term merits of option-based hedging solutions compared to forwards. On its turn, that piece capitalized on earlier efforts to assess usefulness of options in FX hedging (*Managing FX hedge ratios: A framework for strategic and tactical decisions*, Normand et al, May 28 2010).

The goal of this follow-up piece is, however, to provide an answer to a different set of questions:

- Given a set of hedging instruments available, is it possible to define an allocation framework that depending on the relative market pricing of the different products is capable of selecting the optimal instrument at any point in time?
- Does the allocation framework prove to be stable when transported across different currencies?
- Given the current pricing of market parameters, which instruments would be the favourite hedging solutions as we write?

For instance, the relative appeal of long volatility positions when carry-to-vol ratios are elevated was investigated in a previous piece (*Extracting vol alpha using carry-to-risk signals*, Jankovic, May 2016).

We restrict our attention to a set of derivatives products that can be easily used by financial and corporate institutions for their FX hedging programmes: forward, riskies, call spreads and seagulls. In the next section, we provide more colour on the features of these products and on their appropriateness for being used as hedging instruments from different institutions. We will refer to an end date of 13 May 2019 for all backtests displayed throughout this piece. Start dates depend on the time series of available data for different currencies, and normally refers to January 2004.

It is worth highlighting a few caveats regarding the content of the piece. While some general remarks can be made about the relative merits of different hedging instruments, a more precise assessment of actual hedging performance depends crucially on the precise composition of the portfolio one wants to hedge. The correlation between FX and the asset classes one is invested in would become an input in the quest for an optimal hedging solution. In order to have the possibility of comparing different instruments as a function of time, and for different currencies, we focus on the pure-FX cumulative PnL generated by the hedging instruments on a standalone basis (i.e., without looking at the actual added value when applied to a well-defined portfolio).

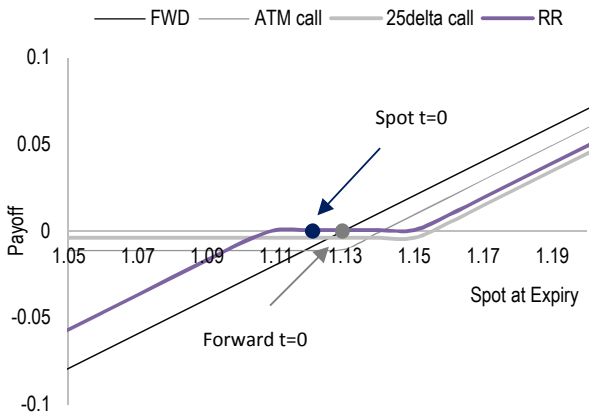
Also, we will assume that, regardless of the instrument chosen, the recommended hedge ratios are always set to 100% (we discuss later the difference between matching notionals or deltas when introducing new trades), at least at inception. In practice, one could decide to pursue an opportunistic approach, whereby not only the instrument, but also the hedge ratios are adjusted dynamically based on market conditions. For instance, one could decide to scale down costly hedging positions during quieter markets. We have addressed the application of such timing considerations, in the context of short-volatility trades, in a recent piece (*Timing FX short-vol trades: A systematic approach*, Ravagli and Duran-Vara, 5 March.)

Lorenzo Ravagli, PhD
(44-20) 7742-7947
lorenzo.ravagli@jpmorgan.com

Hedging payoffs for different market parameters and scenarios

We offer an overview of different derivatives products that are often used as part of FX hedging programmes. While in the following we will assess the performance of hedging strategies across FX pairs, with different domestic currency where the company is domiciled, we will start by focusing on EUR/USD as a case study. We will focus on a EUR-based fund invested in the US, or alternatively, in a EUR-based corporate receiving cash flows in USD. While the actual implementation of the hedges for financial institutions and corporates involves some structural differences, for both companies the risk would be that of a rally in EUR/USD. Hedging structures would buy EUR upside, with an associated Carry related to the difference between EUR and USD rates. An environment where USD rates are higher than EUR rates implies a negative Carry for the forward, i.e. an expected cost for the European-based hedger (or a cost of Carry). This reverses for a US-based hedger.

Exhibit 2. Payoffs of typical hedging instruments (as of 1 April)



Source: J.P.Morgan

As discussed, the goal of this piece is to recommend an optimal FX hedging product based on the relative pricing of market parameters, over time. In Exhibit 2, we show the payoffs (at expiry) corresponding to four possible hedging solutions involving derivatives: Forward, ATM call, OTM (25delta) call, risk-reversal (25delta), all referring to a 3M maturity. EUR/USD parameters in the chart refer to a 1 April 2019 pricing date: spot 1.1207, forward 1.1293, ATM vol 5.6%, riskie -0.36%. Calls require the payment of an upfront premium.

As we want to hedge a rise of EUR/USD, in order to avoid any confusions regarding FX market conventions, the risk-reversal considered here refers to the EUR call - USD call one. While riskies can be structured to be zero-cost at inception, in the following we refer to the plain 25delta construct, which might involve paying or receiving a premium upfront, depending on market skew.

One could derive (semi-)analytical expressions for the break-evens of the different products as a function of market parameters. To start with, the chart clarifies that the relative performance of the products depends on the realization of spot at expiry: in particular, the forward is the best performing instrument for large moves higher in the spot, and the worst performing one for large drops, where long-vol payoffs are protected. Such observations, valid for EUR/USD in Q2 2019, would also apply more generally to other currencies and market parameters (putting aside extreme pricing scenarios). It's important to stress that the payoffs displayed in the chart all refer to the same trading notional. Results would significantly change if the delta, rather than the notional, was assumed to be the same at inception. We'll share a bit more color on the notional vs. delta matching later in the piece.

