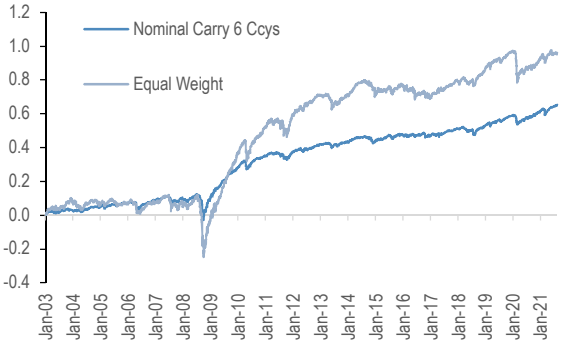
Macro Factors and FX Vols

Global FX Strategy
Juan Duran-Vara AC
(44-20) 3493-7685
juan.duran-vara@jpmorgan.com
J.P. Morgan Securities plc

- The Global FX strategy team has several spot *single-factor frameworks* (Chandan, 2018) to inform their macro views. Here we **explore the impact of those signals on FX vols and FX vol portfolios.**
- We find that **carry and external balances signals have the highest absolute correlation to FX vol** (*VXY indices*).
- We see that long/short vol macro factor portfolios based on those signals fail to deliver attractive returns, due to high trading costs and negative impact of the long vol leg.
- However, **using carry signals improves risk adjusted returns**. Further, **nominal carry short-vol portfolios outperform in terms of Sharpe** an equal Vega allocation across currencies, **producing Sharpes above 1.** They do so without worsening the skewness, kurtosis or max drawdown metrics.
- Looking at **current signals**, in the nominal-carry top 6 short-vol portfolio we would be shorting the following 1m ATM vols: **BRL, MXN, ZAR, RUB, TRY and CLP**. This highlights the heavy tilt the model has towards EM vols.
- As a final exercise, we used 'filtering' on a nominal carry short-vol portfolio. Filtering further increases the Sharpe ratio to 1.33.

Nominal carry short-vol portfolios have a smoother PNL profile
Total return time-series for the equal weight (equal Vega – 19 ccys) short-vol portfolio and for the Top 6 nominal carry short vol portfolio



Source: J.P. Morgan

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Juan Duran-Vara
(44-20) 3493-7685
juan.duran-vara@jpmorgan.com

J.P.Morgan

Introduction and overview

The Global FX strategy team has several *spot single-factor frameworks* (Chandan, 2018) to inform their macro views. In this note we make use of those factor signals in order to better understand their impact on FX vols and FX vol portfolios.

For that purpose, we first explore the relationship between changes in FX vol (*VXY* indices) and the PnL of those single-factor portfolios. We see that in terms of absolute correlation (r-squared) to FX vol changes, carry and external balances are the ones that show the highest values. We also see that all the factor variance can be reduced to a single principal component (a carry/external balances component).

We then explore the creation of FX vol portfolios based on the macro factor signals. We see that long/short vol macro factor portfolios fail to deliver attractive returns, due to the high trading costs and negative impact of the long vol trading leg. However, carry signals seem to improve risk adjusted returns.

Given these results, we further investigate the benefits of using the nominal carry signal in order to construct short-vol portfolios. We find that nominal carry short-vol portfolios outperform in terms of Sharpe an equal Vega allocation across currencies, producing Sharpes above 1. They do so without worsening the skewness, kurtosis or max drawdown metrics.

Looking at current signals, if we wanted to replicate the nominal-carry top 6 short-vol portfolio today, we would be shorting the following 1m ATM vols: BRL, MXN, ZAR, RUB, TRY and CLP. While if we were to consider the nominal carry top 3 long/ short portfolio we would be short the following vols; BRL, RUB, TRY and going long CHF, EUR and TWD. This highlights the heavy tilt the model has towards EM vols.

As a final exercise, to see the full potential of the nominal carry short-vol portfolio, we test 'filtering' on it. Filtering further increases the Sharpe ratio of the nominal carry short-vol portfolio to 1.33.

Further work could include using portfolio construction techniques on these portfolios, including risk constraints, and limiting the number of EM currencies considered in the portfolio.

Correlation between macro factors and vols

To understand the relationship between macro factors and vols, we take the daily % changes in the *VXY Volatility indices* (Global, EM and G10) and linearly regress them (univariate) on the daily return of the single factor portfolios in their respective universe. All these factors and their underlying data are explained in detail in the *T.E.A.M cross sectional model* (Chandan and Duran-Vara, 2020) publication – see appendix. These portfolios all rebalance at month-end except growth (weekly). These macro factors are created by ranking currencies on the underlying signal. Highest (lowest) 5/3/2 FX bought (sold) in Global/EM/G10 portfolios in equally-weighted manner. The test comprised the period 2003-2021.

Exhibit 1: Carry and external balances have a high absolute correlation (r-squared) to FX vols

R-squared and slope (GL only) for linearly regressing (univariate) the daily % changes in VXY indices (Global, EM, G10) on the daily PnL of the *single-factor* portfolios. The ranking is done by the first column (factors affecting GL- VXY more)

	R-squared			Slope
	GL	G10	EM	GL
Nominal Carry	15%	10%	13%	-1.73
Carry*	14%	8%	9%	-2.10
Risk-Adj. Carry	11%	11%	5%	-1.87
CAB	11%	3%	19%	1.72
Real Carry	11%	4%	9%	-1.68
Core BAB	9%	0%	19%	1.85
BAB	8%	3%	15%	1.69
FDI and Equity	7%	2%	3%	-1.70
FDI	6%	6%	2%	-1.72
Equity PI	2%	1%	6%	-1.02
External balances *	2%	0%	11%	0.91
Growth	1%	0%	3%	0.53
Value PPI	1%	3%	0%	0.46
Growth No Overlay	0%	0%	0%	-0.23
Equity Momentum	0%	0%	0%	-0.15
Value CPI	0%	3%	3%	0.00
Interest Rate Momentum	NA	0%	NA	NA

*Composite Measures. Source: J.P. Morgan

The single factors include carry (nominal, risk-adjusted and inflation-adjusted), valuations (REER-CPI and PPI), external position metrics (current account balances / CAB, basic account balances / BAB, core BAB, FDI inflows, FDI and equity inflows and equity PI inflows). We also look at equity momentum, growth (FRI with and without USD overlay), interest rate momentum (G10 only), as well as composite measure of external balances and carry.

Juan Duran-Vara
(44-20) 3493-7685
juan.duran-vara@jpmorgan.com

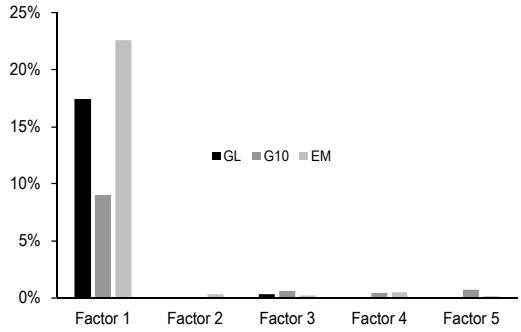
J.P.Morgan

In terms of absolute correlation (r-squared) to FX vol changes, carry and external balances are the ones that show the highest values (Exhibit 1). We can see that in all three universes either a carry or external balances factor tops the list; nominal carry in the global universe (15% r-squared), risk-adjusted carry in G10 (11% r-squared), and CAB or Core BAB in EM (19% r-squared). Value, growth, equity momentum, and interest rate momentum do not show any significant absolute correlation (r-squared) – all factors are below 3% r-squared in all of the universes.

Further observations are that in terms of r-squared carry precedes external balances in 'global' (top 3 factors are carry); in G10 only carry matters (only carry breaches the 10% r-squared), and that in EM measures of external balances are more significant (top 4 factors are balances). The results can motivate using the appropriate carry and balances signals to create vol portfolios.

Exhibit 2: Single-factor variance affecting FX vols can be explained by a single principal component

R-squared for linearly regressing (univariate form) the % daily changes in VXY indices (Global, EM, G10) on the top 5 principal components obtained from a PCA dimensionality reduction of *single-factor* daily PnL returns



Source: J.P. Morgan

We also did a PCA analysis of the single-factor daily returns. We then regressed the % daily changes in VXY indices on the top 5 principal components. We observe that only one (the 1st) principal component is correlated (Exhibit 2). The intuition behind is that carry and external balances are very much negatively correlated, and are essentially the *the inverse of each other* (Chandan and Delair, 2021), while equity and FDI inflows, like carry, are negatively correlated to vol (Exhibit 1). Thus all the factor variance can be reduced to a single principal component.

Macro factors vol portfolios

In this section we explore the creation of FX vol portfolios based on the macro signals described on the previous section. This is done in a similar manner to the *spot single-factor frameworks*, but using FX vols instead of FX spot as underlying asset.