We expand the scope of hedging instruments, beyond those displayed in Exhibit 2, and continue the exercise of highlighting their sensitivities to market parameters, one at a time. Carry is generally the market parameter that impacts the performance of all hedging instruments. In the limit where cost of Carry is large, all products are negatively impacted and hedging is typically associated with a cost (direct as in case of calls, or indirect as for forwards): under such conditions, one could in principle opt for a reduction of hedge ratios (assuming low risk for the currency to reprice higher). Throughout this piece, backtests will assume a full, 100% hedge of notionals is kept over time. Conversely, when carry is positive, hedging is associated with positive expected PnL: forwards then represent the most natural choice, given that they lock-in the positive carry even if the FX spot does not move. The positive Carry impact on long call positions would be via closer strikes to the spot level.

Exhibit 3. Sensitivities of hedging products to market parameters

Product	Most relevant market parameters	Comments
Forward	Carry	Large fwd pts make implicit cost higher
ATM call	Vol, Carry	Higher vol makes cost higher; negative carry pushes ATMF strike further out
OTM call	Vol, Skew, Carry	Systematically higher skew makes the instrument pricier
Risk-reversal	Skew, Carry, Vol	Close substitute for FWD; skew introduces an extra premium (can be +ve or -ve) for RR
Call spread	Skew, Carry, Vol	Cheapens the hedge but caps the effective spot range. Unsuitable for large spot moves.
Seagull	Carry, Vol	Similar to call spreads but even cheaper. Exposed to downside.

Source: J.P.Morgan

Derivatives products generally depend on pricing of vols and skews, in addition to forward points (Exhibit 3). The appeal of ATM calls for hedging purposes depends on carry and vol while OTM calls and risk-reversals also need to factor in skew. Call spreads also embed a large sensitivity to the skew, yet opposite to that of risk-reversals. For seagulls (call spreads financed by short puts), the sensitivity on the skew is modest: a higher sensitivity would be on the pricing of OTM options vs ATM ones, namely on the convexity of FX smiles.

Exhibit 4 similarly summarizes the preferred products under limit cases for market parameters. We have already commented on the case where the Carry of the pair is positive. In the limit of zero implied volatility, the cost of calls would go to zero too, allowing the possibility of hedging FX higher at strictly zero cost. When skews are large and negative, risk-reversals offer a significant discount when hedging topside spot. The opposite holds for call spreads when skews are large and positive.

Exhibit 4. Hedging under limit cases for pricing parameters

Limit cases for pricing parameters	Best products
Carry>>0	Forwards
Vol->0	Call options
Skew<<0	Riskies
Skew>>0	Call spreads

Source: J.P.Morgan

While not a market parameter per se, a signal monitoring the possibility of large moves in the underlying could be included as an input in the hedging decision process (Exhibit 5). Forwards and riskies are preferable in case where large moves higher were to take place; call spreads, calls, riskies and seagulls outperform in the opposite scenario. Under muted scenarios, cheap optional structures long-ATM vol might be preferred.

Exhibit 5. Hedging products under different scenarios for the underlying spot variable

Scenarios for the spot variable	Best products
Large drop	Call spreads, Calls, Riskies, Seagulls
Muted	Call spreads, Seagulls, ATM calls
Large rise	Forwards, Riskies, Calls

Source: J.P.Morgan

While following a set of different drivers over short-term horizons, currencies tend to follow long-term valuations when it comes to multi-month/year moves. Daily FX Alpha Chartpack, Chandan (see *here*) among other FX cash trading signals follows REER, FRIs and EASIs as potential long-term indicators for undervaluation of FX spot. Undervalued currencies might be the ones mostly exposed to large repricing higher, especially when short-term drivers were to trigger the moves. However, for simplicity, in the following we rely on a measure of momentum for flagging the risk of large moves: the main advantages for the latter approach are the possibility of defining (almost) parameter-free proxy estimates of momentum, and the good track-record when observing performances over relatively short dated horizons (1M), like pursued in this piece (see for instance *Designing robust trend-following system*, Tzotchev, February 2018).

While financial institutions assess hedging costs from a mark-to-market perspective, corporates prefer structures which don't require the payment of a premium upfront. Hedge accounting considerations favor forwards, calls and (zero-cost) riskies over other instruments. If large ex-post hedging losses are difficult to justify by corporate treasurers when motivating their choices to the internal board, so are insurance premia when the scenarios to hedge do not materialize. For other clients, a reduced protection to higher FX vs. forwards might be acceptable if other assets in the portfolio naturally mitigate FX losses: the correlation between FX and other asset classes in the portfolio would come into play as the key factor.

Exhibit 6 sheds additional light on the hedging products from this latter perspective. The premium, positive or negative, associated with riskies is mostly related to the sign of the skew (see later). Pricing of seagulls mostly depend on the strikes involved. Max gain/loss of the hedges under different scenarios are reported: we define as "adverse" the scenario we need the hedge for, namely a rise in EUR/USD, and as "positive" the one where EUR/USD drops, with ideally no/minimal impact from the hedge. Forwards, calls and riskies allow a full hedge under "adverse" scenarios, although they may involve a hedging error (related to rates differentials, premia, location of strikes etc.). Call spreads and seagulls offer full protection only up until a fixed % move in the spot market. Calls/call spreads offer a capped loss (the upfront premium), whereas other instruments are exposed to potentially unlimited hedging losses. Obviously, these different features would have a significant impact on the VAR of the hedged portfolios.