The macro vol factors buy/sell portfolios are created by first ranking FX vols (USD pairs) on the underlying signal. Highest (lowest) 3 FX vols are sold (bought) in the global portfolios in an equally-weighted manner. Thus creating a 100% long / 100% short portfolio. Note that if a macro signal would trigger a buy (sell) signal in *spot single-factor frameworks,* this would trigger a sell (buy) in FX vol. For the sake of clarity and simplicity, only factors that were purely in this format were included, thus we have excluded composite measures and the growth with overlay framework, which has a risk on/off component.

The test comprised the period January 2003-October 2021, and in terms of FX vols, we used 1M 25delta strangles. This is to make use of the infrastructure used for *Timing FX short-vol strategies: A systematic approach* (Ravagli and Duran-Vara, 2019). On a daily basis, we cumulate positions by entering a new trade, kept in the book until expiry; notionals are chosen as to ensure that options have the same vega at inception across time and across currencies. We include the 18 most liquid US dollar pairs, 9 G10 and 9 EM. These portfolios and macro signals all rebalance on a daily basis, given that we have to enter a new position every day. Trading and hedging costs are considered in the results below.

Exhibit 3: Just the 'nominal carry' factor generates portfolios with a positive Sharpe ratio

Sharpe ratios for the FX Vol single-factor long/short portfolios created out of the macro factors described in the previous section

Factor	Sharpe
Nominal Carry	0.32
Risk-Adj. Carry	0.04
Real Carry	-0.21
FDI	-0.40
FDI and Equity	-0.48
Value CPI	-0.52
Equity Momentum (1y)	-0.57
Equity PI	-0.62
CAB	-0.85
Value PPI	-0.90
BAB	-0.93
Core BAB	-1.02
Growth No Overlay	-1.22

Source: J.P. Morgan

Juan Duran-Vara
(44-20) 3493-7685
juan.duran-vara@jpmorgan.com

In Exhibit 3 we clearly see that all but two of the macro vol portfolios in question fail to produce positive Sharpe ratios. This is mainly because of the high cost associated with such portfolios – which are much higher than in an equivalent FX Spot portfolio. A random signal FX vol portfolio, i.e with no predictive power obtains Sharpe ratios of -0.7 to -0.9.

In the FX Spot portfolio the costs associated are an order of magnitude lower. There is a difference in Sharpe ratio of just 0.05 (0.78 to 0.73) between including and excluding costs for the nominal carry global spot portfolio over the same period. This is because a number of factors; first because the liquidity in FX spot is higher, second because there are no hedging costs associated with trading FX spot, unlike when trading FX vol. Thirdly because the rebalance happens daily in the FX vol portfolio, while it happens monthly in FX Spot.

Nonetheless, the predictive power shown in Exhibit 1 does seem to have an impact on the performance of the portfolios (Exhibit 3). Broadly speaking, the factors with a higher r-square in Exhibit 1 (first column) seem to perform better – even though the regression is based on VXY and not on the individual vols. The highest performance comes from nominal carry, which happens to have the highest r-square in Exhibit 1. The second and third best performing portfolios (risk adj. carry and real carry) also are at the top 5 of the table for r-square in Exhibit 1. Likewise FDI and FDI and Equity that are middle of the range in terms of r-square, are also middle of the range in terms of Sharpe. Finally, growth (no overlay), value PPI and equity momentum, that appear to have no predictive power, perform badly.

Exhibit 4: Inverting the 'negative slope' factors slightly improved results

Sharpe ratios for the FX Vol single-factor long/short portfolios created out of the 'inverse' macro factors described in the previous section

Factor	Sharpe
CAB inverse	-0.64
BAB inverse	-0.91
Core BAB inverse	-0.71
Value PPI inverse	-0.87

Source: J.P. Morgan

The only incongruence in this relationship comes from CAB, BAB, Core BAB, and to a lesser extent Value PPI. This is likely due to the negative slope relationship (Exhibit 1) between these factors and vol (VXY). For that purpose we inverted the signal for these factors (sells became buys, and buys became sells). We see a slight improvement in results, however not enough to create attractive portfolios (Exhibit 4).