Exhibit 6. Main features of the products for different scenarios

Product	Premium upfront	Fully hedged in "adverse" scenario	Hedging error	Capped loss in "positive" scenario
Forward	No	Yes	Yes	No
ATM call	Yes	Yes	Yes	Yes
OTM call	Yes	Yes	Yes	Yes
Risk-reversal	>=0 or <0	Yes	Yes	No
Call spread	Yes	No	Yes	Yes
Seagull	>=0 or <0	No	Yes	No

Source: J.P.Morgan

The quest for an optimal hedging solution hinges on a balance between actual performance of the instruments vs. internal accounting/risk-management requirements an institution needs to satisfy. Striking a compromise

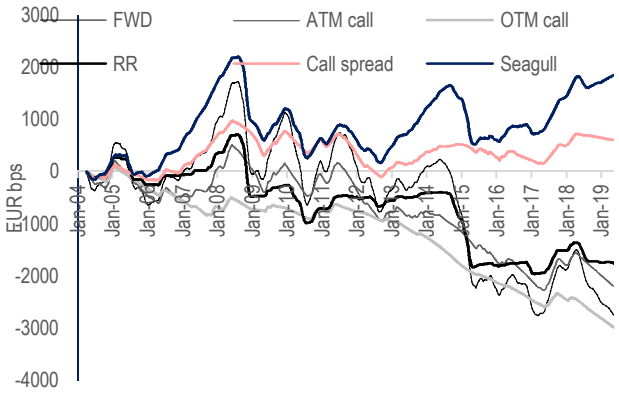
between maximum hedge (or hedging error) and cost on downside is usually advisable. The above compromise could be defined mathematically via an optimization procedure relying for instance on the implied distribution at expiry (or on some other pre-specified scenarios). In the first place, this could involve comparing semi-analytical expressions for the break-even points of the different structures. While keeping the doors open for tackling the full optimization problem in future studies, in this study we will pursue a simpler approach: we will isolate the sensitivities of products to one single market factor at a time and later aggregate the different signals together via a scorecard-based approach. We will then compare the PnL generated by the dynamic allocation strategy to that of the different products.

We now analyze long-term backtests across the different hedging products. Exhibit 7 showcases EUR/USD, in bp EUR. OTM call refers to 25delta strikes. Riskies correspond to 25delta and require paying or receiving a premium upfront. Call spread is ATM/25delta. Seagull is 25delta/ATM/25delta, which might require the exchange of a premium upfront. Backtests refer to 3M instruments, held until expiry: we assume to trade on a daily basis a notional corresponding to 1/63 unit of the underlying. This should grant a full hedge for the unit notional over the 3M period. While this will not practical for being implemented as an actual hedging strategy, it will allow monitoring more closely the evolution of market parameters over time. For simplicity, we have not included daily mark-to-market of the strategies, and will judge the relative performance of hedging strategies just based on the cumulative PnLs (not the Sharpe ratios) as monitored over ~15 yrs periods. More comprehensive analyses, considering the added value of the FX-hedging PnL to the actual portfolios, will overcome such approximations. Bid/ask spreads on vol are assumed to be 0.3 vol points (for multi-legged structure, we assume paying costs just on the leg with highest-Vega).

The long term performance of outright long vol positions on EUR/USD is impacted by the negative time decay. This result is consistent with earlier studies (*Timing FX short-vol strategies*, Ravagli and Duran-Vara, 5 March) highlighting the presence of a clear volatility premium in the currencies space. For reducing the sensitivity to the vol premium, while keeping some of the attractive features associated with optional structures, we will favour spread constructs like call spreads and seagulls over call options. Seagulls also benefit from the overvaluation of FX OTM options as detailed in literature (*Isolating a risk premium on the volatility of volatility*, Ravagli, Risk Magazine, December 2015).

Exhibit 7. Cumulative P/L from 3M EUR/USD structures – European hedger viewpoint

No delta hedging, no transaction cost. Structures held to maturity.



Source: J.P.Morgan

Another important aspect is worth additional comments. Backtests above assume the same notional is traded for all hedging structures, which implies that deltas at inception are not equal to each other. If one uses for instance an OTM call, matching the traded notional to the one which needs to be hedged means that there is a window of spot values at inception where the position would be unhedged; full hedge would be granted for spot values above the strike. This feature reduces the premium paid upfront, making it potentially more appealing than a forward hedge. Obviously, given the near 100% delta at inception, forward-based solution gain more than lower-delta ones when the spot is rising. Matching the deltas at inception would imply scaling up the traded notional depending on the moneyness of the product. Rather than offering a discount vs the forward, in this case the benefits of optionality would materialize via the increased sensitivity (i.e., delta) to large moves on the upside, thanks to the positive convexity, thus granting the structure the potential of delivering large gains at expiry.

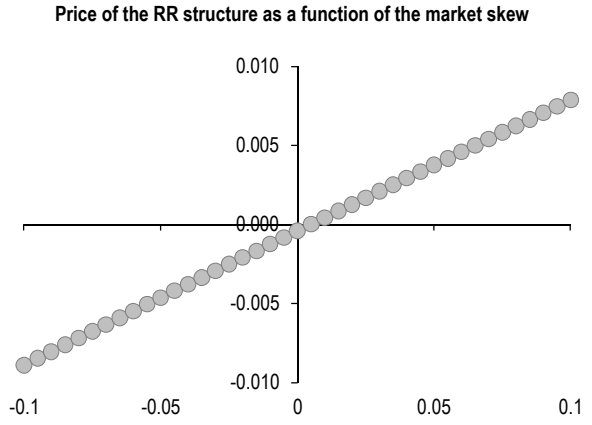
Obviously, the two implementations would deliver quite different outcomes, with the latter one requiring a more active monitoring of positions in the portfolio. In the previous piece published on the topic (*Currency hedging with options*, Sandilya, 4 April 2018), we considered both notional and delta-matching solutions as equally viable. Given the additional complexity as introduced by the dynamic selection approach, and the difficulty by corporate clients to manage dynamically the evolution of the Greek letters of their trading books, in this piece we have opted for the conservative choice of just monitoring the approach where 100% of the notional is hedged. As for other approximations discussed above, future pieces

might shed additional light on solutions where the delta is the quantity of interest for hedging purposes.

Performance of different products based on market conditions

Having offered a general overview on hedging solutions, we start to investigate more specifically how different products are sensitive to market parameters. We start by taking forwards are as the benchmark and assess how other hedging products compare to the benchmark as a function of market parameters, taken one at a time, along the lines of the previous section. We then consider combining the different indicators together for switching dynamically from forwards to the other products. In the next section, we will extend to reasoning to a scorecard-based framework where all hedging products are compared with each other, over time.

Exhibit 8. Market skew drives the prices of risk-reversals



Source: J.P.Morgan

We start by highlighting skew sensitivities of the products. Exhibit 8 displays the pricing associated with standard (i.e., non zero-cost) 25delta riskies, for a realistic case study scenario, as a function of market skew. What we see there is that the time decay associated with the risk-reversal, putting aside other possible pricing parameters (vol, rates, maturities etc.), is directly related to the sign of the skew: a positive skew implies the cost of the structure at inception is positive, i.e. the time decay is negative. While when vols and maturities are high the breakeven point on the skew might slightly deviate from zero, given that the forward is not sensitive to the skew, we immediately understand how the sign of market skew directly impacts the relative appeal of risk-reversals vs forwards for hedging higher spot values.

Call spreads exhibit the opposite sensitivity to risk-reversals as a function of market skews (i.e., they are short skew, intended as EUR call – EUR put vols). For hedging a higher spot, call spreads are supported when the skew is positive. Seagulls, by being long ATM vol and selling OTM calls and puts, are as a first approximation not excessively sensitive to the skew.

The argument on the carry is possibly even more immediate. While, as discussed on Exhibit 3, Carry impacts directly (i.e., on the upfront premia) or indirectly (i.e., location of strikes) all derivatives overviewed here, a positive (negative) Carry immediately allows locking-in a positive (negative) time decay via forwards. While this might appear as a brutal approximation, we will favor Forward when Carry is positive, and other instruments when Carry is negative.

Volatility is an obvious parameter option-based strategies are exposed to, whereas forwards are not directly impacted pricewise. Coming up with a "synthetic" indicator summarizing whether volatility is cheap or not is a task which goes beyond the scope of the present piece. A few possible attempts might relate to: a) an estimate of the vol premium (implied vs. realized vols); b) the ranking of vol levels on a historical basis; c) cross-asset/business cycle estimates of FX fair value levels; d) other PnL-based cheap/expensive assessments. For simplicity, we rely on previous published research, suggesting the appeal of monitoring carry/vol indicators regarding the possible outperformance of vol-based strategies (*Extracting vol alpha using carry-to-risk signals*, Jankovic, May 2016). This of course represents another approximation, but basically, we will favour other derivatives over forward when the absolute value of Carry over vol is above the running median of the indicator, and forwards otherwise.

As discussed earlier, the fourth indicator we monitor is not strictly speaking a market parameter but a measure of momentum on the underlying currency. We estimate that by computing moving-average indicators over 1M, 3M, 6M and 1Y periods: the aggregate score, ranging from -4 to +4, proxies the strength of the momentum on the upside or downside (*Designing robust trend-following system*, Tzotchev, February 2018). We refer to Exhibit 5 for the sensitivities of the products to momentum indicators.

Lorenzo Ravagli, PhD
(44-20) 7742-7947
lorenzo.ravagli@jpmorgan.com

Exhibit 9. Vol products vs forwards based on market parameters

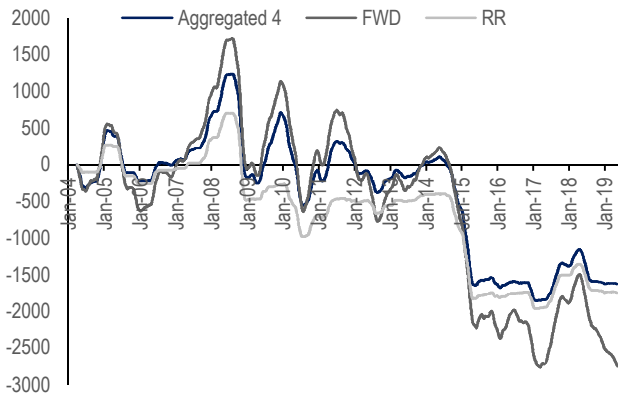
Parameter	RR vs FWD	CS vs FWD	SG vs FWD
Carry>0	FWD	FWD	FWD
Carry<0	RR	CS	SG
|Carry|/vol>median	RR	CS	SG
|Carry|/vol<=median	FWD	FWD	FWD
Skew>0	FWD	CS	NA
Skew<=0	RR	FWD	NA
Strong upside momentum	FWD	FWD	FWD
Not strong upside momentum	RR	CS	SG

Source: J.P.Morgan

Exhibit 9 summarizes the trading rules introduced for switching dynamically between forwards and the three other derivatives, based on the four market indicators considered. This will constitute the starting point of the more general allocation process as pursued in the next section, involving all instruments at once. We stress that in some cases, especially regarding the momentum-based rule, we have favored simplicity and intuition over a more comprehensive assessment of all possible case studies regarding the interplay between market parameters and strategies. Basically, for each instruments we consider the relevant indicators (three or four), and allocate proportionally between forward and the other instruments: as an example, if three indicators are supporting the risk-reversal and one the forward, the resulting allocation would be 75% vs. 25%.