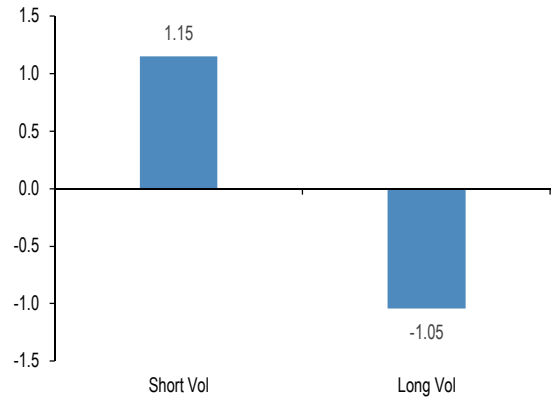
Carry Short-Vol portfolios

In the previous section we saw that the long/short macro factor portfolio gives limited results in the FX vol space – at least when using the format and *single-factor signals* considered. A great deal of the lack of performance can be attributed to the high trading costs associated with such portfolios, as mentioned before. The other reason, and probably just as, if not more, important is that there is a very significant asymmetry in returns between the short leg and the long leg of the FX vol factor portfolio.

As can be seen in Exhibit 5, for the nominal carry portfolio discussed in the previous section the difference is striking, the short-vol leg produces a Sharpe ratio of 1.15, while the long leg has a negative Sharpe ratio of -1.05. The overall portfolio settles on a Sharpe ratio of 0.32 (Exhibit 3). This difference in performance is consistent with the findings in *Timing FX short-vol strategies: A systematic approach*, where the authors highlight the merits of the construction of short-vol portfolios and the high costs of being long-vol systematically.

Exhibit 5: There is a big asymmetry in performance between the long and short leg of the FX vol factor portfolios

Sharpe ratios for the FX Vol nominal carry factor divided by the long/short legs of the portfolio



Source: J.P. Morgan

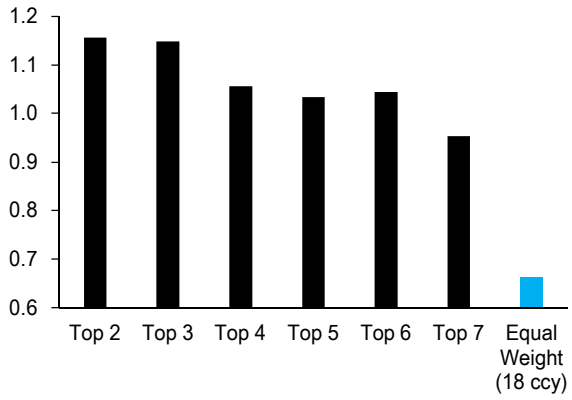
However, there is another practical takeaway from Exhibit 5. That is, a short-vol portfolio that is composed of the top 3 nominal carry currencies in the portfolio, allocating 33% of the portfolio to each produces Sharpe ratios in the order of 1.15, which is a significant number even for a *short vol portfolio.*

Juan Duran-Vara
(44-20) 3493-7685
juan.duran-vara@jpmorgan.com

For that purpose, we set ourselves the task of investigating further the benefits of using the nominal carry signal in order to construct short-vol portfolios (see Exhibit 6, 7). We explore what happens if we increase the number of currencies and we also compare the statistics to other portfolios.

Exhibit 6: Nominal carry short-vol portfolios outperform in terms of Sharpe….

Sharpe ratios obtained for the Top X CCY nominal carry short-vol portfolio versus an equal weighted short vol benchmark



Source: J.P. Morgan

Exhibit 7: …..without significantly deterioration other statistics

Statistics obtained for the different portfolios considered

Strategy	Risk Adj Ret	Skewness	Kurtosis	Max DD/Vol
Equal Weight - 18 CCY	0.66	-3.8	37.2	-4.9
Nominal Carry Short 6 CCY	1.04	-3.6	48.5	-4.7
Nominal Carry Short 3 CCY	1.15	-6.6	123.9	-4.2
Nominal Carry L/S 3 CCY	0.32	-0.2	199.6	-3.0

Source: J.P. Morgan

From Exhibits 6 and 7 we can note a number of things, first that the Top X CCY Nominal carry short-vol portfolios outperform in terms of Sharpe an equal weighted (equal Vega) allocation across currencies, which is the benchmark *we normally monitor*. A top 3 Nominal Carry short-vol portfolio obtains a Sharpe of 1.15 versus 0.66 in the equal weighted case. However, this comes at the cost of higher skewness and kurtosis, -6.6 vs -3.8 for the former and 123.9 vs 37.2 for the latter.

However, if we increase the number of currencies to the top 6 nominal carry, in order to diversify, we still obtain significant higher risk-adjusted returns of 1.04, and more importantly (Exhibit 7), this improvement in Sharpe ratio comes at no cost to the Maximum Drawdown/ Vol (Max DD/Vol) metric. This is -4.9 in the equal weighted case and -4.7 in the top 6 nominal carry case. Further there is no worsening of the skewness metric either, that is -3.8 in the equal weighted case and -3.6 in the top 6 nominal carry case. There is also limited impact to the kurtosis that goes from 37.2 in the equal weighted case to 48.5 in the top 6 case.