We start by analyzing risk-reversals (Exhibit 10). Riskies outperform forwards in the long-run, and especially so since the beginning of 2018, as the large and negative carry started weighing on the latter. We also stress how forwards, being endowed of a delta at inception near 100%, gain more during rising EUR/USD markets than riskies, but are also subject to bigger PnL drops. The dynamic solutions allocating to both forwards and riskies outperforms both in terms of cumulative PnL over 15yrs, at least for EUR/USD, which is very comforting.

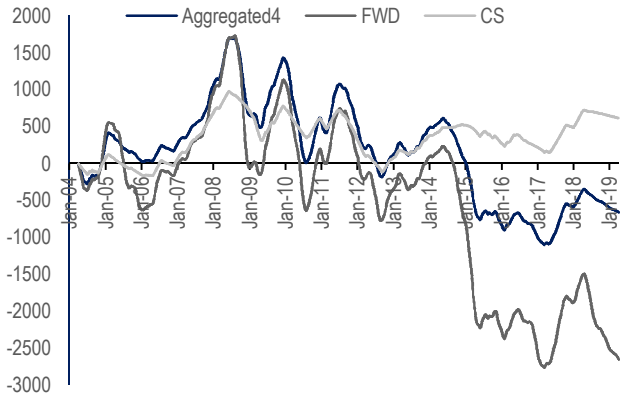
Exhibit 10. Payoffs of typical hedging instruments



Source: J.P.Morgan

Exhibit 11 investigates the case of the call-spread. In the first place, we observe how the cumulative PnL generated by call spreads largely outperforms that of forwards, at the expense of a more reduced reactivity to markets where EUR/USD is rising. We will check in the following whether similar results hold for other currencies as well. In this case the dynamic solution delivers a reasonable compromise, offering a better cumulative PnL than the forwards and higher sensitivity to market shocks than call spreads.

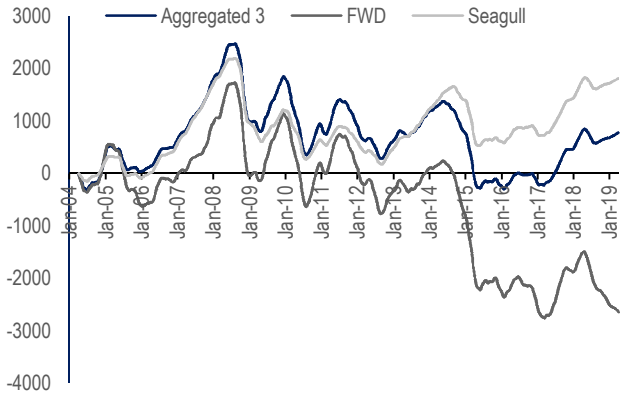
Exhibit 11. Payoffs of typical hedging instruments



Source: J.P.Morgan

The case of seagulls is considered in Exhibit 12. In this case, we rely on just three indicators given the modest sensitivity to skews. We also stress that the positive long-term performance of seagulls is supported by the high sensitivity to the vol of vol premium discussed earlier. As for the call spread above, the dynamic solution offers a good compromise between forwards and seagulls in terms of cumulative hedging PnL, positive in the long-run, and reactivity to FX moves.

Exhibit 12. Payoffs of typical hedging instruments



Source: J.P.Morgan

The results shown in this section appear quite promising, and this despite some necessary oversimplifications or (to some extent) arbitrary assumptions regarding the relationship between market parameters and products. Also, it would be important to assess how such methodologies would perform on other currencies than EUR/USD, a point we address later on in the piece.

Introducing a scorecard for selecting across the four instruments

We now pursue a more general approach for choosing across hedging instruments over time. Compared to the previous section, where the allocation involved forwards and just one other derivative, we now look for a dynamic selection across the four products. For simplicity, we will pursue a scorecard approach. We define different regimes for the market parameters considered, and based on these, attribute scores to the four hedging instruments. We then aggregated the scores for each instrument, and allocate weights proportionally. The allocation weights are updated on a daily basis, daily trades are held until expiry and positions are cumulated over 3M periods

Exhibit 13. Daily scores attributed to the hedging instruments based on market parameters

Parameter	FWD	RR	CS	SG
Carry>0	3	0	0	0
Carry<=0	0	1	1	1
|Carry|/vol>median	0	1	1	1
|Carry|/vol<=median	3	0	0	0
Skew>0	0.5	0	2	0.5
Skew<=0	0.5	2	0	0.5
Momentum score=4	2	1	0	0
Momentum score=2	0	0	1	2
Momentum score=0	0	0	1	2
Momentum score=-2	0	0	2	1
Momentum score=-4	0	1	1	1

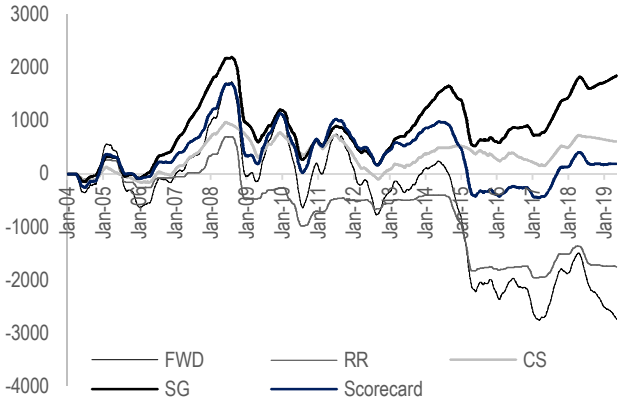
Source: J.P.Morgan

The rules are summarized in Exhibit 13. We impose the constraint that all scores are non-negative and such that their sum for each parameter/regime is equal to 3. The latter choice ensures that all market parameters have the same impact on the final allocation. Choosing only non-negative scores avoids the possibility where aggregated scores are all zero, preventing an actual allocation between different instruments. This choice is consistent with our intention of keeping a full hedge over time.