Hence we can conclude that the combination of these two 'risk-factors' - short-vol and nominal carry - has historically produced very positive returns and results. As it can be seen in Exhibit 8, it also soothes the PnL profile of the short-vol portfolio.

Further, if we take the results in Exhibit 2, i.e. the fact that single-factor variance affecting FX vols can be explained by a single principal component with an r-square of 17%, we could argue that by using the nominal carry signal (r-square of 15%, in Exhibit 1), we are considering the bulk of the variance that can be explained by the single factor frameworks as we have them.

A final thing to note from Exhibit 7 is that if we want to create portfolios that have little or no skewness and /or if we want to reduce the max Maximum Drawdown/ Vol (Max DD/Vol) metric, we might still want to consider the nominal carry short long/short portfolios we discussed in the previous section. However, the improvement in these two metrics comes at the expense of higher kurtosis.

Looking at current signals, if we wanted to replicate the nominal carry top 6 short-vol portfolio today, we would be shorting the following vols: BRL, MXN, ZAR, RUB, TRY and CLP. While if we were to consider the nominal carry top 3 long/ short portfolio we would be short the following vols BRL, RUB, TRY and long CHF, EUR and TWD. This, highlights the heavy tilt the model has towards EM vols, which could be a problem to for many investors.

Juan Duran-Vara
(44-20) 3493-7685
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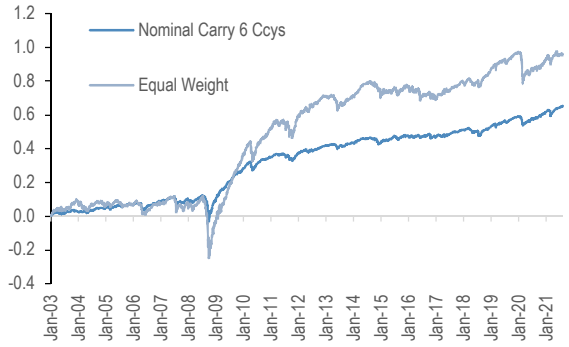
Exhibit 8: Nominal carry short-vol portfolios have a smoother PNL profile

Total return time-series for the equal weight short-vol portfolio and for the Top 6 nominal carry short vol portfolio



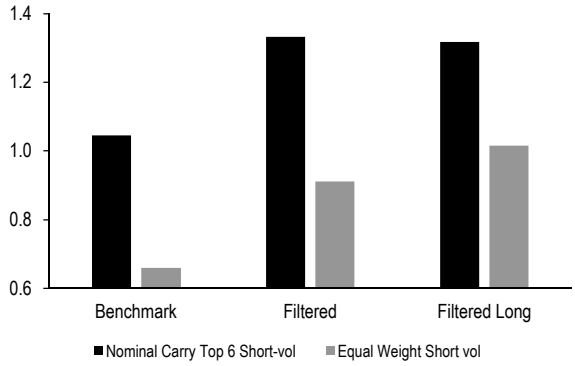
Source: J.P. Morgan

A final exercise, to see the full potential of the nominal carry short-vol portfolios is to test filtering on them. The "filtered" portfolio is the portfolio that arises from the scaling down short-vol positions when the warning indicators flash higher-risk conditions as described in *Timing FX short-vol strategies: A systematic approach*. Finally, we also look at the follow-up version outlined *here*, which allows the portfolio to go long gamma when the same risk indicators are pointing to a risk-on environment; we refer to this model as the "filtered long" portfolio.

As we can see in Exhibit 9, just like it does with the equal weight portfolio, filtering increases the Sharpe ratio of the Top 6 Nominal Carry short-vol portfolios from 1.04 to 1.33 or 27% - although less than it does for the equal weight portfolio; 37% from 0.66 to 0.91. However, "filtered long" technique does not further increase performance, as it stays at 1.31, unlike the equal weight were it is increased to 1.01.

Exhibit 9: Filtering further increases the Sharpe ratio of the nominal carry short-vol portfolios

Sharpe ratios of the different portfolio construction techniques analyzed



Source: J.P. Morgan

Further work could include using portfolio construction techniques on these portfolios, including risk constraints, and limiting the number of EM currencies considered in the portfolio.

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