The rules applied are largely consistent with those of the previous section. For instance, having assessed that forwards and seagulls have zero or little exposure to skews, the sign of market risk reversals sets the choice between call spreads and riskies. The rules for Carry and |Carry|/vol are consistent with a binary choice between forwards and vol-based products. The resulting bias in terms of a higher average allocation to forwards is consistent with standard market practice, whereby forwards remain the most traded hedging tool. If ever, we acknowledge a certain degree of arbitrariness regarding the rules for the momentum signal. We have however empirically tested that small modifications in the scorecard impact modestly the results for the backtests.

We start by applying the approach to EUR/USD (Exhibit 14). The scorecard solution offers a good compromise, if compared to the individual products, in terms of cumulative PnL (positive, as for seagulls and call spreads) and hedging power (with more sensitivity to rising EUR/USD than riskies and call spreads). We have avoided any temptations of overfitting results, which hopefully should grant the approach more stability when applied on other currencies, as pursued later.

Exhibit 14. Results of the scorecard approach for EUR/USD

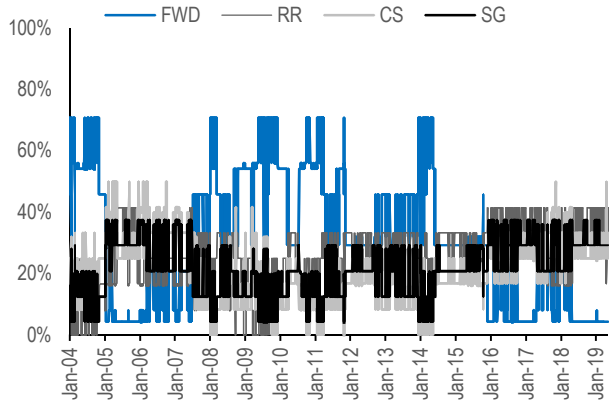


Source: J.P.Morgan

Exhibit 15 displays the time series of the weights for the four instruments based on the approach. Typically, the allocation to the forward ranges between 5% to 70%. In the long-run, the approach attributes an average 31% weight to forwards, 26% to risk-reversals, and around 21% each to call-spreads and seagulls. In a nutshell, in the long-run this approach would recommend a roughly 30%/70% split between forwards and other derivatives-based hedging solutions. This model-based split could represent a realistic modification as applied to their hedges to be considered by a range of institutions.

Lorenzo Ravagli, PhD
(44-20) 7742-7947
lorenzo.ravagli@jpmorgan.com

Exhibit 15. Time series of weights based on the scorecard

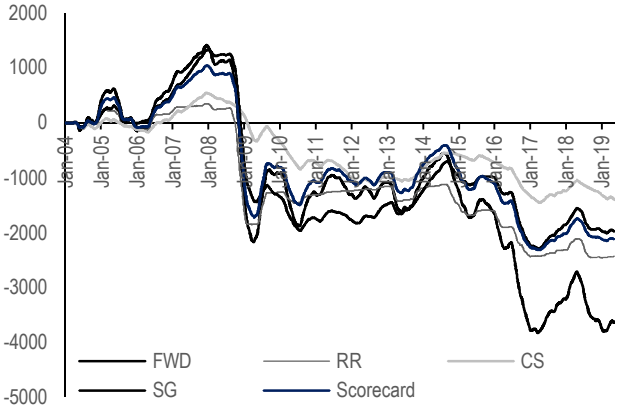


Source: J.P.Morgan

Results for other currencies

We now apply the scorecard methodology to a wider set of currencies (8 G10/6 EM in total). By relying on FX-market standard conventions on each ccy_1/ccy_2 pair, we assume for simplicity that fund/company are ccy_1-domiciled and ccy_2 is the foreign currency they are invested in or receiving cash flows from. Just to avoid any confusion, the risk-reversal will be long calls on ccy_1 and short calls on ccy_2. For considering the case where funds are domiciled in ccy_2, one would need to replace puts with calls on ccy_1/ccy_2 as hedging instruments. For trading costs, we conservatively assume (bid/ask) of 0.3 vol points for G10 and 0.5 vol points for EM currencies. Backtests will be displayed in cumulative ccy_1 bp.

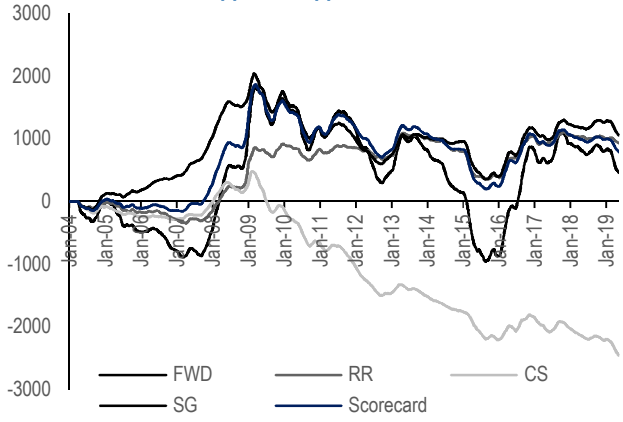
Exhibit 16. Scorecard approach applied to GBP/USD



Source: J.P.Morgan

For GBP/USD (Exhibit 16), the best instrument is the call spread and the worst the forward. The scorecard approach almost matches the cumulative PnL of call spreads (trailing by just 50bps per year) whilst improving the sensitivity to moves in GBP/USD of the latter.

Exhibit 17. Scorecard approach applied to EUR/GBP

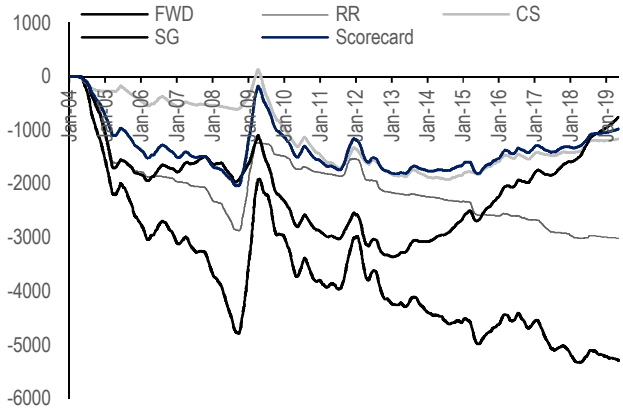


Source: J.P.Morgan

For EUR/GBP (Exhibit 17), again the scorecard approach almost matches the best performing instruments in terms of PnL, namely seagulls and riskies, outperforming forwards by around 20bps per year.

We now focus on a few EM cases, for which we expect the impact of the cost of carry to be significant in the long run. For EUR/PLN (Exhibit 18), seagulls and call spreads are once again the best performing instruments, and forwards are by far the worst. The scorecard approach cuts by more than 75% the long-term hedging costs associated with forwards whilst preserving to a large extent the protection offered by the latter to spikes of EUR/PLN higher.

Exhibit 18. Scorecard approach applied to EUR/PLN

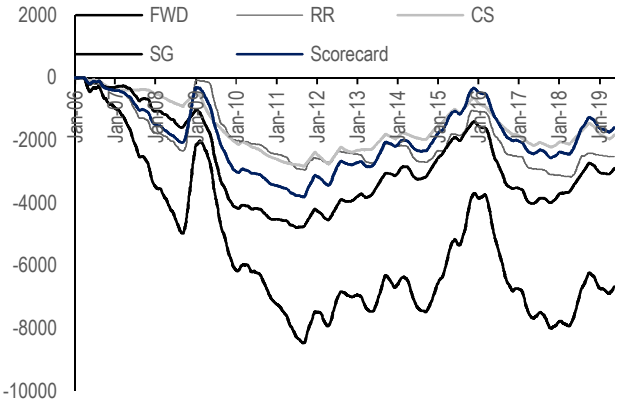


Source: J.P.Morgan

Hedging costs associated with forwards are particularly severe on USD/BRL (Exhibit 19). The scorecard solution outperforms the long-term PnL generated by call spreads, the best instrument for this currency, cutting forwards hedging costs by about 75%.

Lorenzo Ravagli, PhD
(44-20) 7742-7947
lorenzo.ravagli@jpmorgan.com

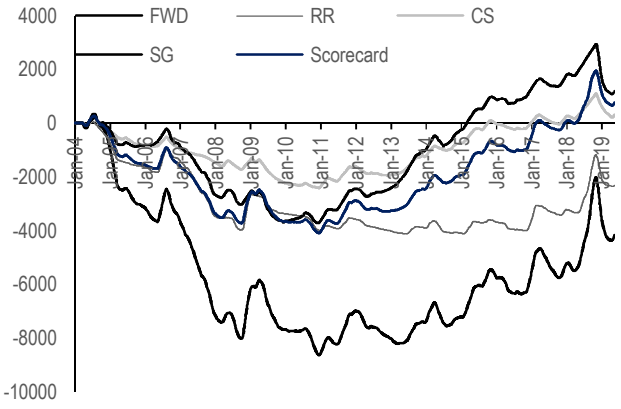
Exhibit 19. Scorecard approach applied to USD/BRL



Source: J.P.Morgan

USD/TRY (Exhibit 20) has underwent a highly-volatile path over the past decade, and especially so since 2016. Despite the high cost of carry (money-market rates on TRY are at the moment around 25%), all hedging strategies would have delivered a positive PnL over the past decade, thanks to the large drops of the currency in the spot market. Amongst these, seagulls have delivered the steadiest performance until the August 2018 sell-off. The scorecard approach allows neutralizing entirely the 260bps per year hedging costs associated with forwards.

Exhibit 20. Scorecard approach applied to USD/TRY



Source: J.P.Morgan

The results of the parameter-based allocation approach are convincing. The scorecard compares well with the underlying strategies, in the sense that it usually manages to track the best performing instrument on each currency, regardless of which one it is. The value introduced by the methodology is confirmed when considering EM pairs, for which the impact of the carry is typically much higher than for G10 currencies.

Exhibit 21. Annualized hedging costs (in bp) for the different hedging solutions

Negative numbers refer to a cost, positive numbers to a gain

Ccy pair	Forward	RR	CS	SG	Scorecard
EUR/USD	-173	-110	39	116	12
EUR/GBP	29	59	-154	66	49
GBP/USD	-228	-153	-88	-124	-133
USD/JPY	142	160	-105	-36	124
USD/CHF	-27	-52	92	262	67
USD/CAD	-37	-48	-50	-22	-16
AUD/USD	102	-42	-31	-112	49
USD/SEK	135	60	21	129	158
USD/BRL	-483	-181	-133	-210	-115
USD/MXN	-23	-38	-187	-207	24
USD/CNH	-159	-124	10	-30	-27
EUR/PLN	-333	-189	-73	-47	-61
USD/TRY	-261	-145	20	76	48
USD/ILS	-176	-138	-127	-252	-123
FX-average	-107	-67	-55	-28	4

Source: J.P.Morgan

Hedging costs (annualized, in bp) for different instruments and currencies are reported in Exhibit 21. We see that, on average, forwards are the instrument associated with the highest hedging costs, although we acknowledge here that results would change if the deltas of the other derivatives were matched to the ~100% delta of the forwards. Risk-reversals on average allow reducing hedging costs by around 40bps per year vs forwards, although in a few cases (USD/CHF, USD/CAD, AUD/USD, USD/MXN) they do underperform the latter instrument.

While the performance of the hedging instruments depends on the currency, in the vast majority of cases the scorecard approach allows outperforming forward-based hedges: exceptions are USD/JPY and AUD/USD. When averaging across all currencies, the scorecard approach outperforms all the other instruments: the added value over forwards amounts to around 110 bps per year. The outperformance of the scorecard approach vs any other instruments is also obtained for USD/CAD, USD/SEK, USD/BRL, USD/MXN, USD/ILS: this result validates the timing functionalities as embedded in the scorecard, namely the capacity of selecting ex-ante the most suited instrument to current market conditions.

Lorenzo Ravagli, PhD
(44-20) 7742-7947
lorenzo.ravagli@jpmorgan.com

Exhibit 22. Long-term average allocations to hedging instruments

Ccy pair	Forward	RR	CS	SG
EUR/USD	30.8%	26.5%	20.9%	21.8%
EUR/GBP	26.6%	20.9%	29.3%	23.3%
GBP/USD	42.4%	24.5%	14.9%	18.2%
USD/JPY	47.9%	22.8%	13.2%	16.1%
USD/CHF	45.6%	19.9%	17.6%	16.9%
USD/CAD	34.9%	16.2%	28.2%	20.8%
AUD/USD	49.1%	24.9%	10.3%	15.8%
USD/SEK	36.3%	15.9%	27.6%	20.2%
USD/BRL	21.2%	17.5%	36.5%	24.8%
USD/MXN	23.8%	16.7%	35.5%	24.0%
USD/CNH	26.4%	15.5%	34.8%	23.4%
EUR/PLN	17.4%	18.3%	37.9%	26.5%
USD/TRY	27.7%	15.3%	34.1%	23.0%
USD/ILS	32.3%	13.9%	32.7%	21.2%
FX-average	33.0%	19.2%	26.7%	21.1%

Source: J.P.Morgan

Exhibit 23. Current allocations to hedging instruments

Ccy pair	Forward	RR	CS	SG
EUR/USD	4.2%	33.3%	33.3%	29.2%
EUR/GBP	4.2%	16.7%	41.7%	37.5%
GBP/USD	4.2%	33.3%	33.3%	29.2%
USD/JPY	29.2%	33.3%	16.7%	20.8%
USD/CHF	32.0%	24.0%	16.0%	28.0%
USD/CAD	45.8%	16.7%	25.0%	12.5%
AUD/USD	29.2%	33.3%	16.7%	20.8%
USD/SEK	45.8%	16.7%	25.0%	12.5%
USD/BRL	45.8%	16.7%	25.0%	12.5%
USD/MXN	4.2%	16.7%	41.7%	37.5%
USD/CNH	45.8%	16.7%	25.0%	12.5%
EUR/PLN	20.8%	25.0%	33.3%	20.8%
USD/TRY	20.8%	25.0%	33.3%	20.8%
USD/ILS	29.2%	16.7%	33.3%	20.8%
FX-average	25.8%	23.1%	28.5%	22.5%

Source: J.P.Morgan

Average allocations per currency across the four different products are displayed in Exhibit 22. We see that on average the allocation to forwards based on the scorecard is at 33%, with the rest split across the option-based instruments. Average allocations, over time and across currencies, are: forwards (33%), call spreads (27%), seagulls (21%), risk-reversals (19%). As EM puts tend to be structurally more expensive than calls, call spreads are preferred in EM over risk-reversals based on the scorecard. For the G10 pairs considered, where the pricing of skews can be either positive or negative, allocation between riskies and call spreads is more even.

Current hedging recommendations

Exhibit 22 shows the latest allocation signals, as of 13 May 2019. Current allocation to forwards (26% FX-average) is below the time series average of around 33%. However, this comes mostly from G10 currencies, where the current allocation to forwards is up to 25 percentage-points lower than over the long run. For EUR/USD, the 25 percentage-points reduction in forwards mostly favours an increased weight to call spreads (+12 percentage-points). After briefly reaching positive territory on mid-April, market skews have returned to negative grounds, which supports riskies as hedging instruments. The negative price momentum, conversely, increases the allocation to call spreads. Low volatility levels and elevated carry concur to spurring a higher allocation to all option-based hedges.

The situation for EM currencies is different compared to G10 ones, in the sense that the sign of Carry and riskies typically doesn't flip over time; this attributes more importance, in relative terms, to the pricing of vols and price momentum signals. Tight (from an historical perspective) EM-USD rates differentials partly offset the effect of the low vols in the |Carry|/vol indicators, thus reducing the allocation to vol-based hedges. This is for instance the case for USD/BRL, whereas on USD/TRY the widening rates differential favor optional structures despite the elevated vol levels. In a few cases (USD/BRL, USD/CNH, EUR/PLN), the EMFX-bearish price momentum indicators favour increased allocation to forwards, and to a smaller extent risk-reversals.

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